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THE OREGON TALENT PLAN

A NEEDS ASSESSMENT AND INVESTMENT STRATEGY

ACKNOWLEDGEMENTS

The consulting team would like to thank the following individuals and organizations for their input and participation.

OREGON TALENT COUNCIL MEMBERS

ADVANCED MANUFACTURING	Mike Donnelly, Materials Manager | Carestream Inc. | White City Don Hendrickson, Senior Manager | Boeing | Gresham
BIOSCIENCE	Soundharya Nagasubramanian, Director, R&D | Welch Allyn | Beaverton Matt Smits, Director, Strategic Programs | Micro Systems Engineering | Lake Oswego
ENERGY	Josh Bratt, Vice Chair, Vice President | Morgan Stanley | Power Oregon/Oregon Energy Systems & Technology Research Alliance (OESTRA)
HEALTHCARE	Becky Pape, CEO | Good Samaritan Regional Medical Center | Corvallis Cheryl Stewart, Director, Human Resources | Bend Memorial Clinic | Bend
INFORMATION TECHNOLOGY	Eileen Boerger, Chair, CEO & Director | CorSource Technology Group | Portland

EX OFFICIO

Kay Erickson, Director | Oregon Employment Department
Kanth Gopalpur, Chair | Business Oregon Commission
Charlie Hopewell, Oregon Workforce Investment Board, General Manager | Jewett-Cameron Company
Dwayne Johnson, STEM Investment Council, Co-founder | ScaleUp Partners LLC
Brent Wilder, Vice President | Oregon Alliance of Independent Colleges & Universities
Duncan Wyse, Higher Education Coordinating Commission, President | Oregon Business Council

STAFF & RESEARCH ASSISTANCE

Melissa Leoni, Executive Director | Oregon Talent Council
Jessica Nelson and Gail Krumenauer, Research Division | Oregon Employment Department

INDUSTRY ASSOCIATIONS & ORGANIZATIONS

Northwest Food Processors
Oregon Healthcare Workforce Institute
Power Oregon
Oregon Bioscience Association
Oregon Manufacturing Extension Partnership
Technology Association of Oregon

CONSULTING TEAM

TIP STRATEGIES, INC.

A privately held Austin and Seattle based economic development consulting firm committed to providing quality solutions for public and private sector clients. Established in 1995, the firm's primary focus is economic development strategic planning.

CONTACT
2905 San Gabriel Street, Suite 205, Austin, TX 78705
PH: 512.343.9113 | www.tipstrategies.com

CONSULTING TEAM
Tom Stellman, *President and CEO*
Caroline Alexander, *Senior Consultant*

SCRUGGS & ASSOCIATES

Based in Portland, Scruggs & Associates, LLC has worked with industry, government, and academic clients to develop targeted economic, innovation, and talent development strategies across the country.

CONTACT
7642 SW Kelly Ave, Portland OR 97219
PH: 704.425.8313 | www.scruggsassociates.com

CONSULTING TEAM
Patricia Scruggs, *Founder and President*

CONTENTS

EXECUTIVE SUMMARY

The Oregon Talent Council (OTC) was established to "advise and be a resource for state agencies and educational institutions on issues of talent development to promote the growth and competitiveness of Oregon's traded sector and high growth industries." Each biennium, the OTC is required to develop a talent plan that identifies talent trends and issues, and recommends training and education investments.

THE TALENT IMPERATIVE

Access to qualified talent is the number one determinant for business growth. With Oregon's employment base growing faster than its labor force, the slack in the workforce is dwindling and the talent shortage is becoming more acute. The number of vacancies are rising and the time to fill a job has increased—now the average vacancy costs an employer up to $45,000. At current vacancy rates, this represents a **lost opportunity cost of $9 billion to Oregon employers each year**, not to mention the forgone state revenues from income taxes. This cost of unfilled vacancies is small compared to the lost productivity from workers not having current skills, which is why businesses report the availability of talent and the skills of the existing workforce as their top concerns.

The talent gap in Oregon and elsewhere is caused by a mismatch of worker skills and industry needs. This gap has grown in large part due to the constant and ever-changing deployment of new technologies like the Internet of Things, artificial intelligence, and scientific advancements in health. At the end of World War II, knowledge doubled every 25 years. Now it is doubling every year. College graduates are finding their skills outdated just a few years after receiving their degree. Recent reports by Accenture and others project by 2025, almost 50 percent of workers will be working remote, as a freelancer or contractor, or through another type of agile employment arrangement. These and other trends have caused a fundamental shift in the workplace and one with which traditional education and training models have not kept pace**. Solving the talent gap and developing a strategy that can give Oregon a competitive advantage will require significant attention to and targeted investments in incumbent worker training (upgrading the skills of those already working).**

WHY FOCUS ON INCUMBENT WORKERS?

Over 80 percent of the workers needed ten years from now are already in the workforce. Focusing on graduates from high school and higher education, while important, will solve less than 20 percent of our talent gap.

Moreover, the skills required of our existing workforce are continually changing. Without skills upgrades, Oregon workers risk becoming outdated and less employable, and company productivity suffers – a double hit to our economy.

Compared to other states, Oregon has almost no programs to keep its incumbent workers competitive and only spends **approximately $6 per worker per biennium on incumbent worker training (including the OTC investments), which is less than a cafe latte each year.**

Ensuring Oregonians can quickly upgrade their skills has incredible benefits for employers, workers and the state alike:

- Employers can more quickly find qualified workers, reducing turnover and vacancy costs while increasing their productivity and overall competitiveness.
- Workers obtain skills to increase incomes and improve upward career mobility.
- The state minimizes unemployment expenditures, gains additional income tax revenues, has a suite of tools that can attract and retain businesses, and compounds its investment in higher education and skills training.

The math clearly shows that states investing in the continual upskilling of workers, alongside the pipeline of new graduates, will be the economic winners. Other states are augmenting traditional education investments by encouraging employers to increase workforce training efforts, and supporting industry consortiums that provide agile training "at the speed of business." By building the capacity to develop shared training models, Oregon not only upgrades the skills of its workers and increases the resiliency of its businesses, it also compounds the state's investments in education by creating pathways for

graduates to remain at the top of their game once they enter the workforce. Not investing in the upskilling of the current workforce is akin to buying a new car and then never changing the oil or tires to keep it running.

Oregon, however, is not making these types of investments. The state spends approximately $1.2 – 1.5 billion on public higher education each biennium to award about 102,000 Associate, Bachelors and advanced degrees, and an additional $36 million in workforce funds to help unemployed and dislocated adult workers and disadvantage youth enter or reenter the workforce. [1] Together, these programs, while important and essential, serve only a small fraction of Oregon's labor force and target mostly entry-level jobs. By comparison, there are over 2 million jobs in Oregon and 500,000 of those are in key occupations that drive the ability of business to grow other jobs. Furthermore, approximately one in four workers are 55 and older and are likely to retire over the next ten years with their replacement jobs requiring a combination of experience and new skills. Yet, the state's total investment this biennium to train its 2 million existing workers was less than $12 million ($6 per worker per biennium or $3 per worker per year)—equivalent to less than 1 percent of higher education and workforce dollars. Almost half of that investment came from the Oregon Talent Council which funded industry consortium projects that are already seeing measurable results in just one year. The Council, however, is being phased out and combined with efforts under the Oregon Workforce Investment Board, with a primary focus on collecting more data and analyzing gaps, and with almost no resources to implement the necessary solutions.

DEFINING THE COMPONENTS OF A TALENT DEVELOPMENT SYSTEM

This plan defines talent as qualified individuals in key jobs that drive the growth of businesses. In other words, talent is a mix of the right skills, experience, education and perseverance. While we may take 4 years to seek an education, we spend 40 years working and refining our skills—skills that are ever-changing. The World Economic Forum's Future of Jobs Report states that **35 percent of core skills will change between 2015 and 2020**. [2]

So how do Oregonians keep apprised of these new skills so they remain relevant, and most importantly, employed? When it comes to training, employers and industry representatives cite a common set of challenges in addressing their talent needs. The three pain points most frequently described are:

1. **New Skill Standardization**. When skills or technologies are new or quickly evolving, it is hard to understand how to train workers or identify job competencies that matter.
2. **Rapid Re-Tooling**. When there is a need to quickly retool (e.g., to meet a new regulation) or when there is widespread need for a skill set, it is difficult to find condensed training to ramp-up workers.
3. **Knowledge Transfer**. As workers in key jobs face retirement or as companies grow rapidly, a consistent way to transfer institutional and operational knowledge from one worker to another in the workplace is necessary, especially alongside new skills training.

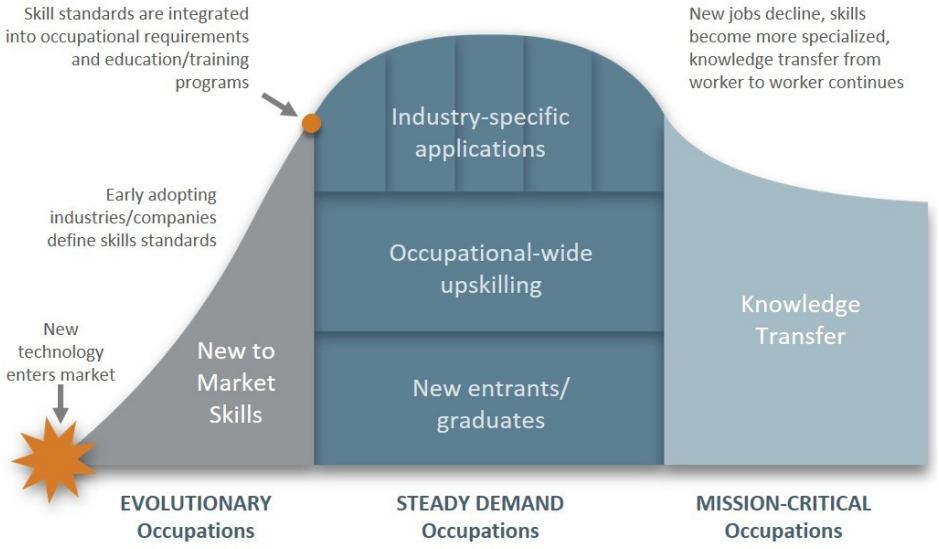
A primary reason employers experience different training needs is that occupations or skills tend to migrate through different stages, and each stage offers unique training challenges for that occupation. These characteristics can be categorized into three demand stages:

- **Evolutionary**: Occupations undergoing significant change or where market demographics are creating demands at rates higher than average.
- **Steady-demand:** Occupations with a steady influx of openings and where training for skill standards are needed.
- **Transitional/mission-critical:** Occupations that are key to the growth of other jobs and where succession issues are significant.

[1] Source: Higher Education Coordinating Commission. This report notes higher education does provide professional development programs and noncredit training, however, this represents only a very small fraction of the total funding.
[2] World Economic Forum, Future of Jobs Report, http://reports.weforum.org/future-of-jobs-2016/shareable-infographics/

A skill adoption curve describes how occupations flow through different demand stages and the needs of the various training models. This model can be used to develop an appropriate investment strategy for skills training. Figure 1 illustrates that, as a skill set matures, different levels or types of training may be required to keep a worker up to date or to add new entrants into the pipeline.

FIGURE 1. SKILL ADOPTION CURVE



PROMISING PRACTICES

Across the country, state and local government, alongside industry and education, are taking a more active and focused role in continuous skills training. Different models are being used depending on what type of skills are needed. Learning from the Oregon Talent Council investments and other programs across the country provides valuable insights into what works and what doesn't work in talent development. A scan of these models reveals a clear set of characteristics about what makes training models successful.

- **Industry-led.** Industry is involved in a meaningful way to design and deliver training and have a vested interest in a program's success.
- **Applied.** Learning objectives are directly tied to job performance; goals benefit the success and bottom line for workers and organizations.
- **Competency-based.** Learner performance and knowledge acquisition are measured by demonstrated skill mastery, not program completion.
- **Flexible.** Program scheduling and delivery modalities are flexible to accommodate needs of the employed.
- **Culture of learning.** Company cultures are created that reward the value of continuous learning.

THE VALUE OF INDUSTRY CONSORTIUM MODELS

Investments in skills training through industry consortium models are very cost effective. Nationally, the average public investment in these types of models is approximately $1,500 per worker and matched by industry. This represents less than one-thirtieth ($1/30^{th}$) the cost of an open vacancy and one-twentieth ($1/20^{th}$) the amount the state spends on every college degree awarded. The payback to employers, workers, and the state can be measured in months, not years.

TARGETING TRAINING ON HIGH MULTIPLIER OCCUPATIONS

Among Oregon's 2 million jobs are key occupations that drive the growth of other jobs. For instance, if a business does not have enough qualified supervisors, it cannot effectively hire more line workers. The Oregon Talent Plan focuses its analysis on the 307 occupations or approximately 500,000 jobs that have high multiplier effects, ranging from specialized production workers to advanced data scientists, accommodating a wide range of skill sets and post-secondary training requirements.

Employers note that critical occupations and skills gaps are determined by more than just the number of jobs—they include demand factors such as job concentrations in Oregon compared to the US, projected new and replacement openings, growth rates, retirement exposure, wage premiums, and industry competitiveness. Thus, in determining the set of occupational clusters that are likely targets for training investments, the Oregon Talent Plan analyzed data based on these various demand

factors. Once occupations were analyzed, they were then grouped into occupational "clusters" of related jobs—where core skill sets are transferable and where training can likely be aggregated. Figure 2 summarizes the categories and occupational clusters.

FIGURE 2. KEY OCCUPATIONAL CLUSTERS

CATEGORY	OCCUPATIONAL CLUSTER	EXAMPLE OCCUPATIONS
CROSS-CUTTING	Business Finance and Compliance	• Accountants and Auditors • Cost Estimators • Compliance Officers
	Data Scientist	• Logistician • Operations Research Analyst • Statistician
	Data-Enabled Analysts	• Business Operations Specialist • Management Analyst • Market Research Analyst • Financial Analyst
	Human Resource Management	• Human Resources Specialists • Training and Development Specialists
INFORMATION TECHNOLOGY AND SOFTWARE	Programmers and Developers	• Software Developers & Computer Programmers • Web Developers
	Systems and Data Administration	• Computer User Support Specialists • Network and Computer Systems Administrators • Database Administrators
	Systems Architects and Analysts	• Computer Systems Architects • Information Security Analysts
SKILLED PRODUCTION AND TRADE	First-Line Supervisors	• First-Line Production and Operating Supervisors, • First-Line Mechanics, Installation, and Repair Supervisors
	Industrial Machinists and Operators	• Machinists • CNC Operators
	Industrial Mechanics and Service Technicians	• Industrial Machinery Mechanics • Mobile Heavy Equipment Mechanics • Aircraft Mechanics
	Welders and Skilled Trades	• Electricians • Plumbers • Welders
HEALTHCARE	Mental and Behavioral Health	• Mental Health Counselors • Mental Health and Substance Abuse Social Workers • Rehabilitation Counselors
	Nursing and Nurse Specialties	• Registered Nurses • Licensed Practical Nurses
	Pharmacy and Medication Management	• Pharmacist • Pharmacy Technician
	Primary Care	• Family and General Practitioners • Physician Assistants • Nurse Practitioner
	Rehabilitation Therapy	• Physical Therapists • Speech-Language Pathologists • Occupational Therapists

CATEGORY	OCCUPATIONAL CLUSTER	EXAMPLE OCCUPATIONS
ENGINEERING AND SCIENTIFIC	Interdisciplinary Engineering	• Mechanical Engineers • Industrial Engineers • Computer Hardware Engineers • Electrical Engineers

AN OREGON TALENT INVESTMENT MODEL

It is imperative that Oregon invests in the ongoing skill development of its workforce. The creation of this more dynamic and agile talent and skills training system, while not easy, is achievable.

Employers cannot solve the talent issues alone. Addressing shared challenges requires greater coordination and collaboration not only with education and workforce organizations, but also among the employers themselves both within and across industry sectors. At the same time, it necessitates systemic changes in how we think about and support talent development. Most important, it demands public and private sector leaders to have an unwavering commitment to address this critical economic issue.

In today's environment of continual learning, investing in public and higher education and then disinvesting in ongoing worker training puts Oregon employers and workers at risk, and dilutes the value and effectiveness of education investments.

Building on best practices from other states, lessons from initial Oregon Talent Council investments and key economic trends, there is a clear need to make training investments in the models that keep Oregon's workforce competitive and resilient, and which amplify the state's education investments. Such training models must also be capable of performing at the speed of business. The Oregon Talent Plan recommends the following investment framework:

1 Invest in agile and industry-led training models that keep existing workers up-to-date (Priority)

Recommendation: *Provide at least $30 million each biennium for industry consortium models that train incumbent workers.*

2 Foster and reward a culture of learning among employers

Recommendation: *Consider an income tax credit program for employers and workers to encourage skill upgrades.*

3 Ensure Oregon's education and workforce systems fund and support a) the inclusion of employability skills into curriculum and b) flexible models of continuous skill development

Recommendation: *Increase the employability of graduates by modifying higher education policies and funding formulas, including incentives for internships and more intentional engagement of industry in determining skill competencies and updating curriculum.*

Recommendation: *Develop a focused statewide strategy and funding package for incumbent worker training.*

The Oregon Talent Council believes that this framework, while still very modest, could directly support models to train approximately 25,000 workers and further incent employers to train thousands more each biennium. And by investing in Industry consortium models rather than individual projects focused on one-time training or a single occupation, Oregon builds the capacity for industry to utilize these models time and again for the array of changing skill sets they will encounter. While this number may appear small, it is magnitudes higher than the number of workers currently served by state investments in incumbent worker training and begins to send a message to businesses here and elsewhere that Oregon understands their economic challenges. Furthermore, it is perhaps one of the most prudent and proactive means to avoid or minimize workers from becoming chronically unemployed. If the combined outcomes of these efforts could help to reduce the average time to fill a vacancy from 90 days to 60 days, the estimated additional state income tax alone would pay for these investments twice over.

[End Note: This plan represents the talent needs that employers and industry leaders view as critical over the next two to five years. The talent needs of Oregon employers, however, will continue to change, and understanding how to effectively address new concerns will be critical. The Oregon Talent Council strongly recommends that the Oregon Talent Plan be updated regularly with significant input form industry and employers.]

INTRODUCTION

Talent is the single biggest issue related to economic vitality. With knowledge now doubling every year instead of every generation, the continuous acquisition of new skills is simply a necessity. The Oregon Talent Council (OTC) was established in 2015 by House Bill 2728 to "advise and be a resource for state agencies and educational institutions on issues of talent development to promote the growth and competitiveness of Oregon's traded sector and high growth industries." The Council's mission is to *make Oregonians the first choice of Oregon industry.* In doing so, the Council defines success primarily by Oregon's employers and workers having the capability and capacity to develop the leading-edge skills that will make them more resilient and give the state an economic advantage.

As the concept for the Oregon Talent Council was being developed, the term "talent" was deliberately used to describe the qualifications of workers that go beyond education credentials. Talent is not just bodies to fill positions. Talent encompasses the idea of a pool of labor that has the right skills, education, level of experience, and perseverance needed to ensure organizations can continue to function optimally.

Talent = Qualified individuals in *key jobs* that drive the growth of Oregon businesses

Employers engaged in the development of this plan understand and appreciate the roles education and workforce organizations play in developing a pipeline of new workers, providing professional credentials, and helping unemployed and underemployed people gain skills to re-enter the job market. They view the OTC's work, however, as different and complementary to existing education and training resources. First, employers view industry as having an increasing role in upskilling workers and recognize the need for industry-led consortiums that can respond in a much faster manner than traditional education institutions. Second, while the workforce system works closely with industry, employers have noted that many available programs, including adult or dislocated worker programs, have restrictions that exclude certain occupations or investments in systemic training infrastructure. Finally, industry needs the flexibility to upgrade skills in quick, bite-sized pieces so workers can acquire new skills "at the speed of business." This context provides the foundation for the Oregon Talent Plan.

FOCUS: INCUMBENT WORKERS

Approximately **80 percent** of the workers needed ten years from now are already in the workplace; yet the skills they will need in ten years will have significantly changed. It is imperative that Oregon focus on keeping key occupations up-to-date on skills and investing in the models (not just individual programs) that create responsive and agile training systems to sustain our economic prosperity.

According to the enabling legislation, the OTC is required to develop a talent plan each biennium that includes:

- Identification of talent issues and trends affecting the competitiveness of Oregon's targeted industries
- An assessment of occupational data and the identification of core occupational clusters where training and upskilling may be needed most
- An investment strategy for how the state can work in collaboration with industry to develop training models that can fill urgent needs as well as be proactive in identifying leading edge skills.
- Recommendations on how the Oregon Workforce Investment Board, STEM Investment Council, and Higher Education Coordinating Commission can support training and education enhancements aligned with industry needs

In the report that follows, Part I: The Talent Imperative discusses trends that will affect the demand for talent. in. Part II: Rethinking How Oregon Addresses Talent identifies key talent issues and highlights research on promising training models and practices from around the state and the nation. Part III: Key Occupations & Skills summarizes an extensive analysis of occupational data and which is presented in more detail in Appendix A. Part IV: An Investment Framework for Talent Development provides recommendations for how Oregon can begin to address key talent challenges.

PART I: THE TALENT IMPERATIVE

Leaders across industries have very similar conclusions on the future of the economy. Large disruptions from the Internet of Things (IoT), big data, artificial intelligence, and automation are fundamentally changing how we work. Add to this the structural changes to the workplace, where more than half of the workforce is likely to be "agile" in one form or another (e.g., remote, contract, freelancer), and there is a sea change in how we define jobs and talent.

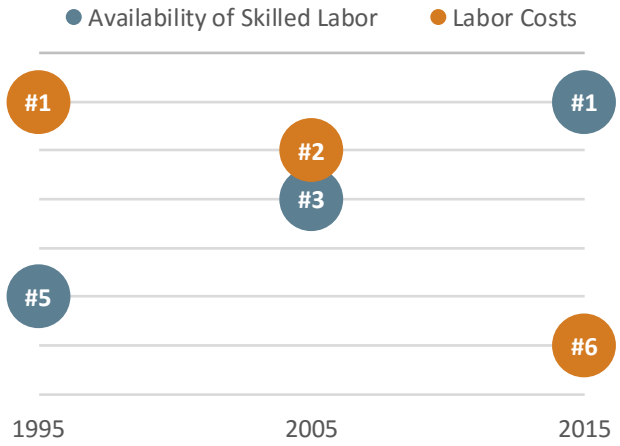
States that know how to rapidly respond to the changing skill needs will be the winners. States that ignore opportunities to invest in systems to upskill existing workers will find themselves falling further behind.

Regional competitiveness is defined by the ability to create, maintain, expand, and attract traded sector businesses. And the success of these businesses is increasingly dependent on access to talent. In fact, access to skilled labor is now more important than labor costs in corporate location decisions.[3] (See Figure 1). Furthermore, a study by the Martin Prosperity Institute found that talent or human capital has a greater impact on regional prosperity than trade.[4]

Oregon's future economic competitiveness depends on developing and maintaining a talent base and being recognized as having centers of talent excellence for our key industries. This requires the coordination of industry alongside education, workforce, and training resources.

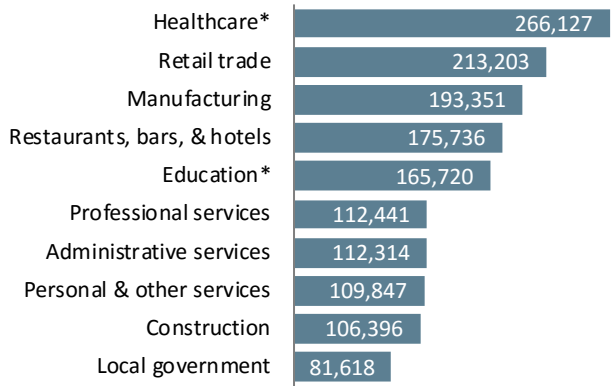
At the same time, Oregon's current competitiveness is threatened, and the state's talent landscape is being challenged as economic growth continues and the state's labor market tightens further.

FIGURE 3. SITE SELECTION FACTORS
RANKINGS COMPARISON, 1995 - 2015



Source: Area Development, Survey of Corporate Executives.

FIGURE 4. TOP 10 INDUSTRY SECTORS
OREGON, 2016



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
*Note: Education includes all public schools, colleges, & universities, and healthcare includes all public hospitals.

THE TALENT LANDSCAPE

Oregon's employment base and occupational structure mirrors the nation's in many ways. Oregon has a civilian labor force of 2.1 million and an employment base of 2.0 million. The ten largest industries account for 75 percent of the state's employment. Healthcare, retail trade, manufacturing, hospitality (lodging, restaurants, and bars), and education are the five largest industry sectors. (See Figure 4). This pattern is similar to the pattern at the national level—the nation's top ten sectors account for 77 percent of the nation's employment base and the nation shares nine of Oregon's top ten industry sectors.

[3] Area Development, 2016 Survey of Corporate Executives.
[4] Martin Prosperity Institute, Talent vs Trade in Regional Economic Development, August 2012.

As Figure 5 shows, Oregon's occupational distribution also follows patterns like those in the US as a whole, with 56 percent of the jobs requiring some kind of education and training (shown in the graphic as High- and Middle-Skill levels). Job openings for all three skill levels are shown in Figure 6. Note: middle skill jobs are those that require more than a high school diploma and less than a four-year degree.

The following trends define the challenges of Oregon's talent landscape, which in many ways arise from the state's success. These findings and those in the industry profiles are very similar to the April 2017 report to Oregon Business Development Department (Business Oregon) by McDearman Associates & RM Donahue Consulting. A more detailed assessment of economic and labor market trends is located in Appendix A.

FIGURE 5. OCCUPATIONS BY SKILL-LEVEL
OREGON, 2016

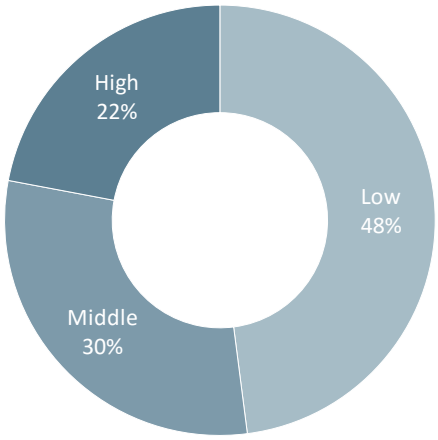
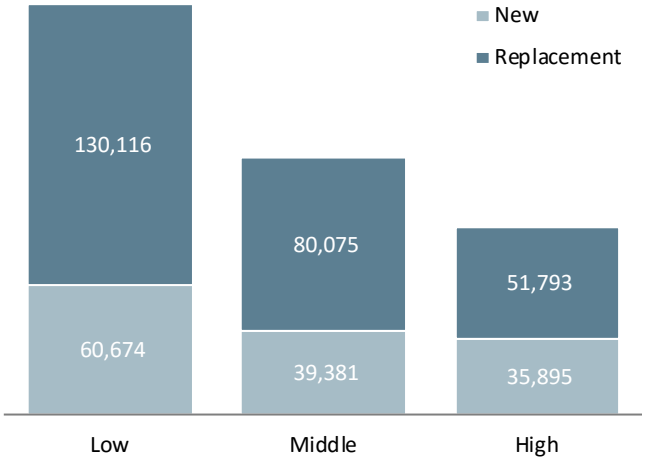


FIGURE 6. OPENINGS BY SKILL-LEVEL
OREGON, 2016-21



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

Strong job growth. Between 2011 and 2016, Oregon added about 200,000 jobs. The state's 9.1 percent job growth was significantly higher than the US growth rate of 6.0 percent. Over the same period, Oregon's earnings per worker rose 13 percent.

Tightening labor market. While the state's employment base grew by just over nine percent, the labor force grew by only three percent. As a result, the unemployment rate has dropped to 4.9 percent in 2016, and employers are reporting greater difficulty filling vacancies. The most common reason cited for this difficulty is a lack of qualified applicants.

Geographic disparities. Labor markets are not uniformly tight across the state. The northern part of the state has a significantly tighter labor market than the rest of the state, characterized by low unemployment. The 2016 unemployment rate varied from a low of 3.9 percent in Benton County to a high of 7.8 percent in Grant County. Eight counties have unemployment rates significantly below the US average: Benton, Yamhill, Washington, Multnomah, Clackamas, Hood River, Sherman, and Wheeler. By May 2017, 15 counties had unemployment rates significantly below the US unemployment rate.

Importing labor. On average, one in five jobs or 20 percent of open positions are filled by workers moving from other states (primarily Washington and California). In addition, more than 110,000 workers commute each day from other states to fill jobs at Oregon-based employers. At the same time, 57,000 Oregonians cross state lines to fill jobs at employers who are based out of state.

More to come. Over the next five years, Oregon's employment base is expected to grow by another 135,000 jobs, which is almost a seven percent increase (compared to the US increase of 5.9 percent). **Healthcare, manufacturing, and professional services are the primary industries driving growth**. These three sectors are expected to account for over 40 percent of employment growth over the next five years. Healthcare alone will be responsible for one in four jobs. Overall, Oregon is expected to have almost 400,000 openings over the next five years. (See Figure 6). **Only one-third of these or 135,000 will be new jobs. The remaining two-thirds of the openings will be replacements**—existing openings that must be filled due to workers permanently leaving an occupation or exiting the labor force. This level of replacement demand is also similar to the US level of 68 percent. Many of the total expected job openings are for middle- and high-skill occupations that will require training and experience.

In summary, industry expansion and the replacement of retiring workers is expected to drive the demand for workers over the next five years. However, the labor markets in many areas of the state are already very tight. In fact, **Oregon employers recruit about 20 percent of new hires from out-of-state.** A more competitive base of Oregon talent and the greater utilization of this talent pool will be key to the state's short-term and long-term economic success.

THE COST OF THE TALENT GAP: OREGON'S LOST OPPORTUNITY

In winter 2017, the Oregon Employment Department reported 50,505 vacancies in the state. Other job analytics sources reported up to 110,000 openings during the same time period. While these openings represent the movement of people from job to job as well as new jobs, they can indicate a mismatch of skills, experience, or both between employers and workers. Regardless, unfilled vacancies due to a shortage of workers or a mismatch of qualifications represent significant lost opportunities for Oregon businesses and taxpayers.

Randstad Workplace Trend Guide estimates an open vacancy costs an employer $500/day in lost productivity, sales, and other related costs. With an average time of almost 90 days to fill a non-executive job, these 50,505 vacancies represent a lost business opportunity cost of over $2.27 billion dollars in a single 90-day period or over $9 billion per year.

Reducing the average time required to fill vacancies by 30 days would provide $3 billion to businesses in potential cost recapture and an increase in state revenues of ~$60 million from income taxes each year.

TRENDS AFFECTING TALENT

While specific skill sets and technologies will come and go over the next ten years, international research organizations and industry leaders have identified major technology platforms and workplace trends that are likely to stick with us for the decade ahead. These trends are restructuring the workplace, redefining critical skills, and revamping how we deliver education and training.

The greatest need for investment in skill development is in the existing workforce. More than 80 percent of the workers we will need ten years from now are already in the workforce.[5] With the growth of new knowledge and technologies, the need to update skills or competencies is at an all-time high. The World Economic Forum's Future of Jobs Report states that **35 percent of core skills will change between 2015 and 2020**.[6] For the most part, employers and workers are not looking for advanced degrees or professional certifications; they are looking for industry-recognized credentials that can be acquired rapidly and in stackable modules.

The widespread deployment of the Internet of Things (IoT) **and big data is creating a need for more advanced computational skills across occupations and industries.** The massive increase in processing power and sensors are transforming every industry and making computational skills a must-have at every job level. Research by Gartner, Inc.,

[5] Calculations from the Bureau of labor Statistics, https://www.bls.gov/opub/mlr/2015/article/labor-force-projections-to-2024.htm
[6] World Economic Forum, Future of Jobs Report, http://reports.weforum.org/future-of-jobs-2016/shareable-infographics/

estimates that by 2021, one million IoT devices will be purchased and installed every hour.[7] The convergence of IoT, cloud, and big data and the adoption of data-driven decision-making as a key business strategy is elevating the strategic importance of workers with information technology (IT) skills and blurring the lines between IT and business strategy. New analytics platforms make business intelligence more accessible to end-users and provide the ability to connect a wide variety of data sources under one platform.[8] This new accessibility has hastened companies' big data investments to gain greater insights into their business and customers.[9] As such, the management, processing, extraction, analysis, and visualization of data have become as foundational to business operations as accounting. The adoption of data to end users means that every job will require basic IT and applied computational skills; the data-based decisions will affect farmers and agriculture workers, warehouse workers and mechanics, as well as market analysts, systems administrators, and CNC machinists.

The rise of smart machines and systems is automating repetitive physical and data processing tasks. Artificial intelligence, robotics and machine-to-machine learning are all aspects of trends where rote tasks are increasingly being replaced by machines and systems. Factors such as cost, technical feasibility, quality assurance, scarcity/cost of labor, and social acceptability will play a role in where and how fast automation will be deployed. A recent study by McKinsey noted that 45 percent of the activities people are paid to perform could be automated by currently available technologies.[10] The most feasible types of work are predictable physical work, data processing, and data collection. The least susceptible is managing others.[11] While this transformation will replace some jobs, it will create demand for new skills and sometimes new jobs. For instance, industrial mechanics that can repair machines are projected to grow rapidly.

The increase in use of agile workforce models has resulted in new employment arrangements. If there is one theme that overrides the many issues facing Oregon's talent, it is the new forms of personal and business interactions. Agile workforce models or the strategic ability to anticipate talent needs, adjust in real time, and utilize workers from a variety of employment arrangements are the new norm. A recent Randstad survey of both companies and workers found that:

- Agile (i.e., independent or contingent) workers are rapidly becoming the "new norm" with 76 percent of companies surveyed using some type of agile worker arrangement that accounted for approximately 30 percent of their workforce. The survey, along with data from Accenture, suggests that, by 2025, more than half of a company's workforce will be defined as "agile."
- Virtual or remote workers made up 22 percent of workers for companies surveyed, with an expected increase to 33 percent by 2025.
- Most workers (63 percent) believe that being an agile employee will make them more qualified in the future workplace. Perhaps that's why 81 percent of employees agree they will be more open to working as an agile employee by the year 2025. Currently, 48 percent of agile workers agree that agile work offers them better career growth than working as a permanent employee, and 56 percent say it generates more income.
- Almost 90 percent of employers and workers agree that, by 2025, the companies that are adept at managing a mix of traditional and agile talent will be the most successful.

The increase of agile workers in the marketplace leads to an increase in on-demand talent pools. Instead of a traditional structure where individuals are hired for a single position and engaged in fixed business functions, a marketplace approach is being used that supports people being dynamically teamed together. This is underscored by a March 2017 report by Accenture that states, *"Businesses are transforming their organizational models and the way they manage their people to take advantage of an increasingly digital and on-demand workforce. Labor platforms are enabling workers to become more*

[7] Gartner, Inc., "Top Strategic Predictions for 2016 and Beyond: The Future Is a Digital Thing," 2 October 2015.
[8] Tableau, Top 10 Big Data Trends for 2017.
[9] New Vantage Partners. Big Data Executive Survey 2016: An Update of the Adoption of Big Data in the Fortune 1000.
[10] McKinsey & Co, 'Where Machines Could Replace Humans – and Where They Can't (Yet)," July 2016.
[11] Ibid.

liquid, supporting distributed teams that are quickly assembled to complete projects and then dispersed. With this flexibility, companies are moving toward models where they run their organization less like a hierarchy of static business processes, and more like an open talent marketplace. Businesses gain the power to quickly look internally or to the external labor market to meet demand for skills. These talent marketplaces are not only more efficient, but also enable companies to change rapidly and innovate in ways that weren't possible before."

In 2014, Glassdoor reported that seven out of ten employees valued skills training more than degrees.

Skill competencies are overtaking educational credentials in recruitment and hiring. With new technologies changing competencies in the machines one operates or the software one uses, employers are turning to verifiable competencies to understand the operating knowledge of workers. A recent report from Deloitte summarizes this trend by noting, "*To judge whether candidates will be effective, employers are shifting their focus from checking credentials to confirming skills*."[12] Oregon employers often noted that they are looking for candidates who can "learn to learn."

Employers are embracing training after decades of disinvestment. Throughout the process of developing the Talent Plan, employers noted their interest in leading-edge training, as well as their need to do more to ensure their employees and key workers in their industry have access to such training.

These anecdotal stories are supported by reports that indicate a sharp uptick in corporate training, including one by Forbes that noted US spending on corporate training had grown to over $70 billion. Although spending varies by industry, the Association for Talent Development's State of the Industry Report noted that the average direct expenditure per employee per year is $1,229.[13] Forbes also reported that high-performing companies spend more and see the learning and development investment pay off at rates well above those of firms that inconsistently invest in training. Other national publications note that in addition to the increases in quality, productivity, and sales, benefits of employer training in career development programs include:[14]

- *A competitive advantage over other companies*: With competition for talent growing, offering an employee-development program is a good way to attract candidates.
- *Increased employee loyalty*: When a company invests in employee training and development, employees feel valued and appreciated and are more likely both to stay and to refer skilled friends and colleagues to work at the company. Plus, loyal employees are more engaged and motivated and require less supervision.
- *Decreased turnover*: According to research from the Society for Human Resource Management, employee replacement can cost a company between six and nine months of the departed employee's salary. Aside from the direct financial losses, a high turnover rate also affects the company's market position, profitability, and revenue. By training employees and investing in their career development, companies can reduce turnover.
- *Flexibility in the market:* When employees are well trained, they are better able to respond to changes in the market, which ensures company success in the long term.

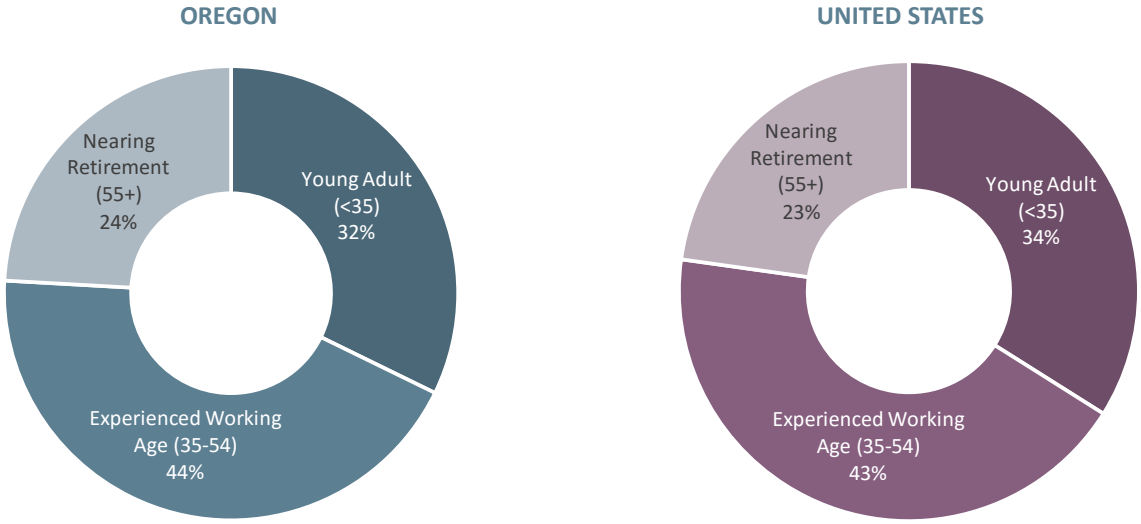
The "silver tsunami" still looms, but succession planning falls short. Figure 7 is a comparison of the age distribution of the Oregon workforce to those of the US workforce. As the figure shows, 24 percent of Oregon's workers are 55 years old or older. In other words, **close to 500,000 workers (almost one in four jobs) are nearing retirement in Oregon.** Finding qualified replacements for these workers and transferring knowledge from the retiree to a replacement will be challenges for employers. Successfully addressing these challenges requires succession planning; yet, many employers are focused more on today's human resource needs and not on those needs five to ten years in the future. This short-term focus leaves

[12] Michael Stephan, David Brown, Robin Erickson, Deloitte University Press, *Talent acquisition: 2017 Global Human Capital Trends*, February 28, 2017.
[13] The Association for Talent Development, State of the Industry Report (2016), https://www.td.org/Professional-Resources/State-Of-The-Industry-Report
[14] Ilona Hetsevich, Why It Is Critical to Invest in Employee Training and Development, February 22, 2017.

employers, particularly small- and medium-sized enterprises, exposed to workforce disruptions resulting from the loss of key individuals.

Succession planning provides a systematic framework that ensures smooth transitions, knowledge transfer, and continuity. It ensures a pipeline of qualified people is in place and prepared to step up when key individuals retire. This strategy also reinforces career pathways and provides more professional development opportunities for promising talent, which helps retain and attract high-quality employees. Most importantly, succession planning ensures that critical programs, services, and processes are sustained beyond the individuals currently responsible for them.[15]

FIGURE 7. AGE DISTRIBUTION OF THE WORKFORCE, 2016



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

UNIQUE TALENT CHALLENGES IN RURAL OREGON

Thinking through the training models and support infrastructure for Oregon's talent must include the unique factors experienced in rural communities. According to the Oregon Employment Department, local areas with low shares of youth below the age of 18 and high shares of people ages 65 and over are likely to face the greatest economic difficulties. The fact that 17 of Oregon 23 rural counties remain below peak employment underscores this issue.

Portland State University reports that rural counties experienced a population growth rate of 2.2 percent (all from in-migration) while urban counties expanded by 5.3 percent over the same period. Rural Oregon's share of population 65 years of age and older increased from around 18 percent in 2010 to nearly 22 percent in 2015. The retirement age population grew by 24 percent, while the working age population and youth population both declined, by 3 percent and 2 percent, respectively.[16]

Twenty years ago, only 13 percent of the workforce in rural Oregon was 55 or older. That share has roughly doubled to 27 percent of the workforce. There are more than 35,000 additional workers ages 55 and older in rural Oregon today. Meanwhile, the prime working age and youth workforces are both lower today than back in 1995.[17]

[15] The HR Council, "Succession Planning."
[16] Oregon Employment Department, The Employment Landscape of Rural Oregon, May 2017
[17] Ibid.

The exit of prime working age residents in rural Oregon was spurred by many issues, including automation and labor productivity of traditional industries, the movement of lower paying jobs overseas, and an aging infrastructure. Now young people are not staying because they do not see or understand the economic opportunity in their region.

Yet, industries like healthcare, agriculture, and natural resources, remain critical employers, alongside tourism and retail. Manufacturing is beginning to see pockets of growth, especially in food and beverage, along with regional concentrations of renewable energy jobs and artisan guilds. Many of these jobs will require skills training and post-secondary education. Employers and community leaders interviewed for this and other workforce and economic strategies noted that addressing skills gaps in rural areas will require:

- **More work-based, on-line, and hybrid training models** that are much more geographically disbursed,
- **A greater focus on retraining of existing workers** to accommodate the lower percentage of younger workers entering the pipeline of jobs, and
- **More entrepreneurial training and support for guilds** and collaboratives where expertise and knowledge transfer is shared.

PART II: RETHINKING HOW OREGON ADDRESSES TALENT

Addressing talent is more than educating or training for what we think may be the jobs of the future. It is about developing the types of dynamic learning systems that can quickly accommodate the structural shifts in what skills are needed, how people work, and how companies seek to remain competitive. Three trends underscore this transformation:

- The adoption of technology has fundamentally changed the speed at which new skills and knowledge are developed; the need to continuously learn has never been greater. This rate or speed of change demands **flexible, bite-size learning models**.
- People are working longer and changing jobs more often; thus, they need more **interdisciplinary and adaptable skill sets**.
- Companies are turning to **dynamic staffing models** to maximize how skills are deployed. The days of static teams are gone. According to a recent study[18], about two-thirds of people will be a freelancer or contract worker at least once in their career, most of them by choice as incomes for these workers increase, and people with specialized or up-to-date skills are rewarded.

Understanding the impacts of these three trends on Oregon's current talent climate enables us to develop or reshape the education and training needs that will be vital for Oregon in the future.

A NEW APPROACH TO TRAINING

Rethinking how Oregon addresses talent will require a redefinition of employability skills, a dedication to invest in the existing workforce, and a recognition that new training models are needed. It will require a three-pronged approach:

1. Redefine employability skills to meet the changing needs of employers
2. Direct more resources toward retraining the existing workforce
3. Rethink the development and distribution of training models

The elements of this approach are discussed in more detail below.

> **Now is the time for leaders to be responsive and responsible: we cannot slow the rate of technological advance or globalization, but we can invest in employees' skills to increase the resilience of our people and organizations.**
>
> Jonas Prising,
> Chairman & CEO, ManpowerGroup

REDEFINING EMPLOYABILITY SKILLS

A changing skill environment has resulted in employers hiring for fit and basic employability skills and then training for specific technical or industry skills. Employers are defining these employability skills as a combination of personal skills (e.g., integrity or reliability), academic credentials, and applied skills (e.g., computational skills, adaptive thinking, or social intelligence).[19] Employers increasingly report that fit, applied/soft skill competencies, and the willingness to learn are the top differentiators for candidates.

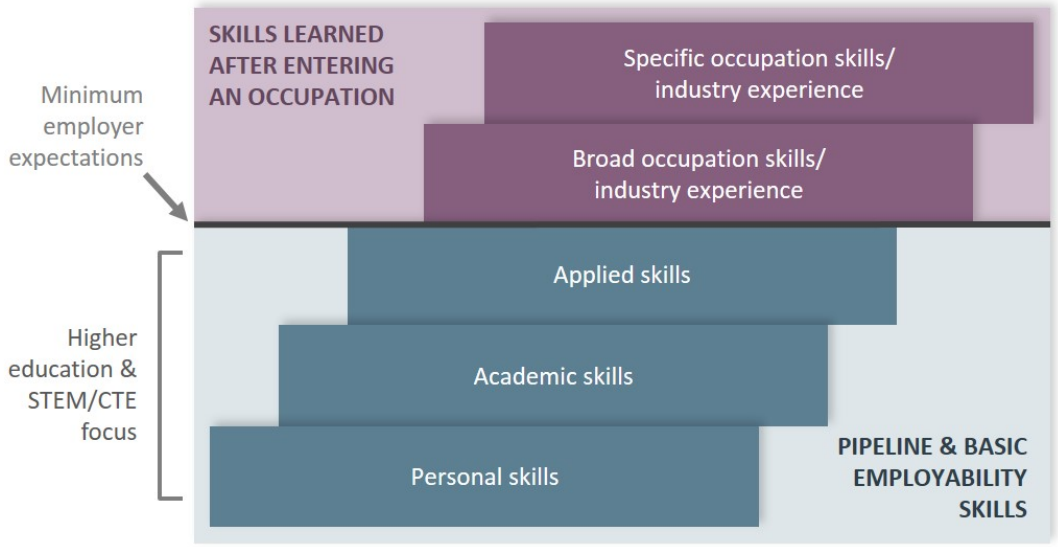
As Figure 8 illustrates, employers' minimum expectations, shown in blue in the lower half of the graphic, indicate a strong preference for a balance of academic and applied skills. Employers view this blend of foundation skills as the focus for how higher education, career and technical education (CTE), and science, technology, engineering, and math (STEM) programs should measure the competency and preparedness of their graduates. If basic employability skills are increased, industry can

[18] http://www.prnewswire.com/news-releases/randstad-us-study-projects-massive-shift-to-agile-employment-and-staffing-model-in-the-next-decade-300376669.html

[19] National Network of Business and Industry Associations, Common Employability Skills, http://www.nationalnetwork.org/wp-content/uploads/2015/03/Common_Employability_Skills-03-30-15.pdf and http://www.iftf.org/futureworkskills/

then focus training resources on helping workers learn the specific occupation and industry skills that drive the company's performance and the state's economic competitiveness. Since these skills are learned through industry experience, the ability to develop shared employer training models can help to accelerate the qualification of Oregon workers.

FIGURE 8. EMPLOYABILITY SKILLS



INVESTING IN THE EXISTING WORKFORCE

As mentioned earlier, over 80 percent of workers needed ten years from now are already in the workforce. In Oregon, that means that more than 1,600,000 of the state's 2,000,000 current workers will still be in the labor force in 2027. Oregon, however, spends very little on keeping its workforce competitive, especially when compared to other states. There are few flexible funding sources, and no state incentives for employers or workers to invest in training. **Therefore, increasing access to training for incumbent workers (the 80 percent) is one of the most important investments Oregon can make for talent.**

Think about talent in the same way we think about our car. We make an initial investment (our post-secondary training or degree), yet it is the small, ongoing maintenance that keeps the car in good condition. On a regular basis, we change the oil and rotate the tires, less often we take the car in for systems maintenance, and once in a while we must do some major investments in brakes, tires, transmissions, and so forth. Our jobs are no different: there is always a series of new revolving skills to learn, and once in a while a new regulation or industry certification is required. We are more apt to keep up to date with our skills maintenance program if training options are readily available and we know the value or application to our job. Incumbent worker training is the maintenance program to higher education's initial cost of the car. But if we never change the oil or rotate the tires, then the value of our initial investment declines significantly.

To support Oregon's 220,000+ full-time higher education students, the Higher Education Coordinating Commission reported $1.2- $1.5 billion this biennium for public higher education institutions, resulting in an investment of approximately $3,100 to $6,455 per student per biennium for public institutions or approximately $35,000 per degree when six-year completion rates are factored. In addition, the Oregon Workforce Investment Board allocated another $36 million in workforce programs, with almost no funds going towards incumbent workers.

> **"When we spend 4 years getting a degree, then 40 years working, it only makes sense that we continue to invest in our skills and knowledge."**
>
> — Comment from an employer focus group.

By comparison, Oregon will spend less than $12 million in the 2015-17 biennium for upgrading the skills of 2 million workers, of which 500,000 are in key occupations supporting the state's high-impact industries. This equates to approximately $6 per worker or $3 per year per worker. In other words, Oregon spends less on skills training for its existing workers than the price of one cafe latte.

Figure 9 summarizes Oregon's investment in incumbent workers (the 80 percent of future workers) compared to the state's investment in higher education and workforce programs to produce new entrants into the workforce (the 20 percent of future workers). It does not include investments in K-12.

FIGURE 9. OREGON'S BIENNIAL INVESTMENT IN ITS WORKFORCE

NEW ENTRANTS through higher education	**EXISTING WORKFORCE**
~220,000 student FTEs ~51,000 degree awards/year	~2,000,000 total workers ~500,000 in key occupations
$1.2 billion to $1.5 billion higher education funds to public institutions >$36 million in workforce funds	<$12 million in incumbent worker training
Public institutions: $3,100-6,455 per student per biennium ~$35,000 per degree	$6 per worker per biennium or $3 per worker per year

UNDERSTANDING THE NEED FOR DIFFERENT TRAINING MODELS

Ensuring that talent has access to the right training will require that different training models accommodate the differences in what drives the demand for various occupations. For instance, a key job like millwrights with limited openings but high levels of retirement might be better served by work-based training to transfer knowledge from one worker to another. Whereby, a rapidly changing skill set in software applications might need a different model such as peer-based learning labs.

Different categories of training models. Employers tend to categorize their training needs into three key groupings or "pain points."

1. **New Skill Standardization**. When skills or technologies are new or quickly evolving, it is hard to understand how to train workers or identify job competencies that matter.
2. **Rapid Re-Tooling**. When there is a need to quickly retool (e.g., to meet a new regulation) or when there is widespread need for a skill set, it is difficult to find condensed training to ramp-up workers.
3. **Knowledge Transfer**. As workers in key jobs face retirement or as companies grow rapidly, a consistent way to transfer institutional and operational knowledge from one worker to another in the workplace is necessary, especially alongside new skills training.

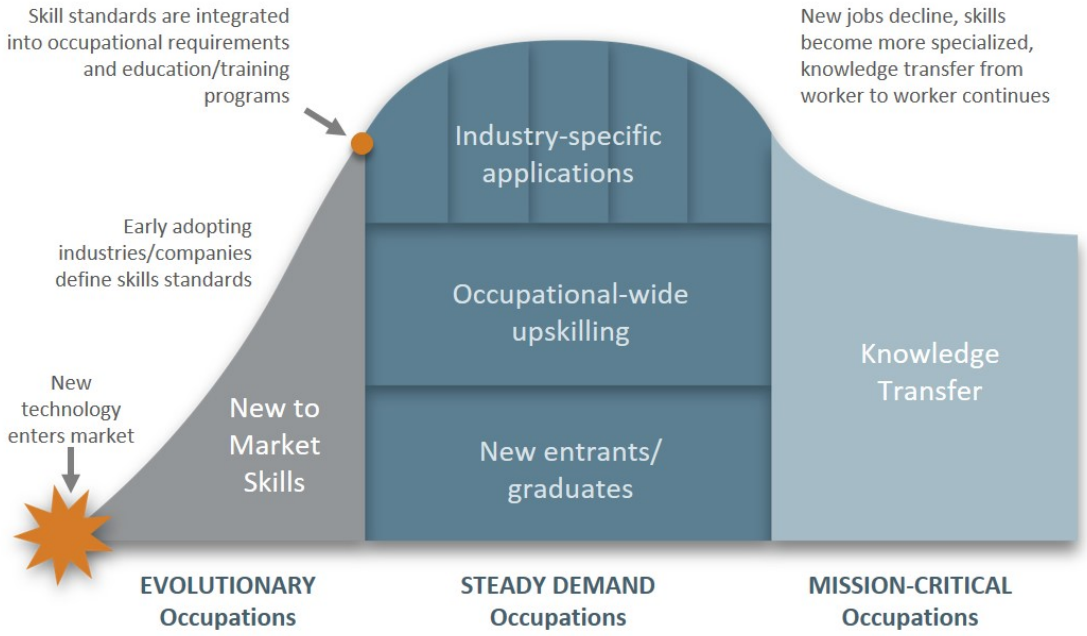
Different demand stages of skills and occupations. Industry input and data analysis indicate that occupations or skills tend to migrate through different demand stages; starting when a skill set or job is new to the market and there is little standardization, then moving through periods when retooling is required. When skills reach a mature stage, they often require experienced workers to transfer their ingrained knowledge to another. These characteristics can be categorized into three demand stages, as shown in Figure 10.

FIGURE 10. DEMAND STAGES & THEIR CHARACTERISTICS

DEMAND STAGE	CHARACTERISTICS
Evolutionary: Occupations undergoing significant change or where market demographics are creating demands at rates higher than average.	• Very high growth rates and more new than replacement jobs • Growth trends in key industries accelerating demand • (examples: cybersecurity, data scientists)
Steady-demand Occupations with a steady influx of opening and where training for new skill standards is needed.	• Critical mass of jobs with above-average growth rates • Significant openings with a mix of new and replacement jobs • (examples: industrial mechanics, software developers)
Transitional/mission-critical Occupations that are key to the growth of other jobs and where succession issues are significant.	• High location quotient or concentration • Higher than average exposure to retirement with more replacement than new jobs • (examples: millwrights, compliance officers)

When training models and demand stages are combined, the result is a pattern of skill development that follows an adoption curve—where early adopters set standards and mass adoption takes place once the value is proven. Using a skill adoption curve, such as that shown in Figure 11, illustrates that, as a skill set matures, different levels or types of training may be required to keep a worker up to date or to add new entrants into the pipeline. These different levels also tend to use different training models as described in the summary of best practices.

FIGURE 11. SKILL ADOPTION CURVE



LESSONS FROM THE OREGON TALENT COUNCIL

As the Oregon Talent Council gathered more input from industry and made initial investments, they began to see how the impact of various efforts differed. Their initial conclusions of what yields greater impact include:

- Investments in models, rather than single focus-programs.
- Support of industry consortiums where employers take a front and center role in defining, developing and implementing training.
- Capacity-building efforts that help employers develop a culture of learning as well as train for specific skills gaps.
- Investments in delivery infrastructure to ensure greater training access for rural areas.
- Ensuring programs can demonstrate and measure return on investment (ROI) for both employers and workers.

OPTIMIZING HOW OREGONIANS KEEP UP-TO-DATE ON SKILLS

As noted earlier, developing, and implementing continuous skills development models will require as one Oregon industry association noted, "training delivered at the speed of business." However, keeping skills up to date after someone enters the workforce is perhaps the greatest talent challenge faced by employers and workers alike.

Across the country, state and local government alongside industry and education, are taking a more active and focused role in continuous skills training. Different models are being used depending on what types of skills are needed. Learning from existing programs and models provides valuable insights into what works and what doesn't work in talent development. A scan of national and Oregon-based models, many of which are OTC grantees, reveals a clear set of attributes characteristic of successful training models. These characteristics are listed below:

CHARACTERISTICS OF PROMISING SKILLS TRAINING MODELS

1. **Industry-led**
   Industry is involved in a meaningful way to ensure program relevancy, real buy-in into the process, and a vested interest in program success.

   Examples: The Center for Energy Workforce Development (CEWD) has developed, in partnership with their members, a set of curricula that promote the skills of most interest to energy employers. By encouraging the adoption of these standardized curricula by programs across the country, the CEWD influences energy training at a national scale, which has a material impact on the size and quality of the talent pipeline that supports the energy sector. Likewise, Oregon Bioscience Association's BioPro program engages industry through its steering committee, which not only reviews courses and course materials but also selects instructors to teach courses. Industry involvement in BioPro guarantees bioscience employers' buy-in into the program and means that program graduates have the skills that Oregon's bioscience industry wants.

2. **Applied**
   Learning objectives are directly applied to job performance; the goal of the program is not just completing training, but understanding how training benefits the bottom line for both workers and organizations.

   Examples: Partners Healthcare in Massachusetts has designed a training program for its workers that utilizes project-based learning so that the skills students are learning in their courses can be immediately translated to their workplace. Workplace mentors, then, serve as bridges between online learning and workplace application. In Eastern Oregon, Baker Technical Institute's career and technical education programs include hands-on, experiential learning opportunities that provide students with skills that can be immediately applied on the job site. Both project-based and

experiential learning create learning experiences that can be more easily applied in the job setting than skills learned primarily through more abstract or conceptual classroom-based experiences.

3. **Competency-based**
   Student performance and knowledge acquisition is measured by demonstrated skill mastery not just program completion

   Example: GreenFig, a program started in Oregon and expanding nationally, offers students a 200-hour micro-degree on digital marketing that includes an array of project-based coursework, delivered on-line by industry professionals from leading companies and facilitated by local mentors. Students end their program by competing in teams to develop marketing solutions for a real company's project. The students are not awarded degrees unless they receive positive ratings from these industry mentors, complete the courses with an 80 percent or higher rating, and pass the exam which gives them an industry-recognized certification.

4. **Flexible**
   Training program scheduling accommodates flexibility-needs of employees

   Examples: Oregon Story Board's virtual reality training makes lab-based learning more accessible as students utilize HaloLens technology for a virtual learning experience rather than travelling in-person to a lab filled with expensive equipment. Manpower's powerYOU and Partners Healthcare's use of online learning provides greater flexibility and access to students who work or are not located near a training center.

5. **Culture of learning**
   Creates company cultures that value continuous learning

   Examples: Oregon Manufacturing Extension Partnership's (OMEP) SmartTalent program seeks to embed learning in the company culture to create an environment where skill acquisition and training completion is rewarded and valued. BlueCross BlueShield of South Carolina's (BSBSSC) apprenticeship program includes mentors that work closely with apprenticeships to provide guidance and transfer valuable knowledge gained over their years of experience.

These and other examples are described in more detail in Appendix C.

BENEFITS TO BETTER SKILLS TRAINING

Many of the promising practices profiles have reported impressive results – for employers and workers as well as education and training providers. In every case, the improved training produces measurable outcomes that influence the bottom line and viability.

For employers, a stronger talent pipeline and access to more effective training models affect a wide range of factors that directly influence the long-term success of the organization. The benefits for employers include:

- Measurable quality, scalability, and/or revenue improvements
- Reduced time to fill open vacancies
- Decreased ramp-up time to productivity
- Improved ROI in capital investments (more proficiency on new equipment)

For workers, stronger connections with employers and more relevant training models affect their access to economic opportunity, leading to higher incomes. The benefits for workers include:

- Increased wages
- Increased job satisfaction

- Increased career/upward mobility options

For education and workforce partners, greater industry engagement enhances institutions' abilities to attract both students and faculty. Talent and employers gain long-term success when educators become more adept at delivering training "at the speed of business through strong employer partnerships. The benefits for education and workforce partners include:

- Attracts students and faculty through cutting-edge skills
- Identifies new, critical skills and provides standardization that
  - Reduce curriculum development time
  - Enhances the quality and relevance of curriculum
  - Is directly related to employability skills

In other words, the returns on investing in updated training models are measurable and significant. The importance of investing in these kinds of dynamic training models cannot be understated.

PART III: KEY OCCUPATIONS & SKILLS

Among Oregon's 2 million jobs are key occupations that drive the growth of other jobs. For instance, if a business does not have enough qualified supervisors, it cannot effectively hire more line workers. The Oregon Talent Plan focuses its occupational analysis on the 307 occupations or approximately 500,000 jobs that have high multiplier effects. These occupations range from specialized production workers to advanced data scientists, accommodating a wide range of skill sets and post-secondary training requirements. This section highlights the more comprehensive data assessments found in Appendix A and the industry-specific analysis presented in Appendix B.

In determining the set of occupational clusters that are likely targets for training investments, the Oregon Talent Plan analyzed data based on demand factors identified by industry. Employers noted that critical occupations and skills gaps are determined by more than just the number of jobs. Demand factors included the concentration of jobs in Oregon compared to the US, projected new and replacement openings, growth rates, retirement exposure, wage premiums, and industry competitiveness. (See Appendix D for details). For instance, if there are two different occupational clusters both with a projected need of 500 jobs over the next five years, yet one has a significant number of workers near retirement and is in a growing Oregon industry, it would be a stronger candidate for training resources. Understanding these nuances can help prioritize industry and public investments in training.

Once occupations were analyzed, they were then grouped into occupational "clusters" of related jobs—where core skill sets are transferable and where training can likely be aggregated. The importance, demand, and need to provide training for these occupations was then verified by employers throughout the state. Some of these occupational clusters cut across industries while others are more germane to one or two industry sectors.

KEY OCCUPATIONAL CLUSTERS

Seventeen (17) occupational clusters in five different categories rose to the top as having a combination of high growth, significant job openings and at least one other critical demand factor that warrants immediate attention. The key occupational groups are as follows:

- **Cross-cutting occupations,** such as financial, analytical, or human resources, that are well-disbursed across an array of industries and vital to the operation of organizations in almost any industry
- **IT and software occupations,** which are both cross-cutting and industry-specific
- **Skilled production and trade occupations**
- **Healthcare occupations**
- **Engineering and scientific occupations**

These categories highlight the top occupational clusters by total weighted score, as further defined in Appendix D.

CROSS-CUTTING OCCUPATIONS

Skills involved in manipulating big data and using such data sets to influence operational efficiency and reach customers are at the forefront of those most desired by employers. Add to this an aging workforce in occupations that are increasingly driven by regulations and new information, and it is no surprise that the occupations shown in Figure 12 top the list of cross-cutting jobs with critical talent needs. The inclusion of human resource workers highlights the rapidly growing demand for these workers, which underscores industry's movement to taking on more talent development and training.

FIGURE 12. CROSS-CUTTING OCCUPATIONS
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Business Finance and Compliance		22,559	2.4%	997	38%	62%			29%	
13-1041	Compliance Officers	3,014	1.9%	91	49%	51%	31.83	0.97	30%	◀
13-1051	Cost Estimators	3,717	2.5%	149	24%	76%	28.92	0.96	36%	◀
13-2011	Accountants & Auditors	14,235	2.6%	717	38%	62%	30.33	0.88	28%	◀
13-2099	Financial Specialists, All Other	1,593	1.8%	40	55%	45%	33.10	0.98	22%	
Data Scientist		3,136	2.9%	138	56%	44%			21%	
13-1081	Logisticians	1,400	2.1%	42	49%	51%	34.00	0.90	18%	
15-2011	Actuaries	178	2.4%	11	46%	54%	43.47	0.83	16%	
15-2031	Operations Research Analysts	991	3.7%	56	62%	38%	36.70	0.93	26%	◀
15-2041	Statisticians	509	3.5%	27	60%	40%	33.62	0.84	20%	
15-2099	Mathematical Science Occupations, All Other	59	0.4%	2	36%	64%	30.72	0.90	26%	◀
Data-Enabled Analysts		33,089	2.3%	1,117	53%	47%			25%	
13-1111	Management Analysts	8,804	2.6%	316	56%	44%	34.40	0.86	35%	◀
13-1161	Market Research Analysts & Mktng. Specialists	5,527	3.5%	247	68%	32%	30.25	0.88	15%	
13-1199	Business Operations Specialists, All Other	14,696	1.8%	366	48%	52%	32.29	0.90	25%	◀
13-2031	Budget Analysts	832	1.5%	31	29%	71%	33.58	0.94	24%	
13-2041	Credit Analysts	742	1.6%	44	22%	78%	35.57	0.98	14%	
13-2051	Financial Analysts	2,489	2.2%	112	46%	54%	44.77	0.96	13%	
Human Resource Managment		12,408	1.9%	493	32%	68%			23%	
13-1071	Human Resources Specialists	6,569	2.0%	262	33%	67%	28.07	0.92	20%	
13-1075	Labor Relations Specialists	1,543	0.3%	37	0%	100%	32.33	1.09	28%	◀
13-1141	Compensation & Benefits Specialists	955	2.6%	46	43%	57%	30.69	0.98	23%	
13-1151	Training & Development Specialists	3,342	2.3%	148	39%	61%	28.44	0.94	24%	

INFORMATION TECHNOLOGY AND SOFTWARE

People in IT and software occupations are increasingly employed by industries outside of software and media companies as big data, cybersecurity, and cloud computing play a bigger and bigger role in product development, communications with customers, and the analysis of business operations. These occupational clusters are continually being bombarded with new software and operating systems, connectivity and mobility applications, and data protection protocols that require agile and on-demand training in a learn-by-doing environment. Figure 13 gives occupational data for these workers.

FIGURE 13. INFORMATION TECHNOLOGY AND SOFTWARE OCCUPATIONS
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Programmers and Developers		22,417	2.3%	790	51%	49%			13%	
15-1131	Computer Programmers	3,469	0.7%	113	20%	80%	35.25	0.91	18%	
15-1132	Software Developers, Applications	11,111	2.6%	394	55%	45%	46.93	0.96	13%	
15-1133	Software Developers, Systems Software	4,036	1.9%	128	50%	50%	48.52	0.94	13%	
15-1134	Web Developers	3,801	3.2%	156	64%	36%	28.04	0.90	8%	

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FIGURE 13. INFORMATION TECHNOLOGY AND SOFTWARE OCCUPATIONS (CONTINUED)
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
Systems and Data Administration		16,651	1.4%	504	45%	55%			15%
15-1141	Database Administrators	1,134	2.5%	50	44%	56%	41.01	1.03	18%
15-1142	Network & Computer Systems Admin.	3,731	1.9%	112	50%	50%	35.16	0.91	14%
15-1143	Computer Network Architects	1,133	1.4%	38	45%	55%	55.75	1.07	13%
15-1151	Computer User Support Specialists	8,674	1.3%	249	43%	57%	24.28	0.96	16%
15-1152	Computer Network Support Specialists	1,978	0.8%	55	41%	59%	28.99	0.92	16%
Systems Architects and Analysts		13,334	2.1%	415	54%	46%			18%
15-1111	Computer & Info. Research Scientists	413	2.0%	13	55%	45%	68.66	1.18	16%
15-1121	Computer Systems Analysts	5,532	2.8%	242	65%	35%	39.84	0.94	20%
15-1122	Information Security Analysts	695	2.8%	30	65%	35%	46.65	1.00	20%
15-1199	Computer Occupations, All Other	6,694	1.4%	130	30%	70%	39.33	0.92	16%

SKILLED PRODUCTION AND TRADES

The future of automation, the Internet of Things, and artificial intelligence are changing production landscapes in areas like advanced manufacturing, food processing, medical devices, and other plant operations. Operators now need mechatronics skills, and the need for industrial repair technicians will grow as more automated machinery comes on line. The foundation for all production will continue to be supported by skilled trades-people and first-line supervisors. Figure 14 provides information on expected needs for these workers.

FIGURE 14. SKILLED PRODUCTION AND TRADES OCCUPATIONS
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
First-Line Supervisors		11,532	1.5%	331	35%	65%			27%	
49-1011	First-Line Supvsr., Mechanics, Install, & Repair	4,612	1.7%	150	34%	66%	31.04	1.01	30%	◀
51-1011	First-Line Supvsr., Production & Operating Workers	6,920	1.5%	181	36%	64%	26.30	0.93	25%	
Industrial Machinists and Operators		6,817	2.8%	363	38%	62%			24%	
51-4011	CNC Machine Operators, Metal/Plastic	2,278	2.8%	128	39%	61%	18.78	0.99	18%	
51-4012	CNC Machine Programmers, Metal/Plastic	628	2.8%	33	35%	65%	27.52	1.11	18%	
51-4041	Machinists	3,910	2.7%	202	37%	63%	22.48	1.12	29%	◀

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FIGURE 14. SKILLED PRODUCTION AND TRADES OCCUPATIONS (CONTINUED)
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Industrial Mechanics and Service Technicians		10,250	2.4%	431	38%	62%			27%	
49-2091	Avionics Technicians	193	2.2%	5	33%	67%	26.15	0.86	20%	
49-3011	Aircraft Mechanics & Service Technicians	1,224	2.1%	43	27%	73%	27.00	0.91	20%	
49-3042	Mobile Heavy Equip. Mechanics, Except Engines	1,791	0.9%	49	11%	89%	23.49	1.00	27%	◀
49-9041	Industrial Machinery Mechanics	5,102	3.4%	276	45%	55%	26.27	1.05	28%	◀
49-9043	Maintenance Workers, Machinery	956	2.2%	34	49%	51%	22.09	1.02	28%	◀
49-9044	Millwrights	984	0.0%	23	11%	89%	25.08	0.94	33%	◀
Welders and Skilled Trades		19,322	1.0%	549	26%	74%			19%	
47-2111	Electricians	8,309	0.5%	181	19%	81%	30.50	1.21	20%	
47-2152	Plumbers, Pipefitters, & Steamfitters	5,563	1.1%	141	34%	66%	32.21	1.32	18%	
51-4121	Welders, Cutters, Solderers, & Brazers	5,098	2.0%	215	27%	73%	19.68	1.04	17%	
51-4122	Welding, Soldering, & Brazing Machine	352	0.1%	12	10%	90%	18.03	1.02	16%	

HEALTHCARE OCCUPATIONS

The sheer numbers of healthcare workers and the high growth rates in healthcare fields continue to push these occupations to the top of the list of high-demand jobs. However, with changing healthcare policies, advances in technology, and data-enabled decisions, the ongoing training of existing healthcare workers is quickly becoming as important as the pipeline of new workers. The occupations listed in Figure 15 below top the list; however, additional occupations in short supply can be found in the Healthcare Profiles in Appendix B.

FIGURE 15. HEALTHCARE OCCUPATIONS
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Mental and Behavioral Health		11,722	2.5%	542	48%	52%			26%	
21-1011	Substance Abuse & Behavioral Disorder Counselors	1,847	2.5%	86	49%	51%	21.53	1.00	26%	◀
21-1013	Marriage & Family Therapists	554	2.7%	32	56%	44%	20.81	0.84	32%	◀
21-1014	Mental Health Counselors	3,356	2.7%	156	49%	51%	24.81	1.11	26%	◀
21-1015	Rehabilitation Counselors	2,253	2.2%	99	46%	54%	19.13	1.05	29%	◀
21-1019	Counselors, All Other	482	2.6%	21	45%	55%	27.08	1.17	30%	◀
21-1023	Mental Health & Substance Abuse Social Workers	2,557	2.8%	128	45%	55%	21.85	1.00	24%	
29-2053	Psychiatric Technicians	672	1.6%	20	61%	39%	18.23	1.05	16%	
Nursing and Nurse Specialties		37,470	2.3%	1,639	39%	61%			28%	
29-1141	Registered Nurses	33,777	2.3%	1,394	37%	63%	39.82	1.19	28%	◀
29-1161	Nurse Midwives	98	3.1%	5	46%	54%	57.99	1.31	30%	◀
29-2061	Licensed Practical/Vocational Nurses	3,595	2.3%	240	49%	51%	23.36	1.10	26%	◀

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FIGURE 15. HEALTHCARE OCCUPATIONS (CONTINUED)
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Pharmacy and Medication Management		8,761	2.1%	281	45%	55%			19%	
29-1051	Pharmacists	4,103	2.0%	150	31%	69%	57.98	1.01	24%	
29-2052	Pharmacy Technicians	4,658	2.3%	131	60%	40%	17.99	1.20	14%	
Primary Care		5,114	2.8%	253	41%	59%			26%	
29-1062	Family & General Practitioners	1,253	1.8%	52	22%	78%	85.48	0.95	30%	◀
29-1063	Internists, General	534	1.8%	21	21%	79%	97.45	1.16	28%	◀
29-1065	Pediatricians, General	503	1.3%	18	14%	86%	83.20	1.00	28%	◀
29-1071	Physician Assistants	1,212	3.3%	66	51%	49%	50.57	1.05	16%	
29-1171	Nurse Practitioners	1,611	4.0%	97	53%	47%	53.01	1.07	29%	◀
Rehabilitation Therapy		7,583	2.6%	384	43%	57%			18%	
29-1122	Occupational Therapists	1,109	2.8%	50	51%	49%	38.97	1.04	14%	
29-1123	Physical Therapists	2,735	2.7%	147	41%	59%	39.12	0.97	14%	
29-1126	Respiratory Therapists	1,162	2.2%	46	35%	65%	31.58	1.12	25%	◀
29-1127	Speech-Language Pathologists	1,667	2.3%	75	38%	62%	36.48	1.04	24%	
31-2011	Occupational Therapy Assistants	235	3.8%	19	55%	45%	26.93	0.97	15%	
31-2021	Physical Therapist Assistants	639	3.0%	46	51%	49%	25.79	0.98	13%	

ENGINEERING AND SCIENTIFIC OCCUPATIONS

While there continues to be a need for various types of engineers and scientists, the demand for these occupations primarily points to the need for a new pipeline of interdisciplinary engineers to replace those existing in the workforce. Figure 16 shows current and projected needs for these occupations.

FIGURE 16. ENGINEERING AND SCIENTIFIC OCCUPATIONS
BY OCCUPATIONAL CLUSTER

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	2016 Jobs	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Interdisciplinary Engineering		17,532	1.6%	606	21%	79%			22%	
17-2061	Computer Hardware Engineers	3,722	0.8%	74	0%	100%	62.06	1.08	15%	
17-2071	Electrical Engineers	2,491	1.9%	86	32%	68%	43.10	0.89	24%	
17-2072	Electronics Engineers, Except Computer	1,406	1.6%	46	29%	71%	44.69	0.92	23%	
17-2112	Industrial Engineers	3,366	2.2%	154	30%	70%	48.31	1.15	24%	
17-2141	Mechanical Engineers	3,803	1.8%	168	23%	77%	42.10	1.02	22%	
17-2199	Engineers, All Other	2,745	1.4%	77	25%	75%	44.47	0.93	28%	◀

EXAMINING OCCUPATIONS BY DEMAND CHARACTERISTICS

Another way to examine occupational clusters is to evaluate them by demand factors (evolutionary, steady-demand, and transitional/mission-critical) described in Figure 10. Figure 17 provides the current and projected needs for occupational workers arranged by these demand stages.

FIGURE 17. OCCUPATIONAL CLUSTERS
BY DEMAND STAGE

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Evolutionary							
Rehabilitation Therapy	7,583	2.6%	384	43%	57%	18%	
Industrial Machinists and Operators	6,817	2.8%	363	38%	62%	24%	
Data Scientist	3,136	2.9%	138	56%	44%	21%	
Mental and Behavioral Health	11,722	2.5%	542	48%	52%	26%	◀
Systems Architects and Analysts	13,334	2.1%	415	54%	46%	18%	
Wellness Occupations	834	2.2%	23	70%	30%	28%	◀
Other Medical Specialties	762	3.0%	43	32%	68%	25%	◀
Digital Media Technicians	2,041	3.1%	78	51%	49%	15%	
Surgical and OR Specialists	2,807	2.4%	102	41%	59%	23%	
Healthcare Educators	710	2.2%	28	45%	55%	25%	◀
Steady Demand							
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Pharmacy and Medication Management	8,761	2.1%	281	45%	55%	19%	
First-Line Supervisors	11,532	1.5%	331	35%	65%	27%	◀
Medical Records and Information Management	2,779	2.0%	110	37%	63%	28%	◀
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Welders and Skilled Trades	19,322	1.0%	549	26%	74%	19%	
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Systems and Data Administration	16,651	1.4%	504	45%	55%	15%	
Community Health and Social Services	7,998	2.4%	412	46%	54%	25%	◀
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Transitional/Mission-Critical							
Plant and Systems Operators	2,116	1.0%	78	20%	80%	32%	◀
Care Specialties	6,207	1.9%	260	27%	73%	28%	◀
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	
First-Line Supervisors	11,532	1.5%	331	35%	65%	27%	◀
Human Resource Managment	12,408	1.9%	493	32%	68%	23%	
Supply Chain, Purchasing, and Logistics	6,537	1.8%	266	23%	77%	28%	◀
Primary Care	5,114	2.8%	253	41%	59%	26%	◀
Oral Health	10,760	1.8%	410	36%	64%	17%	
Engineering Support	2,305	1.3%	35	14%	86%	25%	◀
Plant and Field Technicians - Energy	1,696	2.1%	100	30%	70%	23%	

Source: TIP Strategies, Scruggs & Associates.

INPUT FROM EMPLOYERS

During the development of the Talent Plan, employer input was sought as part of the talent assessment to refine the nuances of various talent gaps and validate findings from the quantitative analysis. This input was collected through interviews, focus groups, and industry events. These activities provide insights on not only what occupations are in high-demand, but also on what specific skills are missing in these critical jobs and what training efforts are most effective. The common themes from the input are summarized in the following section with additional input found in sector reports.

A NEW SET OF CORE COMPETENCIES IS EMERGING

The digitization of work—the plethora of data, the continual connectivity, the increase in automation—is requiring new skill competencies in a broad array of jobs.[20] The new skills desired by employers include a blend of creativity to think about new solutions, greater technology skills for implementation, and new media literacy as well as social intelligence. Specifically:

> **The difference now is the life cycle of skills is shorter than ever and change is happening at an unprecedented scale.**
> The Skills Revolution, Manpower Group

Comprehensive Skills

- **Adaptive and design thinking.** Having the ability to conceptualize options, develop solutions beyond that which is routine, and adapt to changing situations.
- **Data analytics.** Having an understanding of statistical and quantitative analysis in order to manage, interpret, and apply data to business solutions.
- **Computational thinking.** Having the ability to logically order and analyze data, and to format solutions in ordered or sequential steps for machines or humans to carry out.
- **Business acumen.** Having the ability to understand how individual job and project decisions affect the overall business operations in terms of cost, quality, opportunities, and other related outcomes.

Operational Skills

- **IT/software literacy.** Having a foundation of IT and general purpose programming skills that enables one to quickly learn and adopt new software tools and platforms into their job function.
- **Media literacy.** Having the ability to understand various media platforms, and how best to communicate effectively through them.
- **Data visualization.** The ability to visually communicate data and information.
- **Virtual collaboration.** Having the ability to work in virtual teams on projects and harnessing the power of technology to develop deep collaborations.
- **Social intelligence.** With co-workers and customers from different cultures, race, and religions, having social intelligence or the ability to sense and adapt our thinking styles and mannerisms to align with that others will be critical.

[20] Manpower Group, *The Skill Revolution*, January 2017

GAPS IN BASIC SKILLS STILL REMAIN

Not surprisingly, employers continue to identify a similar set of missing skill sets consistent with the previous talent plan as well as other state and national reports. These, skills, primarily applied in nature, emphasize the need for a more comprehensive definition of knowledge and education as defined in Part II, Figure 8.

- Applicants for lower- and middle-skill entry-level jobs are missing:
  - Basic workplace readiness skills, such as reliability, punctuality, and professionalism
  - Ability to pass background checks and drug tests.
  - Strong work ethic.
- New graduates from higher educational institutions in Oregon tend to be missing:
  - An understanding of the general communication in the workplace.
  - Agility and the ability to adapt to changing job or project demands.
  - Cultural competencies in how to deal with diverse teams.
  - For technical degrees, little understanding of the business environment and cost parameters in which jobs operate.
  - The ability to prioritize and manage time.
- Experienced applicants tend to be missing:
  - Mentoring and supervisory skills to manage others.
  - Novel and adaptive thinking.
  - New media literacy and virtual collaboration skills.
  - Computational skills to apply data to decision-making.

These skills gaps mean that employers must spend time once an employee is hired in providing an ad-hoc "finishing school" for applied skills. Since Oregon does little to invest in incumbent-worker training or industry consortiums, individual employers end up creating one-off programs that are not easily aggregated or replicated, and which is a costly and inefficient manner to upskill workers. The most effective way to address basic skills gaps is to incorporate skills training into education curriculum.

EMPLOYERS EXPERIENCE A LACK OF COORDINATION OR ACCESS TO TALENT

Perhaps more important than gaps in skill sets is employers' frustration with Oregon's distributed system of education and workforce, where locating a single point of contact to access needed resources or talent is extremely difficult. This was illustrated by numerous examples given by employers with business locations in other states or who recruit workers from educational institutions outside of Oregon. While the following are perception and not documented facts, such perceptions often discourage employer participation in industry-education partnerships, especially at the state level.

From an employer's perspective:

- Oregon's de-centralized university system results in multiple entry points and makes it more difficult to find graduates or interns. Except for programs like Multiple Engineering Cooperative Program (MECOP), a cooperative program between four of Oregon's largest universities, employers find navigating Oregon's higher education system very frustrating.

- With one or two exceptions, notably Oregon Tech, employers perceive that Oregon's higher educational institutions do not do a good job in effectively engaging employers in curriculum development or exposing students to Oregon careers. While there were pockets of programs where individual faculty went "the extra mile," most employers who worked with institutions both within and outside of Oregon placed Oregon institutions low in their ability to fully engage industry to benefit students and research.
- Employers who interfaced with community colleges were, on the whole, more positive than those who interfaced only with universities, especially in rural parts of the state. Their biggest frustration was the state's funding formula, which, in their opinion, does not treat non-degree efforts like industry-based training the same as an associate or transfer degree. Some employers felt that employees taking non-credit classes, or those taking just a few for-credit classes essential to their job yet not enrolled in a degree program, were not as welcomed as degree or transfer students.
- While employers noted pockets of good relationships with local workforce boards, they also noted a need for statewide workforce strategies to support industries found throughout the state (e.g., healthcare and manufacturing). Employers also observed the abundance of "regional plans that say the same thing" and the lack of actual training funds available to implement or coordinate these plans. It was not apparent how workforce and skills gap data collected from one regional workforce board are shared with other workforce boards or partners in the state.
- Employers overwhelmingly noted interest in embracing more work-based or apprentice-style models. However, conversations with state agencies which deploy those models perceived a lack of interest by employers. The channels by which information about state programs reaches employers continue to be an issue. It is unclear where this breakdown occurs, since the state has active industry associations representing most business segments.

LESSONS FROM THE OREGON TALENT COUNCIL

The Oregon Talent Council evolved its initial thinking from an investment focus on training for specific occupations to a focus on shared training models that responded to multiple skill needs. Since today's jobs can change rapidly, establishing training programs to address specific skills gaps may not be as effective as developing agile models that can quickly adapt to different skills needs. These insights contributed to the definition of unique objectives that guided the occupational analysis of the talent assessment:

- **Understand the relative demand dynamics of different occupations.** For instance, are there certain reasons or demand drivers that one group of occupations have that others may not? Are there patterns to issues like retirement exposure that would suggest more or less emphasis on certain training investments?
- **Identify occupations that cut across industries.** Understanding the demand for skills in cross-cutting occupations can help multiple industries address talent shortages jointly, helping to stretch limited public dollars.
- **Not all mission-critical occupations have large number of jobs or projected openings.** Some jobs, like millwrights, can be show stoppers. Knowing which occupations have the greatest domino effect on others, and ensuring there is training to accommodate these are a necessary part of the training portfolio.

PART IV: AN INVESTMENT FRAMEWORK FOR TALENT DEVELOPMENT

Employers cannot solve their talent issues alone. Addressing shared challenges requires greater coordination, collaboration, and support not only among education and workforce organizations but also among the employers themselves within and across industry sectors. As one Oregon Talent Council member noted, "It requires real leadership to engage in forward-leaning thinking and a willingness to drive action toward new training approaches."

The creation of a more dynamic and agile system is not easy. It necessitates the support of the state's education and workforce organizations and leadership of elected officials to generate and maintain the momentum needed to make systemic changes in how the state thinks about and supports talent development. The issue is clear: **in today's environment of continual learning, investing in public and higher education and then disinvesting in ongoing worker training not only puts Oregon employers at risk, it dilutes the value and effectiveness of education investments.**

The goal of the Oregon Talent Plan is to propose an investment strategy that cultivates a statewide workforce training system by which current and future Oregonians have the qualifications necessary to be productive workers and earn livable incomes. At the heart of this strategy is the state's ability to support the continuous skill-development of the existing workforce and create an environment where employers, workers, education, and workforce partners drive toward a shared set of goals.

POSITIONING TALENT FOR THE FUTURE

Oregon's investment in education to deliver the next generation of workers continues to be important, but it is no longer sufficient to address talent gaps. Investments in upskilling existing workers are imperative if the state's economy is to grow. Together, industry, the education/workforce system, and state government should work to:

- *Develop industry-based and rapid-response training models that are responsive to ever-changing skills and will augment the more traditional models of education.*
- *Reward employers and industry consortiums that invest in employee and worker training and apprenticeships.*
- *Understand how employers define core skills and job competencies and systematically use that information to incorporate more-employable skills into academic curriculums.*
- *Ensure that a portion of higher education funds is used to foster more non-credentialed learning and continued skill development.*

Building on best practices from other states and integrating the key trends that will affect what skills are needed, the recommended talent investment strategy has three objectives:

1 **Invest in agile and industry-led training models that keep existing workers up-to-date**

2 **Foster and reward a culture of learning among employers**

3 **Ensure Oregon's education and workforce systems fund and support a) the inclusion of employability skills into curriculum and b) flexible models of continuous skill development**

Each of these three objectives is presented in more detail in the pages that follow.

1 Invest in agile and industry-led training models

Direct investments in industry consortium training models is the top priority of the Oregon Talent Plan. With the rapid pace of change, upgrading skills of our current workforce will increase the resiliency of Oregonians and organizations.

Recommendation: *Provide at least $30 million each biennium for industry consortium models that train incumbent workers.*

Investments should be made across three key categories that address the most common "pain points" experienced by employers and workers: a) bringing new skills to market, b) rapidly retooling or upgrading existing occupations, and c) developing systematic methods for structured work-based training and knowledge transfer. Figure 18 shows the correlation between these categories and the demand stages of the occupational clusters discussed in Part III. Figure 19, which follows, presents the desired outcomes of each group, along with examples of appropriate training models.

FIGURE 18. SKILLS DEVELOPMENT MODEL: TRAINING FOR THE 80 PERCENT

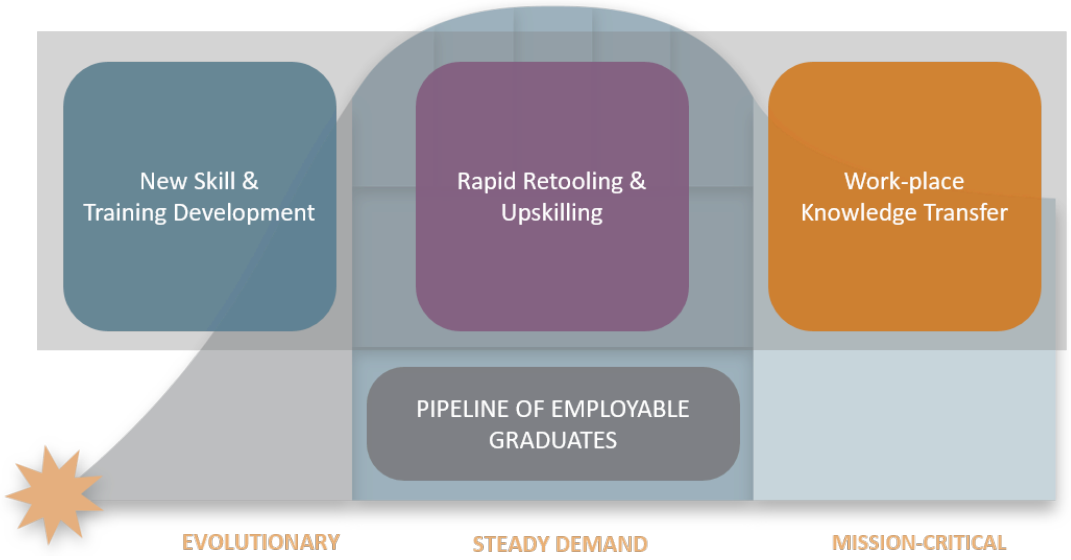


FIGURE 19. TRAINING MODELS FOR EACH DEMAND STAGE

MODELS	DESIRED OUTCOME	SAMPLE TRAINING MODELS
New Skill & Training Development	*Standardization of new skills and identification of training models and demand*	• Learning labs • Industry-led training collaboratives
Rapid-Retooling & Upskilling	*Rapid retooling core skills from one industry to another; Upskilling occupations for new technologies and regulations*	• Industry certifications and badging • "Finishing" programs • Industry/education consortiums
Work-Place Knowledge Transfer	*Systematically transferring core knowledge and skills from one worker to another*	• Structured on-the-job training & work-based learning • Apprenticeships

Industry should play a key role in making decisions on where investments are best deployed. Investments, regardless of the training category, should adhere to best-practice investment characteristics:

- **Funds should be invested in repeatable models**, such as BioPro or Smart Talent, rather than in one-time training for a specific employer or skill set.
- **Funds should go directly to industry associations or industry-led consortiums** (including staffing agencies) that can demonstrate a shared training need among groups of employers. These consortiums would then find the most appropriate training providers and methods to fill skills gaps.
- **Industry should match funding** and have the capacity to manage the model after state investments are made.

[Note: The recommended $30 million is approximately the same level of general funds allocated to the former Engineering Technology Industry Council (ETIC), and what was originally envisioned for the Oregon Talent Council. Compared to previous talent investments in higher education, industry-based models like those currently funded by the Oregon Talent Council are very capital efficient –requiring only modest funding per worker (approximately $1,250 per worker). Therefore, $30 million in available funds could reach almost 25,000 workers each biennium. To put this in perspective, it is 2 percent of the public higher education budget spent on student outcomes, or 3.6 percent of the $35,000 of public funds spent per degree awarded.]

2 Foster and reward a culture of learning among employers

A key talent gap in Oregon are efforts that help create an overall culture of learning and training for employers and employees alike. In addition to direct investments in shared training models, an effort to encourage individual employers to invest in training workers will reach more workers in need of new skills, and increase the overall competitiveness of businesses.

Recommendation: *Consider an income tax credit program for employers and workers to encourage skill upgrades.*

Many states offer tax credits over and above federal on-the-job training and Work Opportunity credits. These credits are focused on helping businesses and industry consortiums offset training costs and encouraging ongoing training models. Most tax credits are capped, with an average credit of between $1,250–$2,500 per employee, although some states offer more for specific industries. A credit of $1,500 per worker would be equivalent to one-tenth (1/10th) the cost of replacing a worker due to turnover, or one-thirtieth (1/30th) the cost of an unfilled vacancy. The payback to employers, workers, and the state is well documented. Many of these programs are part of business attraction-and-retention strategies and run by state commerce or economic development agencies.

For Oregon, a training tax credit capped at $10 million per biennium would help upgrade the skills of 8,000 workers per biennium (4,000 per year). One thing that would set an Oregon incentive apart from other states would be the ability to allow self-employed individuals to access a portion of the training assistance. Based on other models, an Oregon tax credit might include:

- Training for skills that provide workers with upward mobility within the company (as opposed to basic skills training that can be provided by education and workforce institutions) or enhanced income opportunities for the self-employed. These could include supervisory and management training; upskilling on new technologies and IT platforms; computational skills; cross-training programs; ISO, Lean, and other productivity processes; industry certifications that result in job reclassification; and industry-specific applications of professional and technical occupations
- A 50 percent credit for employers for direct training costs such as training fees, travel, and wages to hire replacement workers during training
    - A maximum credit per employee (e.g., $1,250) for companies with 100 or more employees with a maximum cap per company; a slightly higher credit per employee for companies with fewer than 100 employees, or companies located in a rural or distressed area; and a maximum credit (e.g., $2,500) for an apprenticeship.
- A maximum credit (e.g., $1,250) or 50 percent of the total cost per year for self-employed workers and those in limited-liability corporations or partnerships.

Examples of other states with training tax credits include:

- **Rhode Island** has a suite of five tax credits tied to its economic-development strategy. Two of these credits most suitable for Oregon talent needs include:
    - *Apprenticeship Tax Credit***:** A tax credit of 50 percent of actual wages or $4,800, whichever is less, for employers who hire an apprentice as a machine toolmaker, machinist, model-maker, gage-maker, pattern-

maker, plastic-process technician, tool- and machine-setter, die-sinker, mold-maker, tool & die maker, and similar occupations

- *Qualified Jobs Incentive Tax Credit*: A credit for companies in targeted industries that are expanding their workforce in Rhode Island or relocating jobs from out of state. It is redeemable for up to ten years and can be as much as $7,500 per job per year, depending on the wage level and other criteria

- **Kentucky's Skills Training Investment Credit** offers state tax credits of up to 50 percent of eligible training costs (including in-house training) for approved training programs for existing employees of companies in the following sectors: manufacturing, agricultural processing, telecommunications, R&D, health care, mining, tourism, tool and die, machine technology, and transportation
- **New York's Employee Training Incentive Program (E-TIP)** for employee training and internships provides a tax credit of up to $10,000 per employee to New York State employers for training investments that upgrade, retrain, or improve the productivity of their employees, or a $3,000 stipend paid to an intern in advanced technologies.
- **Georgia's Retraining Tax Credit** provides a credit of 50 percent of direct-training expenses up to $1,250 per employee. Retraining tax credits can be used to offset up to 50 percent of a company's Georgia corporate income tax liability. If the earned credit exceeds that limit, the unused credit can be carried forward for up to ten years and applied to future years' tax liability.

3 Ensure Oregon's education and workforce systems fund and support a) the inclusion of employability skills into curriculum and b) flexible models of continuous skill development

Third in the line of recommendations critical for a successful talent development effort is the support and active engagement of the state's education and workforce organizations. As the definition of formal education becomes more fluid, and as employers and workers both begin to value skills training over degrees, the way education is delivered will need to keep pace with demands of the customers. This plan recognizes the need for and importance of traditional education and degree programs. Yet, it also recognizes that there is an increasing desire for complementary models of education delivered in more bite-sized pieces and in formats that can be accessed by people who are working. The market for so-called "nano-degrees" and "micro-certificates" has grown rapidly, along with the desire for competency-based and self-paced training.

This section outlines key metrics, program characteristics, and desired outcomes that employers and workers have noted as critical to education and training programs and provides two recommendations for achieving these outcomes. While many of these suggestions exist in isolated programs, there does not appear to be a widespread adoption or a systematic approach in Oregon.

Recommendation: To increase the employability of higher education graduates, the following should be implemented:

- **Degree programs should be required to have a professional component that reinforces employability skills such as work-based communications, project and time management, social intelligence, and other related skills.** (This was the number one criticism of Oregon graduates.) Oregon Tech and Linn-Benton Community College were mentioned as institutions that do a good job of incorporating employability skills. Oregon State University's College of Science is currently developing professional development modules to be incorporated into curriculum. It has been suggested that such professional or work-ready course/curriculum should be shared and used throughout the public system.
- **Internships and general work experience should be considered an essential part of education.** A more-structured approach should be taken to help students find and be prepared for work experience throughout their education process, not just towards the end of their degree program. Employers note a very disjointed approach among most public institutions and a more-systematic approach at private colleges and universities. The HECC should enhance funding for internship coordination, especially for schools outside of the Willamette Valley, and provide ongoing support for enhanced career services such as platforms like Oregon Handshake.
- **Degree programs should measure success by job placement and professional growth path as well as degrees awarded.** Programs with higher job placements rates should be rewarded, and their process shared across educational institutions to accelerate results.
- **Higher education's use of industry advisory councils should be enhanced.** Three issues were noted with regards to advisory councils.
    - The influence and use of advisory councils differ greatly from institution to institution and program to program. It is unclear to employers sitting on these councils whether there is any type of training or assistance to help form and run an effective advisory council or even if there is a defined set of expectations. A larger, more coordinated effort to help institutions make the most of their industry input would have a considerable impact.
    - There appears to be little sharing of information between councils. Employers feel these councils spend a lot of time re-inventing the wheel by having redundant conversations (such defining the key skills that make a good "T"-shaped student.) There should be a systematic way in which information on common issues is gathered, analyzed, and shared.

- There should be shared advisory councils for related programs. Employers noted that their staff often sit on multiple advisory boards at different institutions for similar or the same degree programs, e.g., computer science programs at Portland State University (PSU), the University of Oregon (UO), and OSU, or life sciences at OSU, Oregon Health & Science University (OHSU), and Portland Community College (PCC). From an industry perspective, this is inefficient and inhibits standardization among programs that allows employers to "know what they are getting" in an Oregon graduate. It has been suggested that degree programs offered at multiple institutions use a shared advisory council, and, where there is a related industry association, that the higher education system should tap into that association to bring a more diverse set of employers to the table.

Recommendation: *To increase the effectiveness and flexibility of training options offered by education and workforce partners, the following should be implemented:*

- **Develop a clearly articulated statewide strategy for incumbent-worker training and use state-level Workforce Innovation and Opportunity Act (WIOA) funds to increase the capacity for statewide, sector-based incumbent-worker training efforts.** There are industry and occupational training needs that are clearly statewide issues—manufacturing and the need for industrial mechanics, healthcare and the need for Level-II-certified nursing assistants, or data analysts and cyber security specialists that cut across industries. In many cases, the need is for incumbent-worker training. To make the most effective use of limited WIOA funds for incumbent workers, other states use statewide programs in addition to the work of local boards. This minimizes development costs by avoiding multiple programs developed in different parts of the state, and maximizes the amount of funding that goes directly to training. Oregon's history of pushing almost all its WIOA funds to local boards has precluded strategic applications of funds to address such shared needs (although there are examples of adjacent workforce boards teaming up to do joint projects).

  A brief evaluation of other states noted that many state workforce boards have made incumbent-worker training a priority over the past few years, and most have developed or are in the process of developing statewide funds to address shared needs within industry sectors. Examples include:

  - **Virginia's Board of Workforce Development** has prioritized incumbent-worker training as a key part of its strategy. Statewide rapid-response and local funds are made available to provide incumbent-worker training. The local board may reserve and use up to 20 percent of the WIOA Title I Adult and Dislocated Worker funds allocated to the local area to pay for the federal share of the cost of providing a training program for incumbent workers. Their policy reads: "*Strategies for developing new workforce skills in the existing workforce shall be designed to benefit business and industry in ways that encourage and support the integration of new technology and business processes, increase employee productivity and support the competitiveness of the company. Incumbent worker programs create a number of positive outcomes including: Improving the alignment of existing workers' skills with new job requirements; Providing individuals access to new career opportunities within a business; Encouraging the retention of existing personnel who otherwise may become dislocated because of skills deficiencies; increasing the wages of newly trained workers; Creating new opportunities for entry-level workers through the promotion of existing workers; and supporting the overall enhancement of local and regional economic development efforts.*"
  - **Rhode Island's Incumbent Worker Training Grants** are administered through the state workforce board. In the FY2016–2017 Biennial Employment and Training Plan, employer partnerships were identified as one of four central priorities. The $1,200,000 incumbent-worker program provides grant awards from $25,000 to $150,000 to industry consortiums, sector partnerships, or groups of employers.
  - **Florida's Incumbent Worker Training (IWT) Program**, funded by WIOA and administered by CareerSource Florida (CSF) provides industry consortium grants as well as matching funds for a company's training costs.

Given the experience of the OTC's investments in the last biennium, it is recommended that any statewide effort prioritize industry consortium grants over training for individual companies.

- **Ensure that funding formulas to universities and community colleges include elements that make it easier for institutions to offer non-degree or credential training classes.** With a need for continuing education beyond an initial degree completion, funding formulas need to reflect education's increasing role in delivering bite-sized pieces of education as well as awarding credentials and degrees. How customized training is funded and supported at community colleges should be re-evaluated and modified so that noncredit training has sustained support, especially when such training is used by industry consortiums or groups of employers.
- **Reward industry engagement**. Higher education faculty are often "rewarded" for publishing articles or being engaged in research, as well as for teaching. Oregon could be at the forefront by also rewarding faculty for being actively engaged with industry.

MEASURING OUTCOMES AND IMPACT

Talent development is more than just learning new skills; it is applying those skills to increase job or employment competencies, having a measurable positive impact on workers and employers. The Oregon Talent Plan recommends that the state develop a shared or common set of metrics and methodology to evaluate outcomes across agencies that make investments in training and education. The evaluation of the state's talent investments could then occur at both the individual investment level and at an aggregate level. Yet. to make systemic changes or significantly move the needle in terms of talent outcomes, a talent strategy will require shared accountability by all major agencies, leadership or a "tone from the top," and early demonstration of success.

EVALUATING INDIVIDUAL TRAINING INVESTMENTS

Evaluations for individual training programs need to go beyond measuring the number of learners or workers completing a program and evaluate the impact and ROI. Training investments should measure three levels of performance:

- **Competency metrics.** Measures that indicate the training resulted in a verifiable skill competency
- **Impact metrics.** Measures that can quantify improvements that are a direct result of training
  - Impact to the employer—These include metrics such as the increase in productivity, revenues and/or quality, and reduction in turnover
  - Impact to the worker—These include metrics such as wage gains, promotions, and job satisfaction
- **Return on investment metrics**. Measures that compare the total impact or benefits to the cost

Alone, individual funding mechanisms such as the Oregon Talent Council investments are insufficient to "move the needle" on any key indicator. **Comprehensive and accurate assessments of the state's talent development investments will require all state agencies investing in talent development to conduct rigorous evaluations of their impact.** A shared set of metrics for evaluating individual programs across the state and across agencies would allow longitudinal analyses to be conducted. These types of analyses can provide insights into the performance of programs and the collective impact of investment over time. Closer collaboration across state agencies and local workforce boards regarding evaluation of investment outcomes

would, potentially, create efficiencies, reduce data collection costs, and contribute to a more robust understanding of the state's progress toward improved competitiveness in targeted industries.

MEASUREMENT OF THE EFFICACY AND DIRECTION OF THE STATE'S TALENT INVESTMENTS

In addition, a set of key metrics should be developed to focus on change at a systemic, not just a program, level. The measurement of the efficacy and direction of the state's talent investments would include a substantially larger dataset, including state-level metrics, in aggregate, related to program cost, participant outcomes, productivity increases, tax revenue generated, etc., as well as a substantially more sophisticated analysis. Metrics related to this type of evaluation would also include those that can proxy for the overall competitiveness of the state and of its targeted industry sectors, as well as the ability of the state's investments to measure growth in high-wage jobs as compared to competitor states. Ultimately, the efficacy and direction of the state's talent investments will involve calculating both a traditional cost/benefit ratio, as well as the "return" on the state's investments as a whole.

APPENDIX A. ECONOMIC AND LABOR MARKET TRENDS

Understanding Oregon's talent landscape requires an in-depth look at economic and labor market trends to identify where Oregon stands out and where Oregon lags. In addition, the Talent Plan takes a deeper dive into occupational demand factors, the five key industries—healthcare, advanced manufacturing, IT and digital services, energy, and biosciences—and the occupations and occupational clusters that support them. The results of this quantitative analysis are presented in the pages that follow. Note: additional occupational assessments by industry can be found in Appendix B.

SUMMARY OF FINDINGS

Oregon has a civilian labor force of 2.1 million and an employment base of 2.0 million. The ten largest industries account for 75 percent of the state's employment. Healthcare, retail trade, manufacturing, hospitality (lodging, restaurants, and bars), and education are the five largest industry sectors. This pattern is similar to that in the US—the nation's top ten sectors account for 77 percent of the nation's employment base, and the nation shares the same top nine industry sectors with Oregon.

Oregon's occupational distribution also follows patterns like those in the US, with 56 percent of the jobs requiring some kind of education and training. Other key trends are summarized below:

Strong job growth. Between 2011 and 2016, Oregon added about 200,000 jobs. The state's 9.1 percent job growth rate was significantly higher than the US growth rate of 6.0 percent (see Figure 20 and Figure 21, below). In this same period, earnings per worker has increased 13 percent (see Figure 22), as compared to only 11 percent for US workers. Across the state, employment growth ranged from gains of almost 24 percent in Deschutes and Morrow Counties to a loss of more than 9 percent in Gilliam County (see Figure 23). Over the same period, Oregon's earnings per worker rose 13 percent.

Tightening labor market. While the state's employment base grew by just over nine percent, the labor force grew by only three percent (see Figure 24 and Figure 25). As a result, the unemployment rate dropped to 4.9 percent in 2016 (see Figure 26), and employers are reporting greater difficulty filling vacancies.

Geographic disparities. Labor markets are not uniformly tight across the state. The northern part of the state has a significantly tighter labor market than the rest of the state, characterized by low unemployment. As Figure 28 shows, the unemployment rate varies from a low of 3.9 percent in Benton County to a high of 7.8 percent in Grant County. Eight counties have unemployment rates significantly below the US average: Benton, Yamhill, Washington, Multnomah, Clackamas, Hood River, Sherman, and Wheeler.

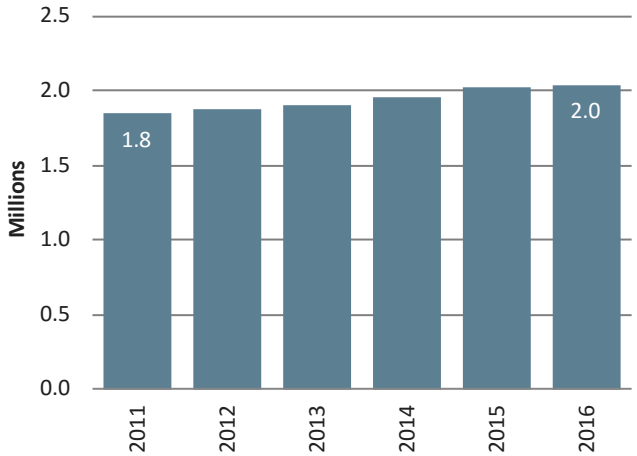
Importing labor. On average, one in five jobs or 20 percent of open positions are filled by workers moving from other states (primarily Washington and California). In addition, more than 110,000 workers commute each day from other states to fill jobs at Oregon-based employers. At the same time, 57,000 Oregonians cross state lines to fill jobs at employers who are based out of state. Figure 29 gives a snapshot of worker inflow/outflow in Oregon in 2014, while Figure 30 shows the rise in worker inflow into Oregon between 2007 and 2014. Finally, Figure 31 presents the percentage of workers imported into the state's key industries. For most industries, this figure is less than 20 percent; however, for IT workers the figure is slightly more than 25 percent.

More to come. Over the next five years, Oregon's employment base is expected to grow by another 135,000 jobs. Healthcare, manufacturing, and professional services are the primary industries driving growth. These three sectors are expected to account for over 40 percent of employment growth over the next five years. Healthcare alone will be responsible for one in four jobs. Overall, Oregon is expected to have almost 400,000 openings over the next five years. Almost half of these openings are in low-skill occupations and almost two-thirds of these openings are replacement jobs.

FIGURE 20. TOTAL EMPLOYMENT
2011 TO 2016

Since 2011, employment in Oregon has increased from 1.8 million to 2.0 million, an increase of 9.1 percent. Over the same period, employment in the US overall grew 6.0 percent.

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.



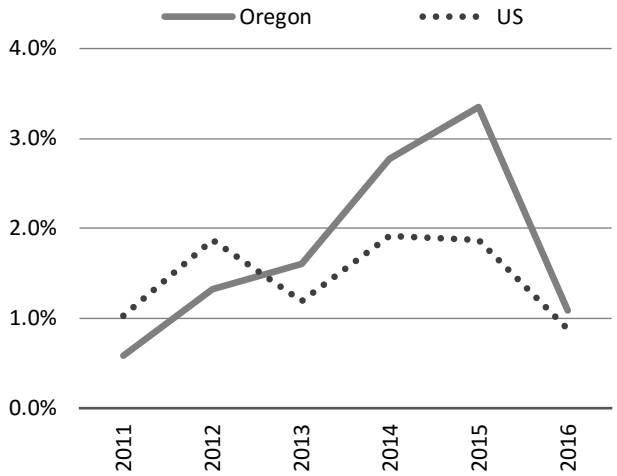


FIGURE 21. COMPARATIVE GROWTH
ANNUAL PERCENT CHANGE, 2011 TO 2016

In 2011 and 2012, Oregon's employment growth lagged growth in the US. Since 2013, Oregon's annual growth has outpaced the US growth rate.

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

FIGURE 22. PAYROLL TRENDS
TOTAL EARNINGS PER WORKERS, 2011 TO 2016

Between 2011 and 2016, Oregon's earnings per worker has climbed 13 percent from $49,776 to $56,271. Over this period, the compound annual growth rate was 2.5 percent. Over this same period, the US earnings per worker grew 11 percent, a compound annual growth rate of 2.1 percent.

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

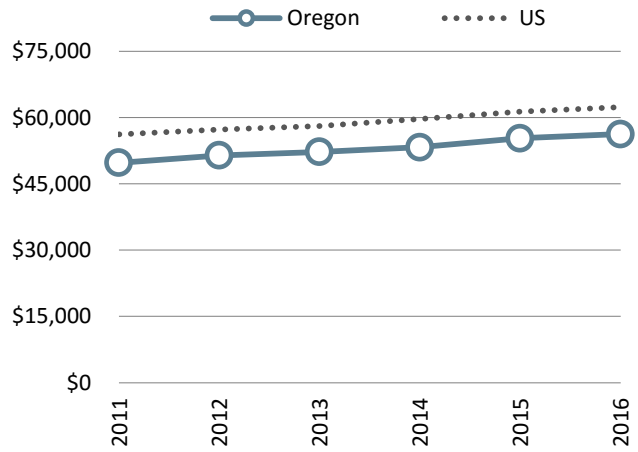
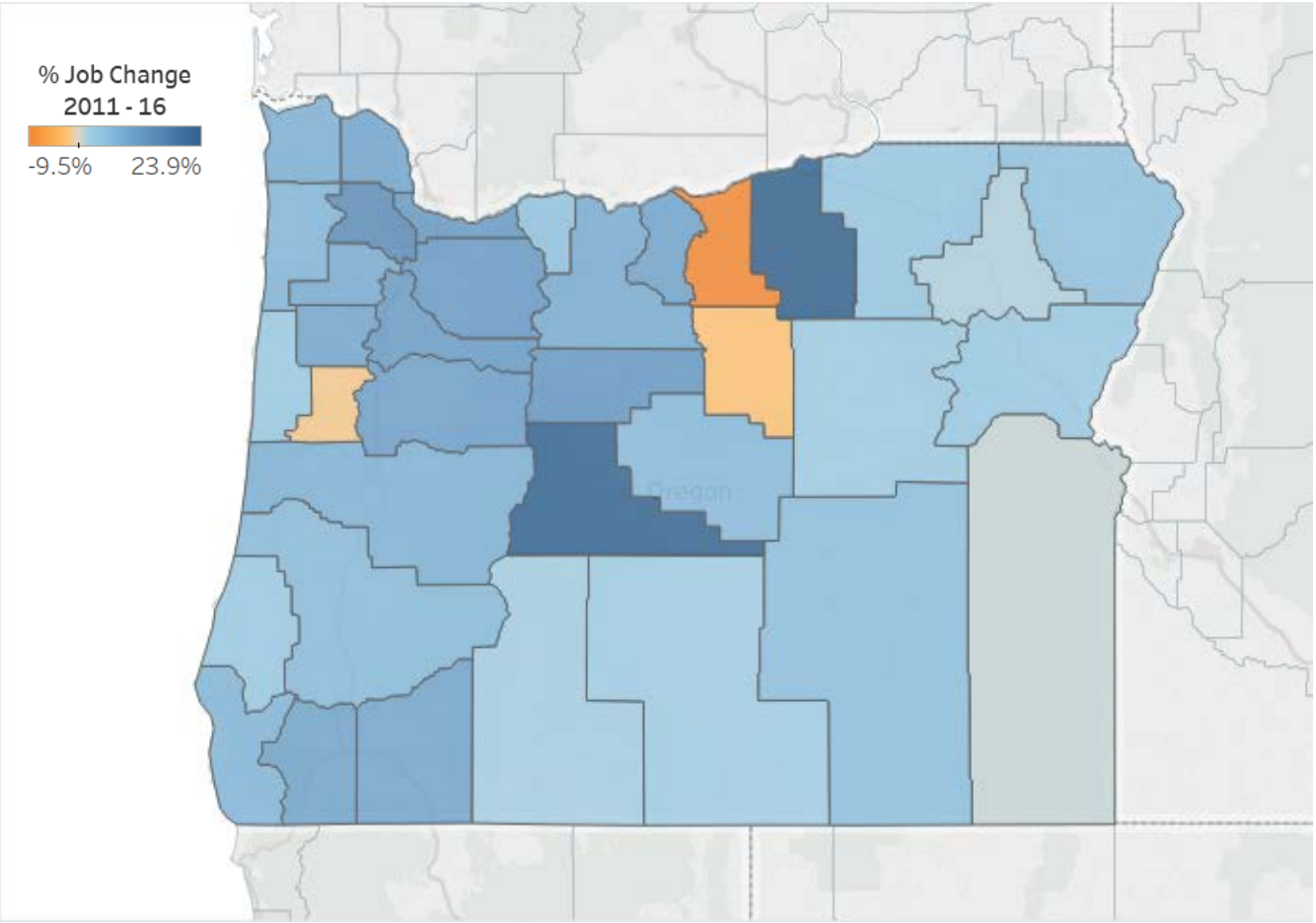


FIGURE 23. COMPARATIVE GROWTH BY COUNTY
PERCENT CHANGE, 2011 TO 2016



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

FIGURE 24. CIVILIAN LABOR FORCE
2011 TO 2016

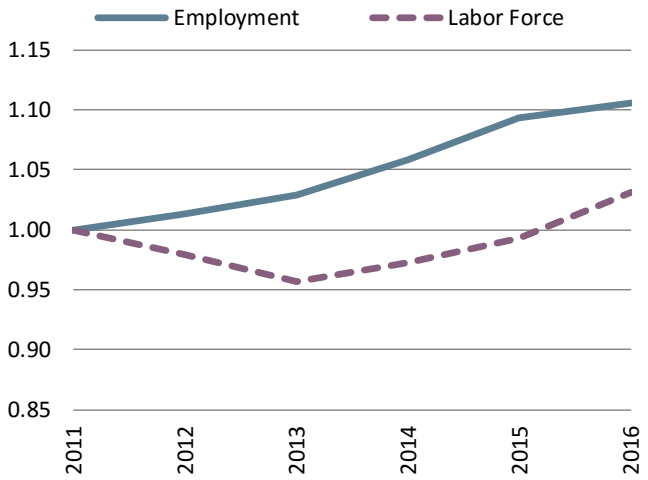
Since 2011, Oregon's labor force has increased from 2.0 million to 2.1 million, an increase of 3.2 percent. Over the same period, the US labor force grew by 3.6 percent.

Source: US Bureau of Labor Statistics via Moody's economy.com

FIGURE 25. LABOR FORCE DYNAMICS
INDEXED TO 2011

Between 2011 and 2016, the labor force grew only 3.2 percent while total employment grew almost 11 percent. By comparison, the national labor force grew 3.6 percent while total employment grew by 8 percent.

Source: US Bureau of Labor Statistics via Moody's economy.com; Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.



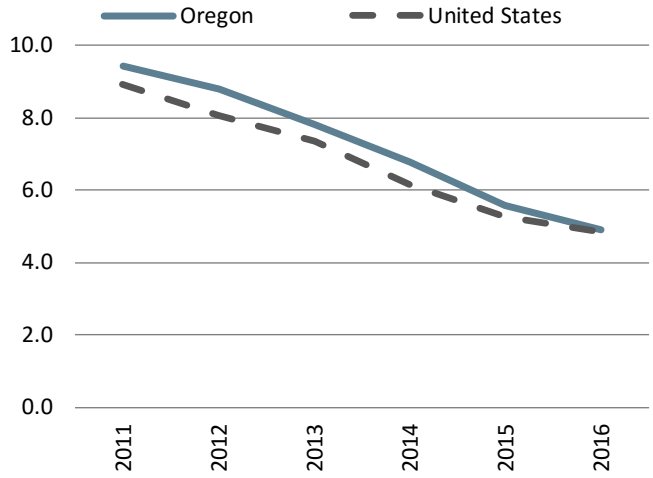


FIGURE 26. COMPARATIVE UNEMPLOYMENT
UNEMPLOYMENT RATES, 2011 TO 2016

As the labor market has tightened, the unemployment rate in Oregon has fallen from 9.4 percent in 2011 to 4.9 percent in 2016, which is just slightly above the US unemployment rate.

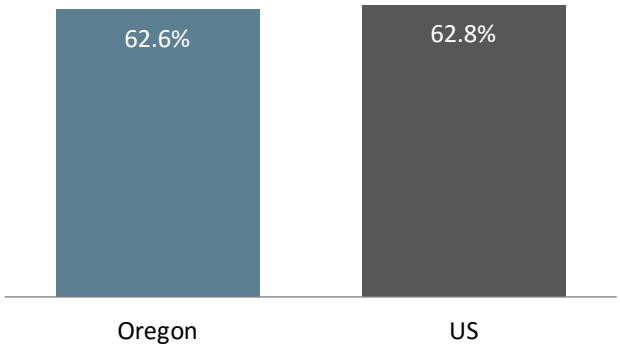
Source: US Bureau of Labor Statistics via Moody's economy.com

FIGURE 27. COMPARATIVE PARTICIPATION
LABOR FORCE PARTICIPATION RATES, 2016

Oregon's labor force participation rate is about the same as the US.

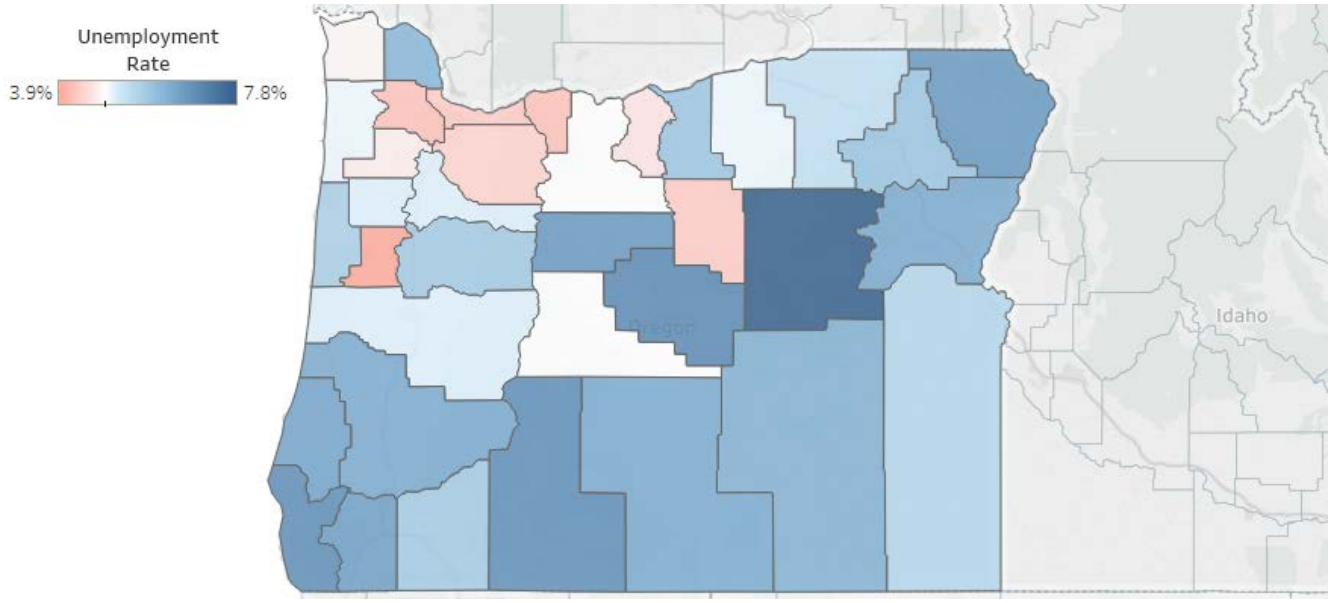
For comparison, North Dakota, Iowa, Minnesota, and Nebraska have the highest participation rates in the US, at about 70 percent or above. West Virginia, Mississippi, and Alabama have the lowest participation rates at less than 57 percent.

Source: Bureau of Labor Statistics.



The unemployment rate varies from a low of 3.9 percent in Benton County to a high of 7.8 percent in Grant County. Eight counties have unemployment rates significantly below the US average: Benton, Yamhill, Washington, Multnomah, Clackamas, Hood River, Sherman, and Wheeler.

FIGURE 28. COMPARATIVE UNEMPLOYMENT BY COUNTY
UNEMPLOYMENT RATES, 2016



Source: US Bureau of Labor Statistics

FIGURE 29. WORKER INFLOW/OUTFLOW
FLOW OF WORKERS TO/FROM THE STATE, 2014

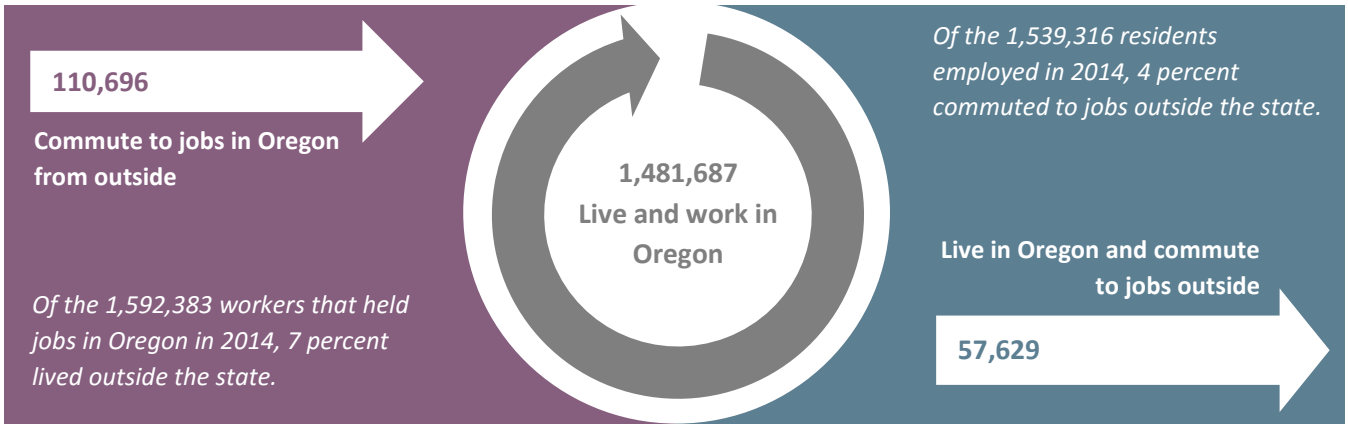
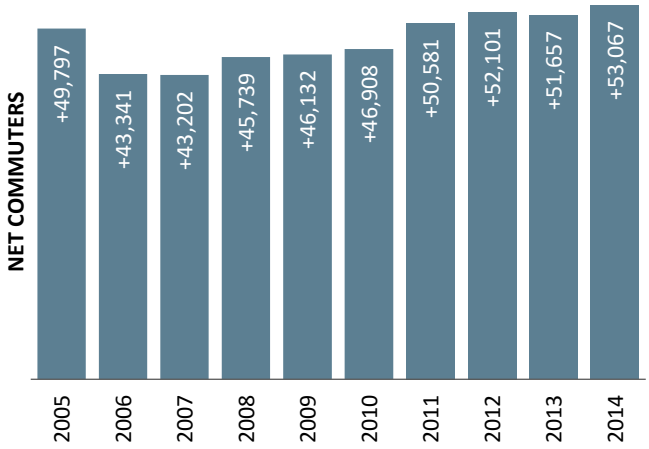


FIGURE 30. COMMUTING FLOWS
2005-2014

The state of Oregon has long been a net importer of labor. The most recent data (2014) shows that the state imports more than 110,000 workers and exports just under 57,000. Since 2007, the net flow of workers into Oregon has been steadily rising, increasing from a surplus of 43,000 in 2007 to over 53,000 in 2014.

Source: US Census Bureau, Local Employment Dynamics.



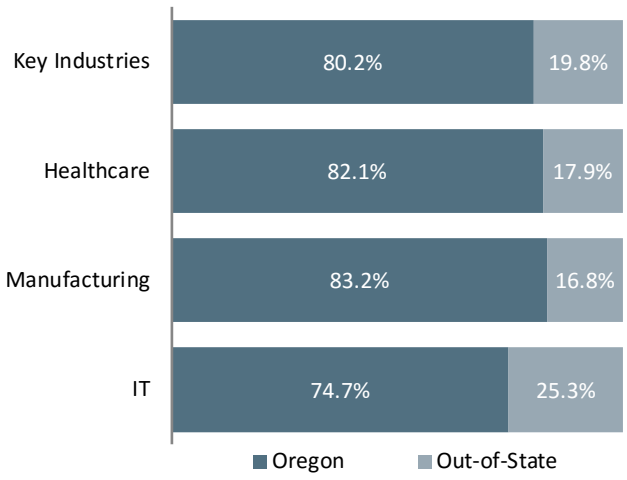


FIGURE 31. JOB TO JOB FLOWS
2015

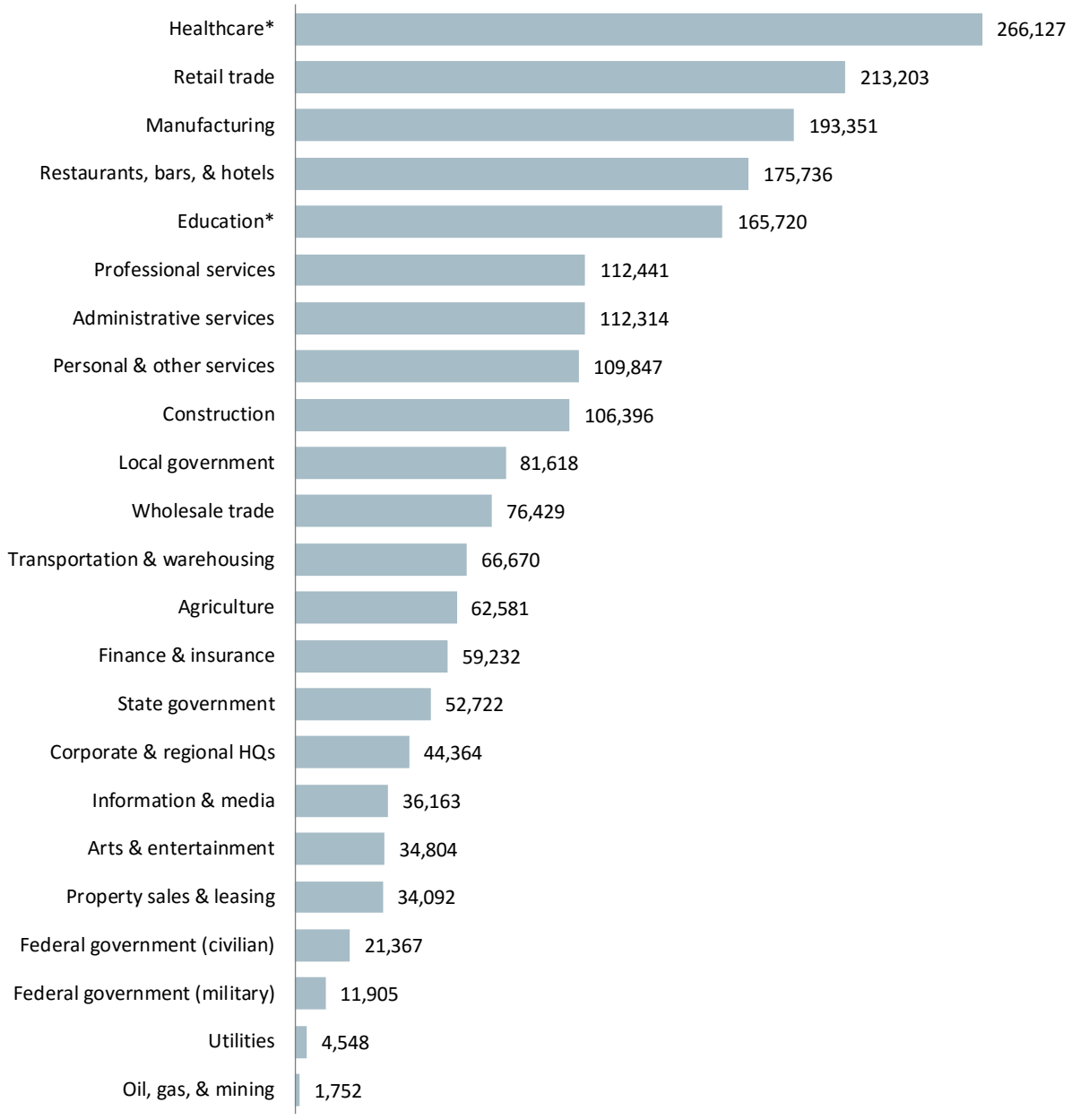
As of 2015, Oregon was recruiting almost 20 percent of workers in its key industries from out-of-state. For the IT sector, the state was recruiting just over 25 percent of its workers from out-of-state.

Source: US Census Bureau, Longitudinal Employer-Household Dynamics, Job-to-Job Flows Explorer.

INDUSTRY OVERVIEW

Oregon's largest industry sectors, in terms of employment, are healthcare, retail trade, manufacturing, hospitality (restaurants, bars, and hotels), and education. The sectors that employ the fewest Oregonians are oil, gas, and mining, utilities, and federal government. The number of workers in each sector are shown in Figure 32.

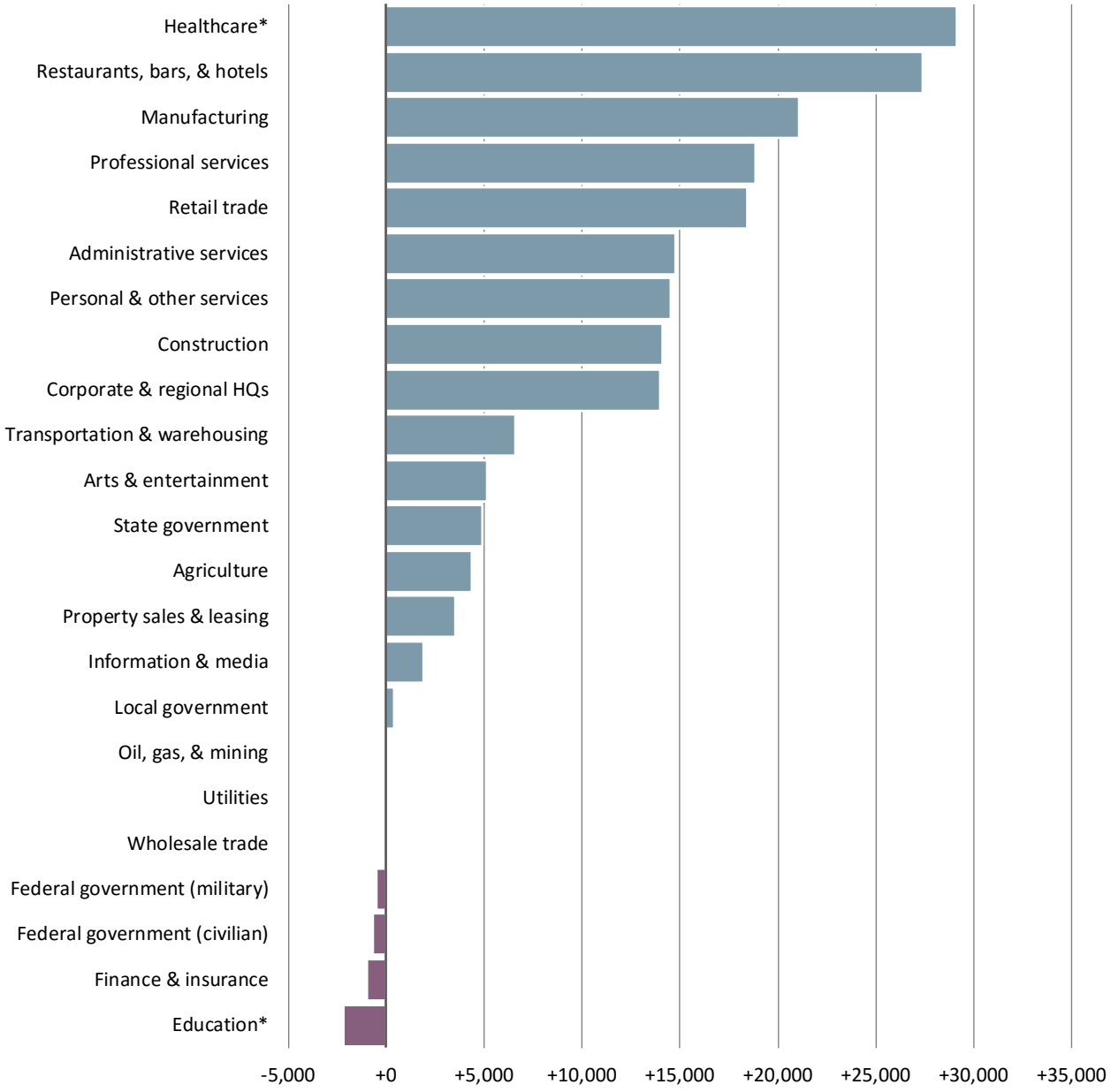
FIGURE 32. EMPLOYMENT BY INDUSTRY
2016



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
*Note: Education includes all public schools, colleges, & universities, and healthcare includes all public hospitals.

As shown in Figure 33, over the last five years, the fastest growing industry sectors were healthcare; restaurants, bars, and hotels; manufacturing, professional services, and retail trade. The healthcare sector accounted for about 15 percent of all new jobs between 2011 and 2016. The manufacturing and professional services sectors each accounted for about 10 percent each.

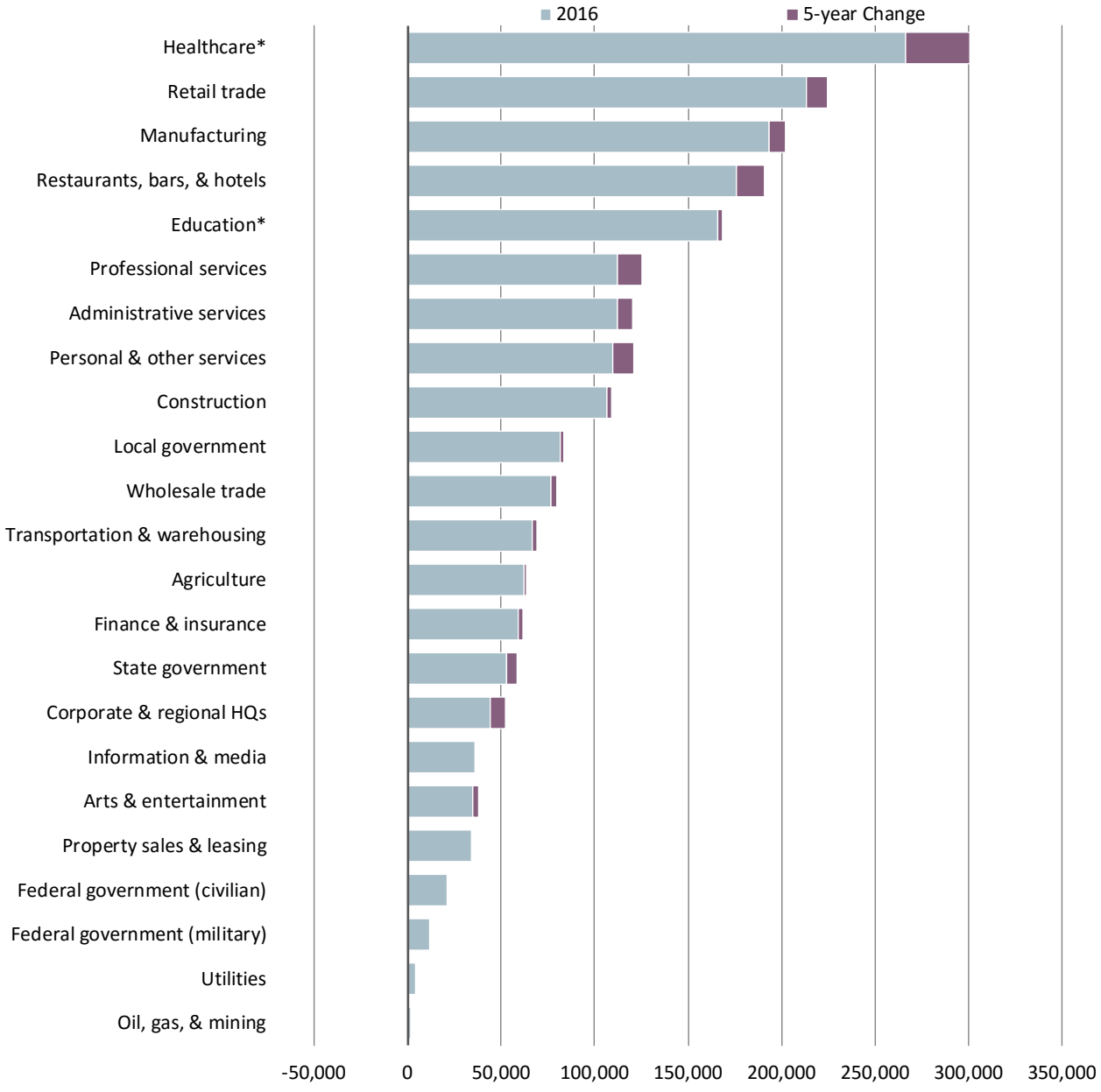
FIGURE 33. NET CHANGE IN EMPLOYMENT BY INDUSTRY
2011-2016



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
*Note: Education includes all public schools, colleges, & universities, and healthcare includes all public hospitals.

Over the next five years, Oregon is expected to add about 135,000 new jobs. The healthcare sector is projected to account for almost one quarter of these new jobs. Professional services; corporate and regional headquarters; and manufacturing are expected to account for just over 20 percent of employment growth over the next five years. These projected changes are shown in Figure 34.

FIGURE 34. TOTAL EMPLOYMENT BY INDUSTRY
JOB BASE 2016 + PROJECTED 5-YEAR CHANGE



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
*Note: Education includes all public schools, colleges, & universities, and healthcare includes all public hospitals.

The Oregon Talent Plan focuses on five of the state's advanced and high-impact industries. A summary of each industry, showing the number of establishments for each, the percentage of change in jobs from 2016 to 2021, the 2016 location quotient (LQ), and the 2016 average earnings per worker, is provide in Figure 35.

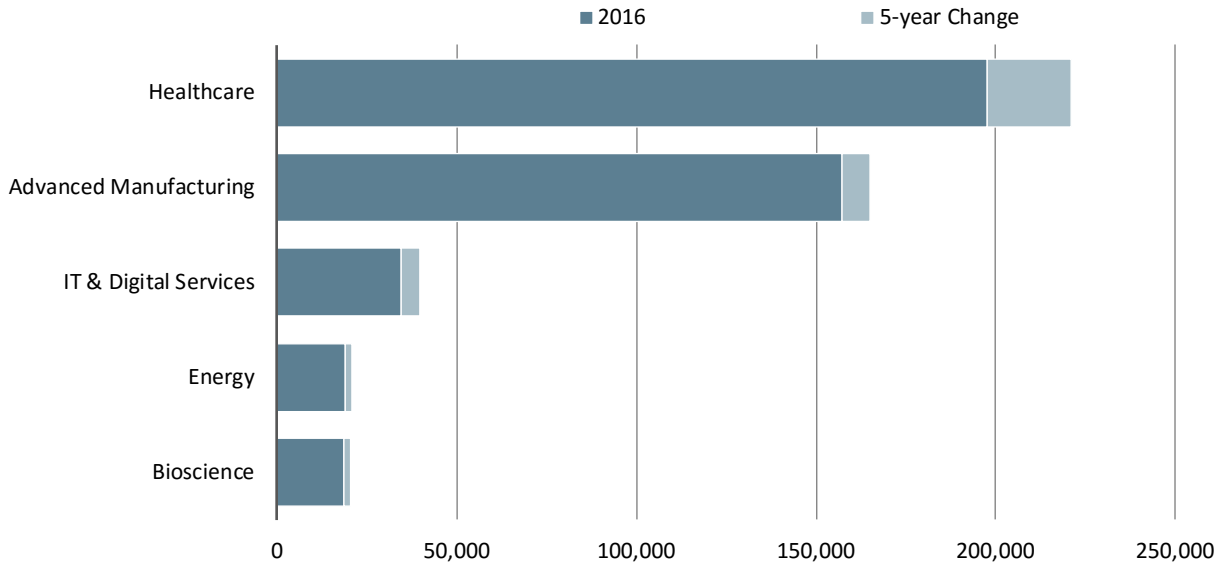
FIGURE 35. KEY INDUSTRIES SUMMARY

INDUSTRY	ESTABLISH-MENTS	2016 JOBS	2021 JOBS	% CHANGE (2016-21)	LQ	AVG. EARNINGS PER WORKER
Healthcare	10,319	197,453	220,813	12%	0.99	$62,461
Advanced Manufacturing	3,499	157,144	164,991	5%	1.37	$67,490
IT & Digital Services	4,274	34,597	39,557	14%	0.90	$106,464
Energy	1,708	19,139	20,644	8%	0.72	$101,921
Bioscience	1,262	18,708	20,391	9%	0.66	$71,651

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

As shown in Figure 36, healthcare and advanced manufacturing are the largest of the key sectors and are expected to drive employment growth over the next five years.

FIGURE 36. EMPLOYMENT BY INDUSTRY
2016 JOB BASE + PROJECTED 5-YEAR CHANGE



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

OCCUPATIONAL OVERVIEW

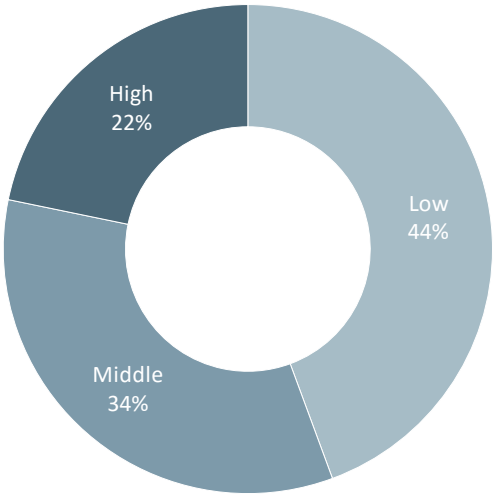


FIGURE 37. OCCUPATIONS BY SKILL LEVEL
2016

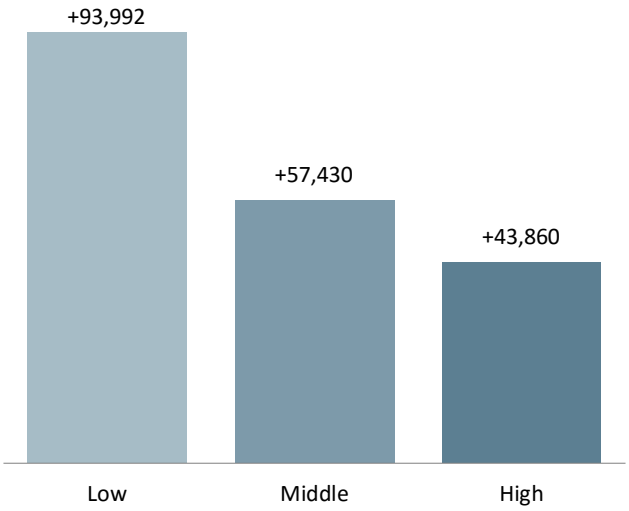
Low-skill occupations account for the largest share of employment. Middle-skill occupations, those that require more than a high school diploma and less than a four-year degree, account for about one-third of all jobs in Oregon. High skill jobs, requiring at least a four-year degree, account for just over 20 percent.
This structure is similar to that of the US overall.

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

FIGURE 38. CHANGE IN EMPLOYMENT
BY SKILL LEVEL, 2011-2016

Over the last five years, employment growth has been driven by an increase in low-skill jobs, which accounted for almost half of all new jobs between 2011 and 2016.

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.



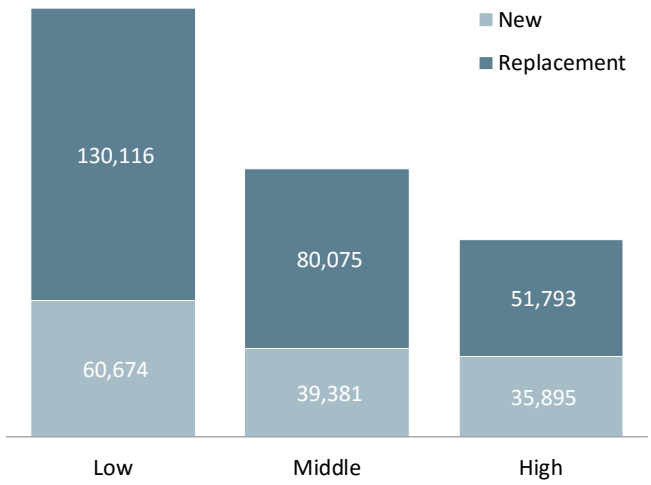


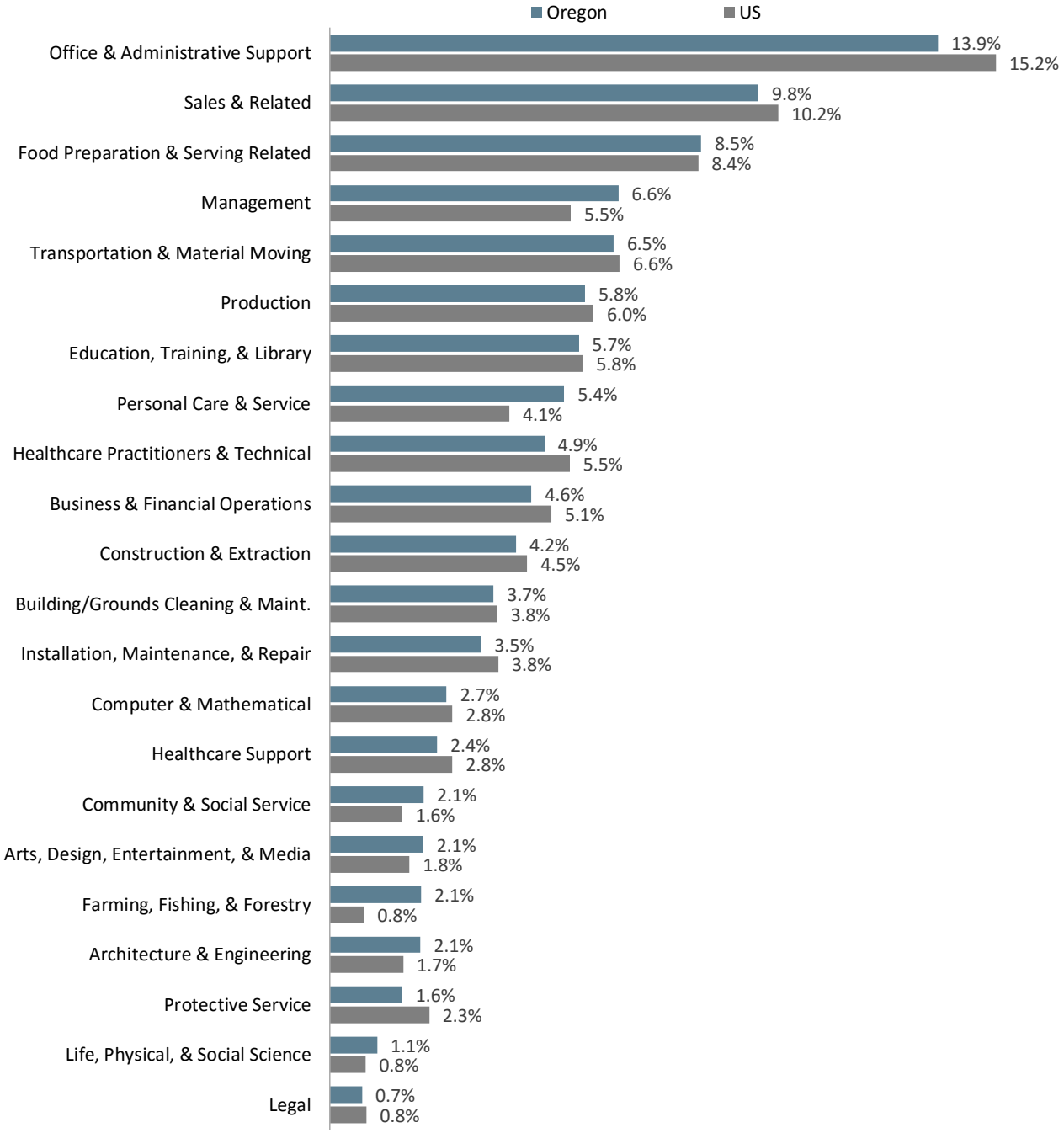
FIGURE 39. ESTIMATED OPENINGS
BY SKILL LEVEL, 2016-2021

Over the next five years, strong demand for low-skill jobs is expected to continue. In addition, replacement jobs are expected to account for almost two-thirds of all openings.

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

Oregon's occupational structure is similar to that of the US with some notable exceptions, as the comparison in Figure 40 shows. Management occupations account for a larger share of total employment in Oregon than they do in the US. In addition, community and social service; arts and media; agriculture; and engineering occupations also account for a larger share of employment in Oregon.

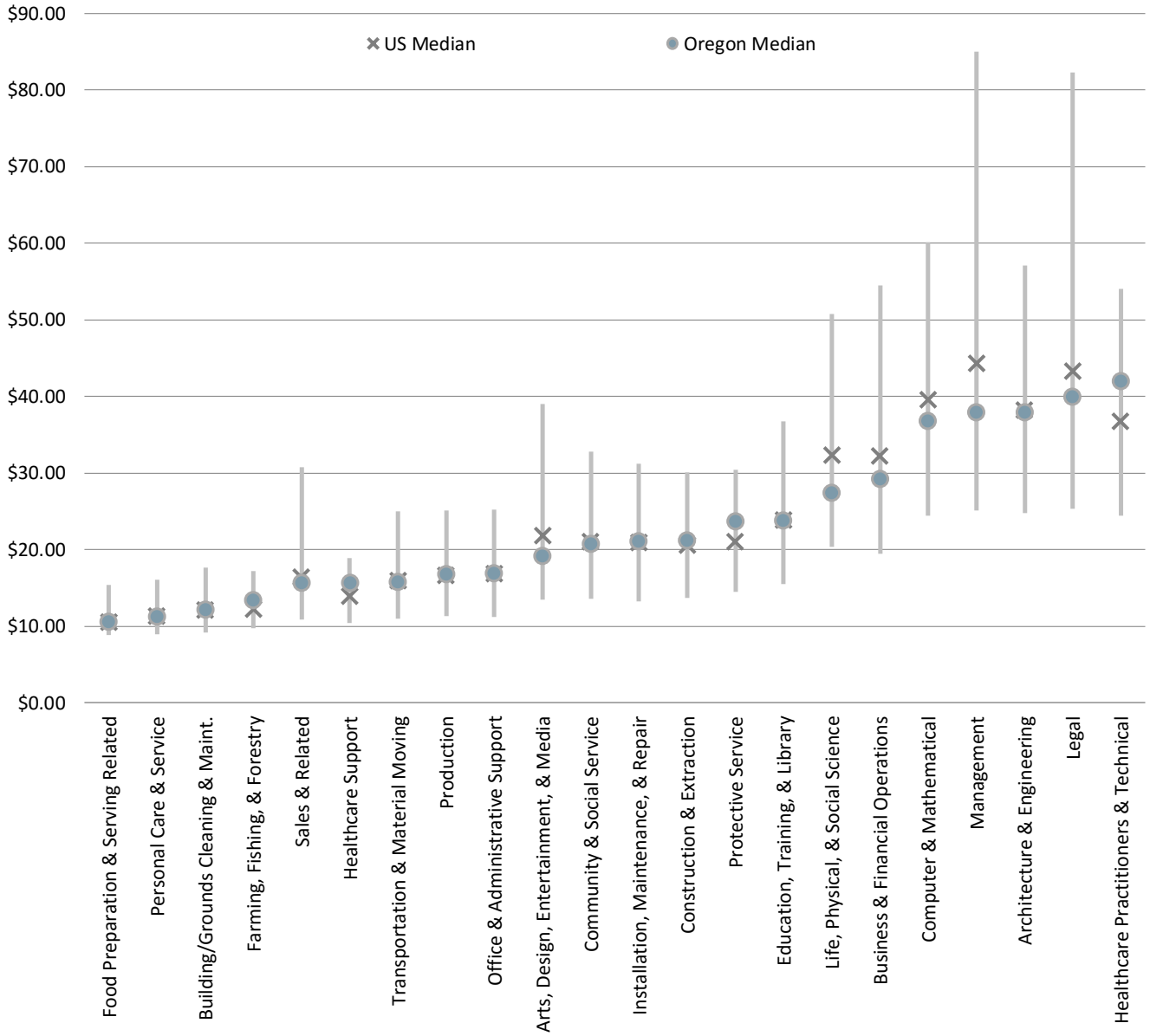
FIGURE 40. OCCUPATIONAL DISTRIBUTION
PERCENT OF TOTAL, 2016



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

For the most part, as Figure 41 shows, Oregon's wages are in line with the nation's. The occupational groups that have higher wages in Oregon than the US are healthcare practitioners, protective services, and healthcare support. The occupational groups that have lower wages in Oregon than the US are legal, management, computer, business and financial operations, sciences, and arts and media.

FIGURE 41. COMPARATIVE WAGE RATES
BY MAJOR OCCUPATIONAL GROUP, 2016



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

KEY OCCUPATIONS

The Oregon Talent Plan is focused on those occupations that have high impact: i.e., pay livable wages, require post-secondary training and education, and are key to the growth of other jobs. This focus reduced the number of targeted occupations from 784 to 307. These 307 occupations represent 525,239 jobs or 26 percent of Oregon's employment base.

The four figures that follow show the top 20 occupations projected over the five years from 2016 to 2021, with each figure highlighting specific criteria. Figure 42 shows the highest-demand key occupations based on annual openings or sheer volume. The number of annual openings reflects the estimated number of new and replacement jobs. Replacement jobs are existing positions that must be filled when workers permanently leave an occupation or exit the labor force for any reason, including retirement.

FIGURE 42. TOP 20 OCCUPATIONS
BY ANNUAL OPENINGS, 2016-21

			DEMAND FACTORS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC CODE	DESCRIPTION	2016 Jobs	Projected Annual Openings (2016-21)	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
29-1141	Registered Nurses	33,777	1,394	37%	63%	39.82	1.19	28% ◀
13-2011	Accountants & Auditors	14,235	717	38%	62%	30.33	0.88	28% ◀
53-3032	Heavy & Tractor-Trailer Truck Drivers	24,402	607	26%	74%	19.74	1.00	33% ◀
49-9071	Maintenance & Repair Workers, General	15,204	603	27%	73%	19.23	1.02	32% ◀
15-1132	Software Developers, Applications	11,111	394	55%	45%	46.93	0.96	13%
13-1199	Business Operations Specialists, All Other	14,696	366	48%	52%	32.29	0.90	25% ◀
13-1111	Management Analysts	8,804	316	56%	44%	34.40	0.86	35% ◀
49-9041	Industrial Machinery Mechanics	5,102	276	45%	55%	26.27	1.05	28% ◀
13-1071	Human Resources Specialists	6,569	262	33%	67%	28.07	0.92	20%
49-3023	Automotive Service Technicians & Mechanics	8,167	255	10%	90%	18.23	1.02	19%
15-1151	Computer User Support Specialists	8,674	249	43%	57%	24.28	0.96	16%
21-1021	Child, Family, & School Social Workers	4,354	247	50%	50%	22.25	1.03	25% ◀
13-1161	Market Research Analysts & Mktng. Specialists	5,527	247	68%	32%	30.25	0.88	15%
15-1121	Computer Systems Analysts	5,532	242	65%	35%	39.84	0.94	20%
29-2061	Licensed Practical/Vocational Nurses	3,595	240	49%	51%	23.36	1.10	26% ◀
29-1069	Physicians & Surgeons, All Other	5,465	227	26%	74%	94.12	1.07	28% ◀
51-9061	Inspectors, Testers, Sorters, Samplers, & Weighers	5,536	224	33%	67%	18.89	1.00	27% ◀
31-9091	Dental Assistants	5,056	218	36%	64%	19.92	1.11	11%
51-4121	Welders, Cutters, Solderers, & Brazers	5,098	215	27%	73%	19.68	1.04	17%
51-4041	Machinists	3,910	202	37%	63%	22.48	1.12	29% ◀

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Gray highlight means a wage premium greater than or equal to 1.210; a ▶ means more than 25 percent of the workforce is 55+.

Figure 43 shows the fastest growing key occupations based on the weighted annual growth rate. The weighted annual growth rate is an average of the actual compound annual growth rate from 2014-16 and the expected compound annual growth rate from 2016-21.

FIGURE 43. TOP 20 OCCUPATIONS
BY WEIGHTED ANNUAL GROWTH RATE

			DEMAND FACTORS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC CODE	DESCRIPTION	Weighted Annual Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
27-4032	Film & Video Editors	5.7%	23	76%	24%	22.36	0.66	13%
51-8093	Petroleum Refinery Operators & Gaugers	5.2%	6	38%	62%	28.21	0.86	30% ◀
27-4014	Sound Engineering Technicians	4.6%	8	42%	58%	25.97	0.98	16%
31-9011	Massage Therapists	4.4%	89	69%	31%	18.53	1.16	15%
51-4051	Metal-Refining Furnace Workers	4.2%	14	16%	84%	22.34	1.08	17%
29-1131	Veterinarians	4.2%	47	46%	54%	37.63	0.83	29% ◀
17-1021	Cartographers & Photogrammetrists	4.0%	26	40%	60%	29.12	0.94	23%
29-1171	Nurse Practitioners	4.0%	97	53%	47%	53.01	1.07	29% ◀
19-4092	Forensic Science Technicians	3.8%	18	38%	62%	30.27	1.10	22%
27-4031	Camera Operators, TV Video, & Film	3.8%	9	68%	32%	22.71	0.89	12%
31-2011	Occupational Therapy Assistants	3.8%	19	55%	45%	26.93	0.97	15%
17-2171	Petroleum Engineers	3.8%	5	55%	45%	68.58	0.91	27% ◀
15-2031	Operations Research Analysts	3.7%	56	62%	38%	36.70	0.93	26% ◀
29-1181	Audiologists	3.6%	9	43%	57%	41.15	1.13	25% ◀
53-2011	Airline Pilots, Copilots, & Flight Engineers	3.6%	29	28%	72%	67.45	0.98	26% ◀
15-2041	Statisticians	3.5%	27	60%	40%	33.62	0.84	20%
13-1161	Market Research Analysts & Mktng. Specialists	3.5%	247	68%	32%	30.25	0.88	15%
49-9041	Industrial Machinery Mechanics	3.4%	276	45%	55%	26.27	1.05	28% ◀
49-3092	Recreational Vehicle Service Technicians	3.4%	15	17%	83%	18.04	1.00	18%
13-2071	Credit Counselors	3.4%	23	52%	48%	23.74	1.05	21%

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Gray highlight means a wage premium greater than or equal to 1.210; a ◀ means more than 25 percent of the workforce is 55+.

Figure 44 shows the key occupations with the highest volume of replacement jobs. While replacement jobs are a result of a variety of factors including turnover (a more common factor in lower-paying jobs), a significant number of top occupations in the Oregon Talent Plan are also facing high retirement exposure, as indicated by the last column.

FIGURE 44. TOP 20 OCCUPATIONS
BY REPLACEMENT DEMAND

			DEMAND FACTORS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC CODE	DESCRIPTION	2016 Jobs	Projected Annual Openings (2016-21)	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
29-1141	Registered Nurses	33,777	1,394	37%	63%	39.82	1.19	28% ◀
53-3032	Heavy & Tractor-Trailer Truck Drivers	24,402	607	26%	74%	19.74	1.00	33% ◀
13-2011	Accountants & Auditors	14,235	717	38%	62%	30.33	0.88	28% ◀
49-9071	Maintenance & Repair Workers, General	15,204	603	27%	73%	19.23	1.02	32% ◀
49-3023	Automotive Service Technicians & Mechanics	8,167	255	10%	90%	18.23	1.02	19%
13-1199	Business Operations Specialists, All Other	14,696	366	48%	52%	32.29	0.90	25% ◀
15-1132	Software Developers, Applications	11,111	394	55%	45%	46.93	0.96	13%
13-1071	Human Resources Specialists	6,569	262	33%	67%	28.07	0.92	20%
29-1069	Physicians & Surgeons, All Other	5,465	227	26%	74%	94.12	1.07	28% ◀
51-4121	Welders, Cutters, Solderers, & Brazers	5,098	215	27%	73%	19.68	1.04	17%
49-9041	Industrial Machinery Mechanics	5,102	276	45%	55%	26.27	1.05	28% ◀
51-9061	Inspectors, Testers, Sorters, Samplers, & Weighers	5,536	224	33%	67%	18.89	1.00	27% ◀
47-2111	Electricians	8,309	181	19%	81%	30.50	1.21	20%
15-1151	Computer User Support Specialists	8,674	249	43%	57%	24.28	0.96	16%
31-9091	Dental Assistants	5,056	218	36%	64%	19.92	1.11	11%
17-2051	Civil Engineers	4,446	186	25%	75%	38.43	0.92	28% ◀
13-1111	Management Analysts	8,804	316	56%	44%	34.40	0.86	35% ◀
17-2141	Mechanical Engineers	3,803	168	23%	77%	42.10	1.02	22%
51-4041	Machinists	3,910	202	37%	63%	22.48	1.12	29% ◀
21-1021	Child, Family, & School Social Workers	4,354	247	50%	50%	22.25	1.03	25% ◀

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Gray highlight means a wage premium greater than or equal to 1.210; a ◀ means more than 25 percent of the workforce is 55+.

Finally, Figure 45 shows the occupations that are difficult to fill, based on the Oregon Employment Department's 2016 Job Vacancy Survey.

FIGURE 45. TOP 20 OCCUPATIONS
CONSIDERED DIFFICULT TO FILL

			DEMAND FACTORS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC CODE	DESCRIPTION	2016 Jobs	Projected Annual Openings (2016-21)	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
29-1127	Speech-Language Pathologists	1,667	75	38%	62%	36.48	1.04	24%
31-2021	Physical Therapist Assistants	639	46	51%	49%	25.79	0.98	13%
29-1122	Occupational Therapists	1,109	50	51%	49%	38.97	1.04	14%
47-2073	Operating Eng. & Other Constr. Equip. Operators	4,275	105	23%	77%	24.38	1.06	28% ◀
21-1015	Rehabilitation Counselors	2,253	99	46%	54%	19.13	1.05	29% ◀
21-1014	Mental Health Counselors	3,356	156	49%	51%	24.81	1.11	26% ◀
29-2032	Diagnostic Medical Sonographers	584	28	53%	47%	41.60	1.23	21%
53-6031	Automotive & Watercraft Service Attendants	5,886	271	11%	89%	11.66	1.02	19%
47-2152	Plumbers, Pipefitters, & Steamfitters	5,563	141	34%	66%	32.21	1.32	18%
51-2041	Structural Metal Fabricators & Fitters	1,189	32	34%	66%	20.86	1.13	21%
47-2111	Electricians	8,309	181	19%	81%	30.50	1.21	20%
31-1014	Nursing Assistants	12,858	603	45%	55%	14.18	1.10	20%
51-4121	Welders, Cutters, Solderers, & Brazers	5,098	215	27%	73%	19.68	1.04	17%
49-3031	Bus/Truck Mechanics & Diesel Engine Specialists	3,771	120	41%	59%	21.62	1.01	25% ◀
49-3021	Automotive Body & Related Repairers	1,873	63	24%	76%	20.07	0.94	21%
53-3032	Heavy & Tractor-Trailer Truck Drivers	24,402	607	26%	74%	19.74	1.00	33% ◀
29-1141	Registered Nurses	33,777	1,394	37%	63%	39.82	1.19	28% ◀
49-9071	Maintenance & Repair Workers, General	15,204	603	27%	73%	19.23	1.02	32% ◀
13-2011	Accountants & Auditors	14,235	717	38%	62%	30.33	0.88	28% ◀
31-9091	Dental Assistants	5,056	218	36%	64%	19.92	1.11	11%

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Gray highlight means a wage premium greater than or equal to 1.210; a ▶ means more than 25 percent of the workforce is 55+.

Figure 46 shows the top ten occupations for each of the OTC key industry sectors based on the occupation's share of industry employment.

FIGURE 46. TOP 10 OCCUPATIONS FOR EACH OTC KEY INDUSTRY SECTOR
BY SHARE OF INDUSTRY EMPLOYMENT

SOC Code	Description	Share of Industry Employment	Jobs	LQ (US= 1.00)	Job Growth (2016-21)	Annual Openings (2016-21)
Healthcare						
29-1141	Registered Nurses	13.6%	33,777	0.91	9%	1,464
31-9091	Dental Assistants	2.4%	5,056	1.16	9%	228
29-1069	Physicians and Surgeons, All Other	2.3%	5,465	1.17	6%	237
29-2021	Dental Hygienists	2.0%	4,104	1.53	8%	141
29-2061	Licensed Practical and Licensed Vocational Nurses	1.3%	3,595	0.38	19%	249
29-1123	Physical Therapists	1.2%	2,735	0.94	13%	155
29-2011	Medical and Clinical Laboratory Technologists	1.0%	2,296	1.06	8%	92
29-2034	Radiologic Technologists	1.0%	2,052	0.79	7%	69
29-2071	Medical Records and Health Information Technicians	0.9%	2,779	1.07	9%	117
21-1014	Mental Health Counselors	0.9%	3,356	1.70	14%	167
Advanced Manufacturing						
51-1011	First-Line Supervisors of Production and Operating Workers	2.6%	6,920	0.87	6%	198
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	2.0%	5,536	0.82	8%	237
51-4121	Welders, Cutters, Solderers, and Brazers	1.9%	5,098	0.97	7%	226
51-4041	Machinists	1.9%	3,910	0.75	12%	212
51-9141	Semiconductor Processors	1.8%	2,908	8.98	4%	86
17-3023	Electrical and Electronics Engineering Technicians	1.8%	4,006	2.15	3%	127
49-9041	Industrial Machinery Mechanics	1.7%	5,102	1.17	14%	290
17-2061	Computer Hardware Engineers	1.6%	3,722	3.64	-3%	75
17-2112	Industrial Engineers	1.5%	3,366	1.04	8%	161
17-2141	Mechanical Engineers	1.3%	3,803	1.03	6%	174
IT & Digital Services						
15-1132	Software Developers, Applications	17.1%	11,111	1.08	12%	433
15-1151	Computer User Support Specialists	6.5%	8,674	1.00	7%	274
15-1121	Computer Systems Analysts	5.4%	5,532	0.72	17%	269
15-1131	Computer Programmers	5.2%	3,469	0.86	5%	125
15-1133	Software Developers, Systems Software	4.8%	4,036	0.75	10%	139
15-1134	Web Developers	4.4%	3,801	1.72	15%	171
15-1199	Computer Occupations, All Other	3.9%	6,694	2.10	4%	141
15-1142	Network and Computer Systems Administrators	2.1%	3,731	0.74	9%	124
17-2061	Computer Hardware Engineers	1.6%	3,722	3.64	-3%	75
13-1199	Business Operations Specialists, All Other	1.6%	14,696	1.16	7%	402

Notes: Purple highlight means an LQ greater than or equal to 1.25; blue highlight means growth greater than or equal to 10 percent.

continued, next page

FIGURE 46. TOP 10 OCCUPATIONS–CONTINUED
BY SHARE OF INDUSTRY EMPLOYMENT

SOC Code	Description	Share of Industry Employment	Jobs	LQ (US= 1.00)	Job Growth (2016-21)	Annual Openings (2016-21)
Energy						
17-2051	Civil Engineers	8.5%	4,446	1.17	6%	192
17-2141	Mechanical Engineers	3.3%	3,803	1.03	6%	174
13-1111	Management Analysts	2.6%	8,804	0.84	13%	353
17-2071	Electrical Engineers	2.6%	2,491	1.05	7%	92
49-9051	Electrical Power-Line Installers and Repairers	2.4%	1,082	0.71	10%	67
17-3011	Architectural and Civil Drafters	2.1%	1,612	1.22	2%	26
19-4021	Biological Technicians	1.8%	2,039	2.09	3%	70
17-2199	Engineers, All Other	1.7%	2,745	1.46	5%	82
13-1199	Business Operations Specialists, All Other	1.6%	14,696	1.16	7%	402
17-3023	Electrical and Electronics Engineering Technicians	1.6%	4,006	2.15	3%	127
Bioscience						
29-2011	Medical and Clinical Laboratory Technologists	2.4%	2,296	1.06	8%	92
19-4021	Biological Technicians	1.8%	2,039	2.09	3%	70
29-2012	Medical and Clinical Laboratory Technicians	1.6%	1,482	0.71	11%	70
51-9081	Dental Laboratory Technicians	1.5%	686	1.29	3%	24
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1.4%	5,536	0.82	8%	237
53-3032	Heavy and Tractor-Trailer Truck Drivers	1.2%	24,402	0.98	4%	644
19-2031	Chemists	1.1%	685	0.61	8%	27
17-2141	Mechanical Engineers	1.0%	3,803	1.03	6%	174
15-1132	Software Developers, Applications	0.9%	11,111	1.08	12%	433
29-2034	Radiologic Technologists	0.9%	2,052	0.79	7%	69

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Notes: Purple highlight means an LQ greater than or equal to 1.25; blue highlight means growth greater than or equal to 10 percent.

OCCUPATIONAL CLUSTERS

In addition to an analysis of the 307 key occupations individually, the Talent Plan includes an analysis of clusters of occupations that require related skill sets or have similar job functions. The key occupations were grouped into 43 clusters that reflect these similarities. These groupings are presented in Talent Needs Assessment Methodology.

Figure 47 shows the 20 occupational clusters with the highest volume of openings.

FIGURE 47. TOP 20 OCCUPATIONAL CLUSTERS
BY ANNUAL OPENINGS, 2016-21

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Nursing and Nurse Specialties	37,470	2.3%	1,639	39%	61%	28%	◀
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Welders and Skilled Trades	19,322	1.0%	549	26%	74%	19%	
Mental and Behavioral Health	11,722	2.5%	542	48%	52%	26%	◀
Systems and Data Administration	16,651	1.4%	504	45%	55%	15%	
Human Resource Managment	12,408	1.9%	493	32%	68%	23%	
Industrial Mechanics and Service Technicians	10,250	2.4%	431	38%	62%	27%	◀
Systems Architects and Analysts	13,334	2.1%	415	54%	46%	18%	
Community Health and Social Services	7,998	2.4%	412	46%	54%	25%	◀
Oral Health	10,760	1.8%	410	36%	64%	17%	
Rehabilitation Therapy	7,583	2.6%	384	43%	57%	18%	
Industrial Machinists and Operators	6,817	2.8%	363	38%	62%	24%	
First-Line Supervisors	11,532	1.5%	331	35%	65%	27%	◀
Pharmacy and Medication Management	8,761	2.1%	281	45%	55%	19%	
Supply Chain, Purchasing, and Logistics	6,537	1.8%	266	23%	77%	28%	◀
Care Specialties	6,207	1.9%	260	27%	73%	28%	◀
Primary Care	5,114	2.8%	253	41%	59%	26%	◀

Source: TIP Strategies, Scruggs & Associates.

An overall demand indicator was calculated for each cluster based on the following criteria:

A. *Overall number of jobs*: (Is there a critical mass?)

B. *Annual growth* (Are jobs growing fasters than the overall economy?)

C. *Annual openings* (Are projected openings at a level that can sustain a training investment?)

D. *Location quotient* (Is there a competitive advantage in Oregon to this job?)

E. *Retirement exposure* (Are mission-critical jobs likely to face a sudden bubble of retirement in which experienced replacements are needed?)

F. *Shift-share or competitiveness* (Is the growth of the relevant industries and the state's competitive position within these industries likely to put addition demand pressures on a job?)

G. *Wage premium (*Does the occupation pay an average wage of $30/hour or more?)

Figure 48 shows the occupational clusters with the highest over-all demand score.

FIGURE 48. OCCUPATIONAL CLUSTERS
BY OVER-ALL DEMAND SCORE

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Pharmacy and Medication Management	8,761	2.1%	281	45%	55%	19%	
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Community Health and Social Services	7,998	2.4%	412	46%	54%	25%	◀
Nursing and Nurse Specialties	37,470	2.3%	1,639	39%	61%	28%	◀
First-Line Supervisors	11,532	1.5%	331	35%	65%	27%	◀
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Industrial Machinists and Operators	6,817	2.8%	363	38%	62%	24%	
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Mental and Behavioral Health	11,722	2.5%	542	48%	52%	26%	◀
Medical Records and Information Management	2,779	2.0%	110	37%	63%	28%	◀
Human Resource Managment	12,408	1.9%	493	32%	68%	23%	
Systems Architects and Analysts	13,334	2.1%	415	54%	46%	18%	
Rehabilitation Therapy	7,583	2.6%	384	43%	57%	18%	
Care Specialties	6,207	1.9%	260	27%	73%	28%	◀
Primary Care	5,114	2.8%	253	41%	59%	26%	◀
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Wellness Occupations	834	2.2%	23	70%	30%	28%	◀
Healthcare Educators	710	2.2%	28	45%	55%	25%	◀
Surgical and OR Specialists	2,807	2.4%	102	41%	59%	23%	
Systems and Data Administration	16,651	1.4%	504	45%	55%	15%	

Source: TIP Strategies, Scruggs & Associates.

Another way to examine occupational clusters is to evaluate which demand factors are more prevalent than others. This evaluation resulted in three different demand stages that were verified by employers as a way to help match jobs with different training needs. Figure 49 presents these three demand stages and the characteristics of each. Figure 50, which follows, arranges the occupations clusters into the appropriate demand stage.

FIGURE 49. DEMAND STAGES

DEMAND STAGE	CHARACTERISTICS
Evolutionary: Occupations undergoing significant change or where market demographics are creating demands at rates higher than average.	• Very high growth rates + more new than replacement jobs • Growth trends in key industries accelerating demand • (examples: cybersecurity, data scientists)
Steady-demand: Occupations with a steady influx of opening and where training for new skill standards are needed.	• Critical mass of jobs with above average growth rates • Significant openings with a mix of new and replacement jobs • (examples: industrial mechanics, software developers)
Transitional/mission-critical: Occupations that are key to the growth of other jobs and where succession issues are significant.	• High location quotient or concentration • Higher than average exposure to retirement with more replacement than new jobs • (examples: millwrights, compliance officers)

FIGURE 50. OCCUPATIONAL CLUSTERS
BY DEMAND STAGE

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Evolutionary							
Rehabilitation Therapy	7,583	2.6%	384	43%	57%	18%	
Industrial Machinists and Operators	6,817	2.8%	363	38%	62%	24%	
Data Scientist	3,136	2.9%	138	56%	44%	21%	
Mental and Behavioral Health	11,722	2.5%	542	48%	52%	26%	◀
Systems Architects and Analysts	13,334	2.1%	415	54%	46%	18%	
Wellness Occupations	834	2.2%	23	70%	30%	28%	◀
Other Medical Specialties	762	3.0%	43	32%	68%	25%	◀
Digital Media Technicians	2,041	3.1%	78	51%	49%	15%	
Surgical and OR Specialists	2,807	2.4%	102	41%	59%	23%	
Healthcare Educators	710	2.2%	28	45%	55%	25%	◀
Steady Demand							
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Pharmacy and Medication Management	8,761	2.1%	281	45%	55%	19%	
First-Line Supervisors	11,532	1.5%	331	35%	65%	27%	◀
Medical Records and Information Management	2,779	2.0%	110	37%	63%	28%	◀
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Welders and Skilled Trades	19,322	1.0%	549	26%	74%	19%	
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Systems and Data Administration	16,651	1.4%	504	45%	55%	15%	
Community Health and Social Services	7,998	2.4%	412	46%	54%	25%	◀
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Transitional/Mission-Critical							
Plant and Systems Operators	2,116	1.0%	78	20%	80%	32%	◀
Care Specialties	6,207	1.9%	260	27%	73%	28%	◀
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	
First-Line Supervisors	11,532	1.5%	331	35%	65%	27%	◀
Human Resource Managment	12,408	1.9%	493	32%	68%	23%	
Supply Chain, Purchasing, and Logistics	6,537	1.8%	266	23%	77%	28%	◀
Primary Care	5,114	2.8%	253	41%	59%	26%	◀
Oral Health	10,760	1.8%	410	36%	64%	17%	
Engineering Support	2,305	1.3%	35	14%	86%	25%	◀
Plant and Field Technicians - Energy	1,696	2.1%	100	30%	70%	23%	

Source: TIP Strategies, Scruggs & Associates.

Many occupational clusters cut across the key industry sectors. Figure 51 shows how the occupational clusters are distributed among the five industry sectors defined in the Oregon Talent Plan.

FIGURE 51. TOP 20 OCCUPATIONAL CLUSTERS
BY TOTAL SHARE OF KEY INDUSTRIES

		Share of Industry Employment				
High Concentration 10.0% ●						
Above Average 2.5% ◉						
Low Concentration 0.2% ○						
	OCCUPATIONAL CLUSTER	**ADVANCED MANUFACTURING**	**BIOSCIENCE**	**ENERGY**	**HEALTHCARE**	**IT & DIGITAL SERVICES**
	Programmers and Developers	○	○	◉		●
	Interdisciplinary Engineering	◉	◉	◉		○
▶	Systems and Data Administration	○	○	○	○	●
▶	Data-Enabled Analysts	○	○	◉	○	◉
	Systems Architects and Analysts	○	○	○		●
	Engineering Technicians	◉	○	◉		○
▶	Business Finance and Compliance	○	○	○	○	○
▶	Human Resource Managment	○	○	○	○	○
	Supply Chain, Purchasing, and Logistics	○	○	○		○
	Digital Media and Design		○	○		○
	Data Scientist	○	○	○		○
	Industrial Machinists and Operators	◉	○			
	First-Line Supervisors	◉	○	○		
	Welders and Skilled Trades	◉		○		
	Industrial Mechanics and Service Technicians	◉	○	○		
	Lab Technicians		◉	○	○	
	Bioscientists and Engineers		◉	◉		
	Advanced Materials and Chemicals	○	○	○		
	Diagonostic Technicans		○		○	
	Medical and Life Sciences		○	○	○	

Source: TIP Strategies, Scruggs & Associates.

Finally, Figure 52 shows the top ten occupations by share of industry employment for each of the key sectors.

FIGURE 52. TOP OCCUPATIONAL CLUSTERS
BY SHARE OF INDUSTRY

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Healthcare							
Nursing and Nurse Specialties	37,470	2.3%	1,639	39%	61%	28%	◀
Oral Health	10,760	1.8%	410	36%	64%	17%	
Rehabilitation Therapy	7,583	2.6%	384	43%	57%	18%	
Care Specialties	6,207	1.9%	260	27%	73%	28%	◀
Mental and Behavioral Health	11,722	2.5%	542	48%	52%	26%	◀
Primary Care	5,114	2.8%	253	41%	59%	26%	◀
Diagonostic Technicans	3,776	2.1%	135	42%	58%	21%	
Lab Technicians	4,463	1.4%	177	34%	66%	27%	◀
Surgical and OR Specialists	2,807	2.4%	102	41%	59%	23%	
Medical Records and Information Management	2,779	2.0%	110	37%	63%	28%	◀
Advanced Manufacturing							
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Industrial Machinists and Operators	6,817	2.8%	363	38%	62%	24%	
First-Line Supervisors	11,532	1.5%	331	35%	65%	27%	◀
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	
Welders and Skilled Trades	19,322	1.0%	549	26%	74%	19%	
Industrial Mechanics and Service Technicians	10,250	2.4%	431	38%	62%	27%	◀
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Supply Chain, Purchasing, and Logistics	6,537	1.8%	266	23%	77%	28%	◀
IT & Digital Services							
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Systems and Data Administration	16,651	1.4%	504	45%	55%	15%	
Systems Architects and Analysts	13,334	2.1%	415	54%	46%	18%	
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Digital Media and Design	6,746	1.2%	216	25%	75%	21%	
Human Resource Managment	12,408	1.9%	493	32%	68%	23%	
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Data Scientist	3,136	2.9%	138	56%	44%	21%	
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	

Source: TIP Strategies, Scruggs & Associates.

continued, next page

FIGURE 52. TOP OCCUPATIONAL CLUSTERS
BY SHARE OF INDUSTRY

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Energy							
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Plant and Field Technicians - Energy	1,696	2.1%	100	30%	70%	23%	
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	
Bioscientists and Engineers	3,511	0.1%	123	18%	82%	18%	
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Engineering Support	2,305	1.3%	35	14%	86%	25%	◀
Environmental Engineering and Science	2,336	2.4%	129	37%	63%	25%	
Medical and Life Sciences	2,773	-0.8%	127	16%	84%	18%	
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Bioscience							
Lab Technicians	4,463	1.4%	177	34%	66%	27%	◀
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Bioscientists and Engineers	3,511	0.1%	123	18%	82%	18%	
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Advanced Materials and Chemicals	2,242	1.6%	87	19%	81%	23%	
Diagonostic Technicans	3,776	2.1%	135	42%	58%	21%	
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Medical and Life Sciences	2,773	-0.8%	127	16%	84%	18%	
Systems and Data Administration	16,651	1.4%	504	45%	55%	15%	

Source: TIP Strategies, Scruggs & Associates.

APPENDIX B. INDUSTRY PROFILES

The Talent Plan is focused on five of the state's advanced and high-impact industries that, together, employ 427,056 or over 20 percent of Oregon workers. Figure 53 shows the industries and how they are defined. In the pages that follow, a detailed profile for each sector presents trends likely to affect workforce needs as well as the findings from the talent needs assessment.

FIGURE 53. KEY INDUSTRIES SUMMARY

INDUSTRY	COMPONENTS
 Healthcare	• Ambulatory Health Care Services • Hospitals • Nursing and Residential Care
 Advanced Manufacturing	• Aerospace, Defense, and Transportation Manufacturing • Food and Beverage Processing and Manufacturing • Metals and Machinery Manufacturing • Outdoor Gear and Apparel Manufacturing • Technology (Hardware) Manufacturing • Wood Products Processing and Manufacturing
 IT & Digital Services	• IT Services • Software Publishing
 Energy	• Energy-Related Services • Renewables • Utilities
 Bioscience	• Bioscience-Related Distribution • Drugs and Pharmaceuticals • Medical Devices and Equipment • Research, Testing, and Medical Laboratories

HEALTHCARE

In 2015, the US spent $3.2 trillion on healthcare.[21] This growth trajectory is anticipated to continue. It is the largest employment sector in Oregon and the Oregon Talent Council portfolio. Despite the huge impact on Oregon's economy, many parts of the state's healthcare workforce are in short supply, especially in rural regions of the state. Changes in federal health policy, advancements in treatment and technologies, an increasing number of people with long-term care needs, and the growing use of big data to manage individual and population health are just some of the factors impacting the healthcare workforce for the foreseeable future.

The intense regulation of the healthcare industry, combined with unique regional market demographics, makes workforce projections challenging. Issues like who is eligible for insurance and how providers get reimbursed (federal and state policies like Medicaid expansion) can have a domino effect on the healthcare workforce. In rural areas where the ratio of physicians to residents is lower, the system can rely heavily on physician assistants and nurse practitioners to deliver care.

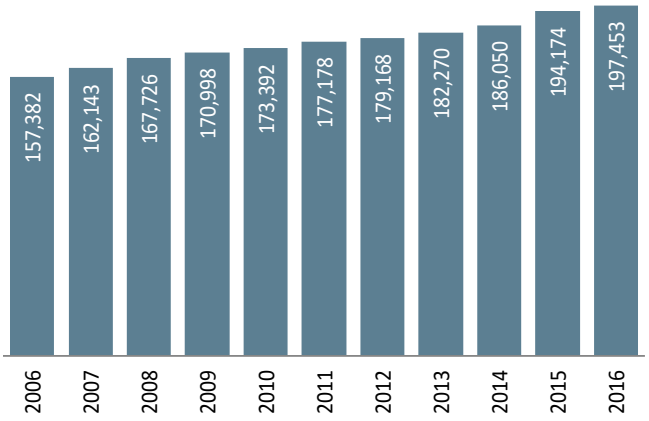
Cost-effective and continual training of healthcare workers is a necessity, not an option. Yet, funding for such training is difficult without a strong public-private partnership. New taxes on hospitals and other state policies such as the inability for community colleges to offer a Bachelor's degree in nursing so graduates can reach all part of the state, only reduce the options and resources available for training.

While uncertainty in healthcare policies makes it difficult to project the mix and quantities of various healthcare workers, the industry appears to agree certain key skills and occupations will continue to be in demand. The trends most noted by Oregon employers as well as national and state studies[22] tend to fall into three categories: impact of healthcare policies, changes in demographics and population health, and effects of advances in technology and information.

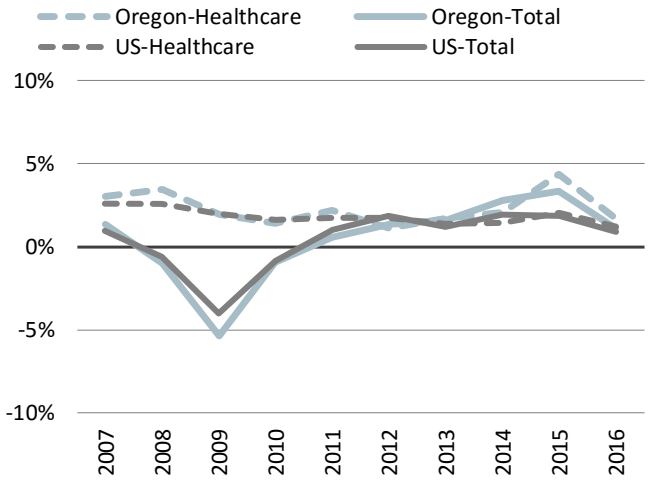
INDUSTRY SNAPSHOT

OREGON	TOTAL
# of Establishments (2016)	10,319
Number of Jobs (2016)	197,453
% Change 2011-2016	11%
Employment Growth Outlook (2016-2021)	
Oregon	11.8%
US	10.2%

EMPLOYMENT TRENDS, 2006-2016



COMPARATIVE GROWTH



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

[21] National Health Spending Report
[22] Oregon Univ. Sys. Healthcare Workforce Initiative Milestone Reports, 2014; Top Healthcare Ind. Issue of 2015: Outlines of a market emerge. PricewaterhouseCoopers.

HEALTHCARE CONTINUED

THE IMPACT OF HEALTHCARE POLICIES

Continued investments in patient-centered care models[23] push the need for coordination across providers. In recent years, the closer integration of community mental and medical healthcare increased demand for patient advocate and coordination/navigator roles. Even with potential changes in healthcare policy, consumer pressures and technology will continue to demand a team-oriented approach. Employers note that in-depth team, supervisory, and patient customer service skills are lacking in many workers—one of the greatest challenges to upskilling their workforce.

Cost containment pressures will continue to push providers toward value or outcome-based payment models that reimburse for outcomes rather than the volume of services (e.g. the traditional fee-for service model). These value-based models require the ability to track and measure quality outcomes and then use this information to make informed choices about treatment and prevention services. In a recent national study, over 66 percent of healthcare providers surveyed said they were already undergoing a transition to value-based payment models, and an additional 17 percent indicating plans to pursue such models.[24] Oregon's OAHHS Value-based Care Readiness Assessment further outlines this trend.[25] As one Oregon healthcare employer noted, "the basic understanding of today's healthcare economics is missing in not only finance and operations workers, but in the key care providers." Training in understanding the effects of outcome or value-based payment in healthcare delivery was another example of non-licensed skills that have a significant impact on the quality of care as well as the cost.

CHANGES IN DEMOGRAPHICS AND POPULATION HEALTH

Changes in demographics (e.g. people living longer) and the overall health of the population (growing numbers of people with obesity, diabetes, and mental illness) impact the healthcare workforce. Two examples noted by Oregon employers include:

- **A rise in behavioral and mental health issues**. Behavioral and mental health services are among the fastest growing aspects of healthcare and cover a broad array of issues from addictions to dementia related behavioral issues in seniors to growing anxiety disorder in youth living in poverty. Many of these issues disproportionately affect rural areas. A recent tour by the Oregon Health Authority noted that services for mental health and addictions as top concerns of rural hospitals where 23 percent of Medicaid stays are related to mental health and addictions, compared to 16 percent statewide. Yet, 19 out of 36 Oregon counties have less than one full-time psychiatrist and ten counties had none.[26] This is compounded by most mental health care workers being much older than average workers, and low pay rates compared to healthcare jobs with similar education.

- **An increase in demand for rehabilitation workers.** With an aging population, advances in treatment for traumatic brain injuries, and new implants and devices, more people are requiring some form of physical, occupational and speech therapy. Such therapies are performed in a variety of settings ranging from hospital and clinics to long-term care facilities and in-home services. A higher than average proportion of this segment of healthcare workers are self-employed or work as contractors.

ADVANCES IN TECHNOLOGY AND INFORMATION

- **Advances in technologies are requiring new skills and knowledge across different levels of care.** The expansion of robotics in diagnostics, surgery, and rehabilitation, along with a growing use of implants and devices with sensors, means that care providers need to apply technological skills alongside medical knowledge. While 3D printing may

23 AHA report
24 Jonathan Bees, HealthLeaders Industry Outlook, February 1, 2017
25 OAHHS Value-based Care Readiness Assessment, July 23, 2015
26 Oregon Health Authority, Oregon's Licensed Behavioral/Mental Health Car Workforce, 2016

HEALTHCARE CONTINUED

be changing the speed, precision, and customization of implants and pre-surgical modeling, it also requires an increasing understanding of new materials and nanostructures.

- **Telehealth.** Digital information and communication enables the industry to provide health care from a distance. Telehealth can be used to access primary medical services that may be unavailable in remote communities, or in critical care and emergency situations. Over 72 percent of hospitals and 52 percent of physician groups report using telemedicine.[27] In 2016, Kaiser Permanente conducted 50 percent of its patient encounters virtually.[28] The use of telehealth is projected to grow as issues such as reimbursement rates for telehealth services or across state licensing are resolved.

FIGURE 54. STRATEGIC IMPORTANCE OF HEALTHCARE IT
% OF IT ISSUES RANKED AS A TOP 3 PRIORITY

Source: HealthLeaders Industry Outlook 2017

- **Big data and healthcare IT** are growing in strategic importance. Health IT continues to be one of the most rapidly growing workforce segments of healthcare and one which has become a foundation for understanding the implications of care models on patient outcomes and treatment costs.
  - One of the most fundamental aspects of Health IT is electronic health records (EHR). As systems for electronic health records continue to be implemented across Oregon, there is significant variation as illustrated by 11 different EHR systems used by Oregon's rural hospitals alone.[29] In addition, most federal or state grants to pilot health IT initiatives provide little if any ongoing training provisions for users of the system, leaving organizations with an updated IT system that is underutilized.
  - The growth of personalized medicine, devices with sensors, and widespread use of electronic records are just a few issues driving big data in healthcare. Big data has created an entire set of new analytics jobs that evaluate health and medical information on individual, community, and population levels. The use of this data is helping to target treatment, increase the effectiveness of prevention, and better understand the cost-benefit of specific care options. Per a February 2017 Annual Industry Outlook by HealthLeaders, patient health, predictive analytics, clinic IT, and EHR interoperability have the greatest potential impact on the future of healthcare delivery.

EMPLOYER INPUT

Healthcare workforce forums were held across the state to verify skill and occupational gaps and to understand desired training options. Key occupational shortages and skills gaps include:

- **Behavioral and mental health workers** are needed across the state, especially workers with experience in coordinating/integrating care with primary physicians.
- **Primary care physicians** (PCPs) to provide care, and also to supervise mid-levels. Recruitment of PCPs is especially challenging in rural areas.

[27] "Closing the Telehealth Gap," *Avizia,* available at: https://www.avizia.com/research-report-closing-telehealth-gap
[28] Kokalitcheva K, "More Than Half of Kaiser Permanente's Patient Visits Are Done Virtually," *Fortune,* Oct., 2016, available at: fortune.com/2016/10/06/kaiser-permanente-virtual-doctor-visits
[29] Rural Hospital Listening Tour, July 2015 www.ohsu.edu/xd/outreach/oregon-rural-health/hospitals/upload/2014-Rural-Hospital-Listening-Tour-Report.pdf

HEALTHCARE CONTINUED

- **Nurse specialties** (e.g. operating room nurses, nurse anesthetists) are of particular concern since the age of these workers is high. Experienced specialists are especially hard to find in rural areas where the numbers needed are low, yet critical for the operations of the health facility.
- **Dental workers,** especially hygienists, were noted as difficult to find, and the average age of a dentist among the highest of all healthcare occupations. Dental technology, like other aspects of healthcare, has changed significantly and the connection to other aspects of health continues to grow. Therefore, there is not only a shortage of workers, there is a shortage of current knowledge and skills.
- **IT/Data and Health Information Record Management,** ranging from IT specialists focused on security and interoperability to people managing health records and using health data to analyze care delivery and cost.
- All types of **rehabilitation therapists** will be needed: Physical therapists in terms of pure numbers, and occupational therapists and speech pathologists in terms of both growth and the ability to recruit to rural areas.

CNAs and entry-level front-line workers. Although the Oregon Talent Plan, through direction by the Oregon Talent Council, focused on jobs that pay a livable wage, entry-level frontline workers such as certified nursing assistants (CNAs) were reported as one of the most pressing issues in Oregon healthcare. The career path to nursing and other related healthcare occupations often starts with being a CNA. The upward mobility, combined with a fairly high turnover similar to entry jobs in other industries, means there is a constant need for new CNAs. This is underscored by national healthcare industry associations and networks. Furthermore, as health systems update their operating model, more employers are looking for CNA II level workers. Unfortunately, many parts of our state do not have a CNA II level training program, so employers conduct ad-hoc training in-house. While other states have developed structured work-based and apprenticeship style training, Oregon has not. Since this issue is a pressing matter nationally, there is an array of best practices that can be adopted in Oregon, some of which are highlighted in the Promising Practice Appendix.

- Providers and front-line workers at all levels that have a current knowledge of **caring for aging populations and those with multiple chronic conditions.**

In addition to keeping up with occupation-specific skills (e.g. new surgical or diagnostics techniques), healthcare executives and HR directors noted **supervisory skills,** especially in nursing and other mid-level positions is lacking.

OCCUPATIONAL ANALYSIS

A 2014 Oregon report[30] summarizes key healthcare trends by noting, "S*hifting the focus of the health care systems to health promotion, disease prevention, chronic care management, and population health through lean, effective organizational systems places greater emphasis on the need for more primary care and mental health clinicians, data analysts, and systems and process improvement specialists. Oregon's health care industry members, particularly those representing long-term care, have also expressed difficulty in recruiting physical therapists, occupational therapists, and speech-language pathologists.*" In rural areas, nurse practitioners, nurses, and medical assistants are also reported as being in chronically short supply, especially in areas where there are few higher education institutions producing graduates.

The average age of many healthcare occupations is well above other jobs. Nurse practitioners, physicians, dentists, and psychiatrists are examples where almost a third of the workforce is over the age of 55, as compared to about 23 percent for all Oregon jobs.[31] Aging workers along with uncertainty in health policies has the potential for creating retirement bubbles over the next 10 years. Replacing the experience and expertise developed on the job will be challenging without formal programs to transfer knowledge to younger workers.

[30] Ibid
[31] Oregon Healthcare Workforce Institute, Oregon's University System's Healthcare Workforce Initiative; Milestone Two Report, 2014

HEALTHCARE CONTINUED

There are 74 healthcare occupations that meet the base criteria of the Oregon Talent Plan. The Oregon Talent Plan analyzed these occupations based on multiple factors affecting the demand for jobs:

- The overall number of jobs
- The growth rate of jobs as measured by the past two-year growth and projected 10-year growth
- The number of projected annual openings
- The percent of workers over age 55
- The location quotient or concentration of jobs as compared to the national average
- The demand of an occupation due to the growth of Oregon's industry as compared to the national growth of the industry

These factors were combined and weighted to develop a total demand score for each occupation. These occupations were then grouped into related jobs. These groupings were then verified through employer input throughout the state. Figure 55 lists the top healthcare occupational clusters.

FIGURE 55. KEY HEALTHCARE OCCUPATIONAL CLUSTERS

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Nursing and Nurse Specialties		29,436	2.3%	1,639	39%	61%			28%	
29-1141	Registered Nurses	26,793	2.3%	1,394	37%	63%	39.82	1.19	28%	◀
29-1161	Nurse Midwives	96	3.1%	5	46%	54%	57.99	1.31	30%	◀
29-2061	Licensed Practical/Vocational Nurses	2,547	2.3%	240	49%	51%	23.36	1.10	26%	◀
Mental and Behavioral Health		4,853	2.5%	542	48%	52%			26%	
21-1011	Substance Abuse & Behavioral Disorder Counselors	1,028	2.5%	86	49%	51%	21.53	1.00	26%	◀
21-1013	Marriage & Family Therapists	167	2.7%	32	56%	44%	20.81	0.84	32%	◀
21-1014	Mental Health Counselors	1,709	2.7%	156	49%	51%	24.81	1.11	26%	◀
21-1015	Rehabilitation Counselors	346	2.2%	99	46%	54%	19.13	1.05	29%	◀
21-1019	Counselors, All Other	86	2.6%	21	45%	55%	27.08	1.17	30%	◀
21-1023	Mental Health & Substance Abuse Social Workers	1,228	2.8%	128	45%	55%	21.85	1.00	24%	
29-2053	Psychiatric Technicians	291	1.6%	20	61%	39%	18.23	1.05	16%	
Pharmacy and Medication Management		1,862	2.1%	281	45%	55%			19%	
29-1051	Pharmacists	1,034	2.0%	150	31%	69%	57.98	1.01	24%	
29-2052	Pharmacy Technicians	828	2.3%	131	60%	40%	17.99	1.20	14%	
Rehabilitation Therapy		5,973	2.6%	384	43%	57%			18%	
29-1122	Occupational Therapists	847	2.8%	50	51%	49%	38.97	1.04	14%	
29-1123	Physical Therapists	2,411	2.7%	147	41%	59%	39.12	0.97	14%	
29-1126	Respiratory Therapists	1,024	2.2%	46	35%	65%	31.58	1.12	25%	◀
29-1127	Speech-Language Pathologists	896	2.3%	75	38%	62%	36.48	1.04	24%	
31-2011	Occupational Therapy Assistants	198	3.8%	19	55%	45%	26.93	0.97	15%	
31-2021	Physical Therapist Assistants	596	3.0%	46	51%	49%	25.79	0.98	13%	
Primary Care		4,656	2.8%	253	41%	59%			26%	
29-1062	Family & General Practitioners	1,135	1.8%	52	22%	78%	85.48	0.95	30%	◀
29-1063	Internists, General	509	1.8%	21	21%	79%	97.45	1.16	28%	◀
29-1065	Pediatricians, General	496	1.3%	18	14%	86%	83.20	1.00	28%	◀
29-1071	Physician Assistants	1,097	3.3%	66	51%	49%	50.57	1.05	16%	
29-1171	Nurse Practitioners	1,419	4.0%	97	53%	47%	53.01	1.07	29%	◀

HEALTHCARE CONTINUED

FIGURE 55. KEY HEALTHCARE OCCUPATIONAL CLUSTERS

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Oral Health		10,305	1.8%	410	36%	64%			17%	
29-1021	Dentists, General	1,298	0.5%	51	23%	77%	86.57	1.08	37%	◀
29-1022	Oral & Maxillofacial Surgeons	48	-0.3%	2	16%	84%	111.70	1.09	33%	◀
29-1023	Orthodontists	60	0.2%	2	21%	79%	110.17	1.11	31%	◀
29-1029	Dentists, All Other Specialists	103	1.0%	4	14%	86%	106.55	1.43	35%	◀
29-2021	Dental Hygienists	4,010	2.2%	132	44%	56%	37.26	1.03	17%	
31-9091	Dental Assistants	4,785	1.9%	218	36%	64%	19.92	1.11	11%	
Medical Records and Information Management		1,865	2.0%	110	37%	63%			28%	
29-2071	Medical Records & Health Info. Technicians	1,865	2.0%	110	37%	63%	20.20	1.07	28%	◀

FIGURE 56. OTHER HIGH DEMAND OR HARD TO FILL OCCUPATIONAL CLUSTERS KEY TO HOSPITALS AND CLINICS

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Surgical and OR Specialists		2,772	2.4%	102	41%	59%			23%	
29-1061	Anesthesiologists	538	2.6%	25	30%	70%	124.17	1.09	29%	◀
29-1067	Surgeons	609	2.9%	28	30%	70%	124.78	1.11	30%	◀
29-1151	Nurse Anesthetists	279	2.7%	16	49%	51%	95.77	1.19	30%	◀
29-2055	Surgical Technologists	1,346	2.1%	33	55%	45%	23.98	1.09	16%	
Diagonostic Technicans		3,000	2.1%	135	42%	58%			21%	
29-2031	Cardiovascular Technologists & Techs.	614	3.1%	27	49%	51%	31.82	1.24	21%	
29-2032	Diagnostic Medical Sonographers	555	3.2%	28	53%	47%	41.60	1.23	21%	
29-2033	Nuclear Medicine Technologists	133	1.1%	4	31%	69%	39.03	1.10	22%	
29-2034	Radiologic Technologists	1,346	1.7%	65	35%	65%	31.98	1.13	21%	
29-2035	Magnetic Resonance Imaging Technologists	352	1.3%	11	35%	65%	37.59	1.17	20%	

Source (both figures this page): 2017.1 – QCEW Employees, Non-QCEW Employees, and Self-Employed
Note: Above average growth highlighted in blue, wages premiums above 10% of US average highlighted in gray, more than 25% of workforce 55 years old or great marked with red triangle, top 10% of demand categories highlighted in orange.

HEALTHCARE CONTINUED

FIGURE 57. OTHER OCCUPATIONAL CLUSTERS HARD TO FILL IN RURAL OREGON

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Other Medical Specialties		641	3.0%	43	32%	68%			25%	
29-1041	Optometrists	397	3.1%	29	26%	74%	51.46	0.98	25%	◀
29-1081	Podiatrists	91	1.3%	6	46%	54%	50.24	0.88	26%	◀
29-1181	Audiologists	153	3.6%	9	42%	58%	41.15	1.13	25%	
Care Specialties		5,166	1.9%	260	27%	73%			28%	
29-1064	Obstetricians & Gynecologists	342	2.6%	15	26%	74%	109.06	1.09	30%	◀
29-1066	Psychiatrists	287	2.0%	18	34%	66%	94.65	1.04	29%	◀
29-1069	Physicians & Surgeons, All Other	4,537	1.9%	227	26%	74%	94.12	1.07	28%	◀

Source: 2017.1 – QCEW Employees, Non-QCEW Employees, and Self-Employed
Note: Above average growth highlighted in blue, wages premiums above 10% of US average highlighted in gray, more than 25% of workforce 55 years old or great marked with red triangle, top 10% of demand categories highlighted in orange.

EDUCATION AND TRAINING RECOMMENDATIONS

The changing landscape and demographics has created demand for both new and replacement healthcare jobs. Many hard to fill jobs were difficult to find because applicants did not have current skill sets—primarily team-based skills and the ability to effectively use new technologies and IT platforms. As one health system executive noted "Once you have graduated, you become instantly obsolete. We need help with training so that our skill sets don't fade away. Our current options include distance learning or traveling too far for classroom trainings."

Upskilling workers in healthcare can be particularly challenging, especially for frontline workers with direct patient interface. Time away from the job for training means that someone else has to replace the worker being trained, and shift schedules make it difficult to access or attend traditional training options. Healthcare employers across Oregon noted a significant need for ways that employers could share costs and facilities to upskill existing workers. Repeated recommendations included:

- Convening training collaboratives among regional hospitals and clinics to share resources around training. This includes having regional resources (making it someone's jobs) to identify common training needs, convene and share effective practices among employers. Issues of interest included:
  - Leadership and supervisory skills, especially in nursing and other mid-level positions.
  - Management skills training including hiring, budgeting, and mentoring.
  - Skills required in a coordinated care setting including team and patient communication, conflict management, critical thinking, project management skills—offered in individual classes and as a series.
  - Programs to help develop skills needed for case management, navigator and patient coordinator roles.
- Helping to develop structured on-the-job training for key frontline workers.
  - CNA I to CNA II pathway was mentioned most often.
  - Training for basic behavioral health related skills that are within legal scope for laypersons (community health workers) to assist at clinics.

HEALTHCARE CONTINUED

- Help aggregate the demand for bringing outside training into the region. An example is care redesign and service line realignment to develop a systematic process for examining and redesigning how care is provided in order to optimize cost and patient outcomes, and to identify and refine job descriptions and competencies to better operate within a coordinated care environment. (Similar to how employers approached Lean training).
- Greater access to RN to BSN (Bachelor's level RN) programs in rural areas. This includes support for community colleges to produce BSN programs.
- Enhanced capacity for clinical training sites and coordination of clinical sites across programs

Across Oregon, Regional Area Health Education Centers (AHECs) provide an array of support for building healthcare workforce, especially much needed family and primary care in rural and distressed areas of the state. While their work focuses primarily on building a pipeline of medical students, their facilitation role and knowledge of multiple health providers in the region may make them a natural partner to develop and help implement incumbent worker training.

ADVANCED MANUFACTURING

The Advanced Manufacturing sector includes technology manufacturing, food and beverage manufacturing, wood products, metals and machinery, outdoor gear and apparel, and aerospace and defense. In Oregon, the sector employs almost 160,000 people and consists of about 4,000 establishments. The largest segment is technology manufacturing segment, which accounts for 28 percent of the sector's employment.

Over the last decade, Oregon's Advanced Manufacturing sector kept pace with the nation's until 2011, when Oregon began to outperform the US. Between 2011 and 2016, the sector added more than 17,000 jobs. Over the next five years, Oregon's IT sector is expected to grow by another 5 percent, which is significantly higher than the US growth rate of 3.5 percent.

TRENDS AFFECTING TALENT

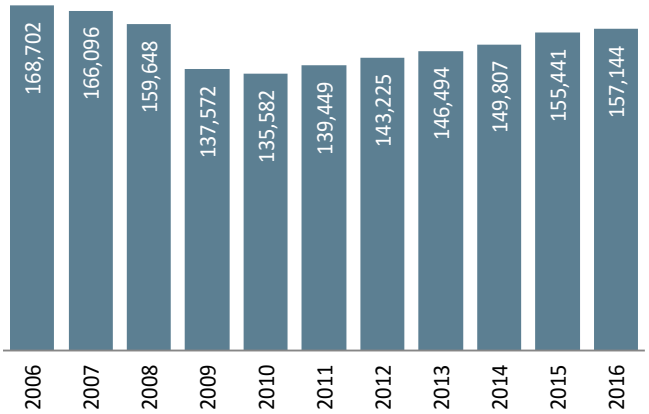
Manufacturer's optimism about the outlook of their industry is at an all-time high. In the most recent National Association of Manufacturers (NAM) Outlook Survey, 93 percent of respondents are positive about their own company's outlook, which is the highest percentage in the 20-year history of the survey. In addition, firms are also less cautious about hiring and capital investment. Manufacturers attribute this additional hiring and capital investment to heightened demand for their products and having new products or innovations in the processes. However, attracting and retaining a quality workforce was a top concern for almost two-thirds of firms that participated in the survey.[32]

Digitization and the Industrial Internet of Things (IIoT) is the next transformational wave. It follows lean production, outsourcing, and automation – three previous waves that have already swept the sector. The Industrial Internet of Things refers to the new operating environment that includes sophisticated levels of digital interactions among networks of humans, intelligent machines, and "big data". The digitization environment enables everything from new, high-profile forms of production, including additive manufacturing (3-D printing), to incremental improvements in process control, asset allocation, resource management, and supply/demand analytics. This will have far-reaching impacts

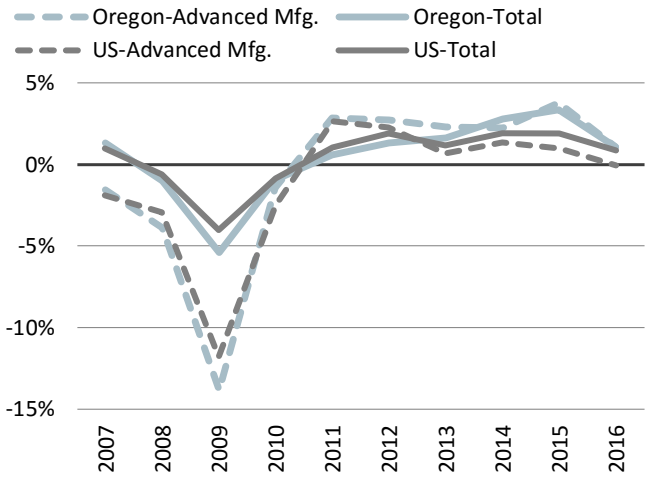
INDUSTRY SNAPSHOT

OREGON	TOTAL
# of Establishments (2016)	3,933
Number of Jobs (2016)	157,144
% Change 2011-2016	13%
Employment Growth Outlook (2016-2021)	
Oregon	5.0%
US	3.5%

EMPLOYMENT TRENDS, 2006-2016



COMPARATIVE GROWTH



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

[32] National Association of Manufacturers. NAM Manufacturers Outlook Survey. Q1 2017

ADVANCED MANUFACTURING CONTINUED

on productivity and efficiency on the manufacturing floor. The development and management of such interconnected systems will require interdisciplinary teams that include a wide range of skills in data science, software development, hardware engineering, robotics, as well as mechanical and electrical systems.[33] In addition, these interconnected systems will create a need for completely new skills in manufacturing, such as a cybersecurity teams to identify potential (or actual) breaches and manage risk.

Additive manufacturing represents a paradigm shift in both design and production. Additive manufacturing is revolutionizing the design process and the supply chain of manufacturers. It is also revolutionizing the skills required of technical and engineering talent in the manufacturing sector. In particular, the talent base associated with additive manufacturing must also have a range of interdisciplinary skills including data management, material science, and equipment design.[34]

Collaborative robots and automation will have a dramatic impact on productivity but not necessarily on staffing levels. Collaborative robots, or cobots, work alongside human employees, assisting humans with tasks thus increasing safety, precision, and productivity. They can be easily programmed and are relatively affordable compared to fully automated systems. The partnership between man and machine combines the advantages of human cognitive thinking and complex reasoning with the robots' ability to work 24/7 with precision and accuracy.[35] These systems are becoming more and more popular with manufacturers. At the same time, manufacturers are continuing to make investments in automation. Although the adoption of automated processes does displace some workers, it creates new positions as well. Both of these trends create additional interfaces between man and machine, which necessitate a basic level of technology skills and comfort.

Survival means adapting to a new organizational environment. Digital links backward (to suppliers) and forward (to customers) are forcing manufacturers to change their organizational structures. This requires new skill sets and different ways of thinking about how to do business in the future. Software and analytical skills will join engineering skills among the core needs of manufacturers.

The manufacturing skills gap is likely to continue. As manufacturers continue to adopt advanced technologies, they expect to see a worsening of the gap between the skills they need and the skills the industrial labor force has. Recently, PriceWaterhouseCoopers found that two-thirds of manufacturers are already having difficulty finding talent with the high-tech skills need to exploit the advanced technologies they have deployed.[36] In addition, only 17 percent of participating manufacturers believed that the adoption of advanced manufacturing technologies would lead to a reduction in staffing needs.[37]

In a supply-constrained labor market, image poses a recruiting problem. Demand for skilled workers outstrips supply, especially for engineering talent. Manufacturers increasingly need to hire workers with STEM skills but they are at a disadvantage in competing for these workers because of the sector's blue-collar image. Advanced manufacturing is not expected to be a major job generator in the years ahead, but the new jobs that are created will be high-skilled jobs, not the factory jobs of the past.

EMPLOYER INPUT

Oregon advanced manufacturing employers noted the following trends and their impact on the state's talent.

- **The man-machine interface is significantly changing the type of skills manufacturers need.** Programmable Logic Contollers (PLCs), linked equipment and remote monitoring, and robotics are creating a need for IT skills in addition

[33] Accenture. Driving Unconventional Growth through the Industrial Internet of Things. 2015.
[34] Deloitte. 3D Opportunity for the Talent Gap: Additive Manufacturing and the Workforce of the Future. 2016.
[35] Mfg Talk Radio. Creating the First Standards: ISO/TS 15066 for Collaborative Robots. July 2016
[36] PWC. Upskilling Manufacturing: How Technology is Disrupting America's Industrial Workforce. June 2016
[37] Ibid.

ADVANCED MANUFACTURING CONTINUED

to manual skills. Finding entry-level workers with these skills is difficult and incumbent workers need to be trained up as well. The lack of talent with these skills, at times, discourages manufacturers from making capital investments in new machinery.

- **In the world of rapidly changing skills, employers are valuing solid foundational skills that better equip workers to learn new skills.** For example, Machine Theory equips workers with a strong understanding of different types of machines, which can be applied across the industrial setting in many different kinds of occupations that support production.
- **In food processing, sanitary design affects all food manufacturers.** Changing regulations are coming online that affect plant sanitation requirements and influence sanitary design. In addition, the aging of equipment and new equipment designs pose additional challenges. These changing are creating a significant need for the skill set, but it is very hard to find.
- **Occupations and specific skills that are hard to find are:**
  - Industrial maintenance workers
  - Refrigeration technicians
  - Quality assurance technicians
  - Skilled millwrights and mechanics
  - HVAC systems installers and repairers
  - Safety and compliance workers
  - Knowledge of composites
  - Production workers and engineers with interdisciplinary mechatronics skills
- **Soft skills were also highlighted as deficient in many of today's applicants.** The lack of basic employability skills among today's applicants is a large concern for employers across the sector. Skills such as punctuality, reliability, and professionalism were highlighted as deficient. Employers consistently expressed a need for workers that can show up to work on time and on a sustainable basis; "play nicely with others", read and do basic computations, and have an aptitude for learning.
- **Lack of talent is preventing some manufacturer's expansion.** While some manufacturers cannot find the talent they need to run additional production lines or open a new location, others are constrained from making capital investments because they do not believe they can find the skills needed to run the new machines.

ADVANCED MANUFACTURING CONTINUED

OCCUPATIONAL ANALYSIS

Of the 307 occupations identify in the Oregon Talent Plan, about 100 occupations are employed in advanced manufacturing companies. These 100 occupations account for about 40 percent of total employment in the industry. Figure 58 lists the top industry clusters for the sector by share of industry employment. Interdisciplinary engineering is the top cluster, followed by industrial machinists and operators, and first line supervisors. Cross-sector clusters such as programmers, data-enabled analysts, and business finance and compliance are also among the top occupational clusters for the sector.

FIGURE 58. TOP OCCUPATIONAL CLUSTERS
BY SHARE OF INDUSTRY EMPLOYMENT

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	Estimated Jobs in Industry (2016)	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Interdisciplinary Engineering	1,136	1.6%	606	21%	79%	22%	
Industrial Machinists and Operators	243	2.8%	363	38%	62%	24%	
First-Line Supervisors	345	1.5%	331	35%	65%	27%	◀
Engineering Technicians	218	1.5%	225	18%	82%	25%	
Welders and Skilled Trades	527	1.0%	549	26%	74%	19%	
Industrial Mechanics and Service Technicians	266	2.4%	431	38%	62%	27%	◀
Programmers and Developers	360	2.3%	790	51%	49%	13%	
Data-Enabled Analysts	420	2.3%	1,117	53%	47%	25%	◀
Business Finance and Compliance	206	2.4%	997	38%	62%	29%	◀
Supply Chain, Purchasing, and Logistics	57	1.8%	266	23%	77%	28%	◀

Among the fastest growing occupations are various machine operators and programmers, and also maintenance and repair-related workers.

FIGURE 59. FASTEST GROWING OCCUPATIONS

SOC Code	Description	Share of Industry Employment	2016 Jobs	% Change (2016-21)	LQ (US= 1.00)	Median Hourly Earnings	Relative to US (US=1.00)	
51-9012	Separating, Filtering, & Precipitating Machine	0.1%	801	44%	1.24	16.86	0.89	
51-9193	Cooling & Freezing Equipment Workers	0.0%	148	35%	1.39	17.84	1.24	●
49-9041	Industrial Machinery Mechanics	0.4%	5,102	34%	1.17	25.38	1.05	
19-1012	Food Scientists & Technologists	0.0%	289	34%	1.36	29.71	0.94	
51-4011	CNC Machine Operators, Metal/Plastic	0.3%	2,278	32%	1.20	17.87	0.99	
51-4041	Machinists	0.4%	3,910	31%	0.75	21.97	1.12	●
51-4012	CNC Machine Programmers, Metal/Plastic	0.0%	628	30%	1.85	26.87	1.11	●
47-2211	Sheet Metal Workers	0.0%	2,998	29%	1.55	22.46	0.98	
13-1021	Buyers & Purchasing Agents, Farm Products	0.1%	233	28%	1.35	21.77	0.84	
49-9043	Maintenance Workers, Machinery	0.1%	956	26%	0.76	21.20	1.02	

Source (both figures this page): 2017.1 – QCEW Employees, Non-QCEW Employees, and Self-Employed
Note: Above average growth highlighted in blue, wages premiums above 10% of US average highlighted in gray, more than 25% of workforce 55 years old or great marked with red triangle, top 10% of demand categories highlighted in orange.

ADVANCED MANUFACTURING CONTINUED

The Oregon Talent Plan analyzed the 100 manufacturing-related occupations based on multiple factors affecting the demand for jobs:

- The overall number of jobs
- The growth rate of jobs as measured by the past two-year growth and projected 10-year growth
- The number of projected annual openings
- The percent of workers over age 55
- The location quotient or concentration of jobs as compared to the national average
- The demand of an occupation due to the growth of Oregon's industry as compared to the national growth of the industry

These factors were combined and weighted to develop a total demand score for each occupation. Occupations were then grouped into related jobs. These groupings were then verified through employer input throughout the state. The final step was to group jobs into related clusters of occupations within one of three categories:

- **Emerging and Evolutionary Occupations.** Those occupations experiencing new to market or rapidly changing skills along with high growth rates. High demand due to competitive pressures with less defined skills due to the evolutionary nature of the job.
- **Competitive and Steady Demand Occupations.** Those occupations that have steady demand (average growth rates) with more consistently defined skills likely requiring some level of upskilling and a blend of new and replacement jobs.
- **Transitional and Mission-Critical Occupations.** Those occupations that have lower than average growth rates, higher retirement exposure and other factors that lead to more replacement jobs than new jobs.

EMERGING AND EVOLUTIONARY OCCUPATIONS

Industrial Machinists and Operators. Growth rates of almost 3 percent and the anticipation of new skills place industrial machinists and operators on the list of rapidly changing occupations.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Industrial Machinists and Operators		5,588	2.8%	363	38%	62%			24%	
51-4011	CNC Machine Operators, Metal/Plastic	2,024	2.8%	128	39%	61%	18.78	0.99	18%	
51-4012	CNC Machine Programmers, Metal/Plastic	545	2.8%	33	35%	65%	27.52	1.11	18%	
51-4041	Machinists	3,018	2.7%	202	37%	63%	22.48	1.12	29%	◀

Industrial IT Team. To deploy and manage an interconnected, digital manufacturing facility and process, a staff of people with a range of IT skills is needed. Skills such as programming, networking, data warehousing and management, and applications development are needed to set up the systems. Then network administration, database administration, information and cyber security, as well as data-enabled analysts are needed to manage the systems, transform the data into useable and actionable formats, and analyze the data to support decision-making and monitor work flows. This application of IT talent in advanced manufacturing is quickly evolving and experiencing an uptick in demand.

ADVANCED MANUFACTURING CONTINUED

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	PROJECTED OPENINGS: New jobs	PROJECTED OPENINGS: Replacement	WAGE ENVIRONMENT: Average Hourly Wages	WAGE ENVIRONMENT: Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years	
Programmers and Developers		2,522	2.3%	790	51%	49%			13%	
15-1131	Computer Programmers	256	0.7%	113	20%	80%	35.25	0.91	18%	
15-1132	Software Developers, Applications	1,246	2.6%	394	55%	45%	46.93	0.96	13%	
15-1133	Software Developers, Systems Software	925	1.9%	128	50%	50%	48.52	0.94	13%	
15-1134	Web Developers	96	3.2%	156	64%	36%	28.04	0.90	8%	
Systems and Data Administration		4,576	1.4%	504	45%	55%			15%	
15-1141	Database Administrators	41	2.5%	50	44%	56%	41.01	1.03	18%	
15-1142	Network & Computer Systems Admin.	354	1.9%	112	50%	50%	35.16	0.91	14%	
15-1143	Computer Network Architects	81	1.4%	38	45%	55%	55.75	1.07	13%	
15-1151	Computer User Support Specialists	429	1.3%	249	43%	57%	24.28	0.96	16%	
15-1152	Computer Network Support Specialists	102	0.8%	55	41%	59%	28.99	0.92	16%	
Systems Architects and Analysts		789	2.1%	415	54%	46%			18%	
15-1111	Computer & Info. Research Scientists	21	2.0%	13	55%	45%	68.66	1.18	16%	
15-1121	Computer Systems Analysts	377	2.8%	242	65%	35%	39.84	0.94	20%	
15-1122	Information Security Analysts	46	2.8%	30	65%	35%	46.65	1.00	20%	
15-1199	Computer Occupations, All Other	346	1.4%	130	30%	70%	39.33	0.92	16%	
Data-Enabled Analysts		1,993	2.3%	1,117	53%	47%			25%	
13-1111	Management Analysts	251	2.6%	316	56%	44%	34.40	0.86	35%	◀
13-1161	Market Research Analysts & Mktng. Specialists	457	3.5%	247	68%	32%	30.25	0.88	15%	
13-1199	Business Operations Specialists, All Other	982	1.8%	366	48%	52%	32.29	0.90	25%	◀
13-2031	Budget Analysts	63	1.5%	31	29%	71%	33.58	0.94	24%	
13-2041	Credit Analysts	12	1.6%	44	22%	78%	35.57	0.98	14%	
13-2051	Financial Analysts	229	2.2%	112	46%	54%	44.77	0.96	13%	

COMPETITIVE AND STEADY DEMAND OCCUPATIONS

Welders & Skilled Trades. The skilled trades occupations, including welders, have long been in short supply not just in Oregon but across the nation, requiring a steady pipeline of talent to support the advanced manufacturing sector. The wage premiums for electricians and plumbers is likely an indicator that the shortage remains an issue for employers; the relatively wage parity for welders could mean that focused efforts to train more welders have been successful.

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	PROJECTED OPENINGS: New jobs	PROJECTED OPENINGS: Replacement	WAGE ENVIRONMENT: Average Hourly Wages	WAGE ENVIRONMENT: Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years
Welders and Skilled Trades		4,285	1.0%	549	26%	74%			19%
47-2111	Electricians	763	0.5%	181	19%	81%	30.50	1.21	20%
47-2152	Plumbers, Pipefitters, & Steamfitters	179	1.1%	141	34%	66%	32.21	1.32	18%
51-4121	Welders, Cutters, Solderers, & Brazers	3,061	2.0%	215	27%	73%	19.68	1.04	17%
51-4122	Welding, Soldering, & Brazing Machine	281	0.1%	12	10%	90%	18.03	1.02	16%

ADVANCED MANUFACTURING CONTINUED

Interdisciplinary Engineers. The technology used in modern manufacturing requires engineers to be cross-functional. For example, mechanical engineers working on smart machines must also have strong electrical and computer engineering knowledge. Although replacement jobs are driving the demand for engineers, the new generation of engineers needs a substantially updated set of skills.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Interdisciplinary Engineering		10,178	1.6%	606	21%	79%			22%	
17-2061	Computer Hardware Engineers	2,552	0.8%	74	0%	100%	62.06	1.08	15%	
17-2071	Electrical Engineers	1,422	1.9%	86	32%	68%	43.10	0.89	24%	
17-2072	Electronics Engineers, Except Computer	864	1.6%	46	29%	71%	44.69	0.92	23%	
17-2112	Industrial Engineers	2,334	2.2%	154	30%	70%	48.31	1.15	24%	
17-2141	Mechanical Engineers	2,065	1.8%	168	23%	77%	42.10	1.02	22%	
17-2199	Engineers, All Other	940	1.4%	77	25%	75%	44.47	0.93	28%	◀

TRANSITIONAL & MISSION-CRITICAL OCCUPATIONS

The aging of the workforce in these occupations will be a critical challenge for advanced manufacturing companies.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
First-Line Supervisors		4,696	1.5%	331	35%	65%			27%	
49-1011	First-Line Supvsr., Mechanics, Install, & Repair	539	1.7%	150	34%	66%	31.04	1.01	30%	◀
51-1011	First-Line Supvsr., Production & Operating Workers	4,157	1.5%	181	36%	64%	26.30	0.93	25%	
Engineering Technicians		4,679	1.5%	225	18%	82%			25%	
17-3021	Aerospace Eng. & Operations Techs.	135	1.1%	8	11%	89%	31.99	1.00	29%	◀
17-3023	Electrical & Electronics Eng. Technicians	2,829	1.6%	122	17%	83%	31.56	1.03	24%	
17-3024	Electro-Mechanical Technicians	416	1.2%	15	5%	95%	30.97	1.21	24%	
17-3026	Industrial Engineering Technicians	618	1.5%	27	27%	73%	28.69	1.03	24%	
17-3027	Mechanical Engineering Technicians	326	1.6%	19	28%	72%	25.06	0.94	25%	
17-3029	Engineering Techs., Except Drafters, All Other	355	1.1%	34	15%	85%	27.13	0.90	26%	◀
Industrial Mechanics and Service Technicians		4,081	2.4%	431	38%	62%			27%	
49-2091	Avionics Technicians	63	2.2%	5	33%	67%	26.15	0.86	20%	
49-3011	Aircraft Mechanics & Service Technicians	169	2.1%	43	27%	73%	27.00	0.91	20%	
49-3042	Mobile Heavy Equip. Mechanics, Except Engines	84	0.9%	49	11%	89%	23.49	1.00	27%	◀
49-9041	Industrial Machinery Mechanics	2,735	3.4%	276	45%	55%	26.27	1.05	28%	◀
49-9043	Maintenance Workers, Machinery	561	2.2%	34	49%	51%	22.09	1.02	28%	◀
49-9044	Millwrights	471	0.0%	23	11%	89%	25.08	0.94	33%	◀

ADVANCED MANUFACTURING CONTINUED

EDUCATION AND TRAINING RECOMMENDATIONS

The manufacturing sector has long relied on traditional training models. However, the rate of technological change that the sector is undergoing will necessitate a transformation of the training system that supports the sector. Yet, that transformation is not, in and of itself, sufficient for ensuring the success of the sector. Without a pipeline of interested students and workers, the sector cannot succeed. Any training strategy must be accompanied by a deliberate and well-targeted outreach campaign to ensure that training slots are filled with high-quality talent.

- **Apprenticeship coordinator.** Small and medium-sized manufacturers expressed interest in implementing apprenticeship programs at their facilities, but lacked the capacity to do so on their own. The employers we interviewed expressed interest in piloting an apprenticeship coordinator, who would serve multiple employers and help with program design and execution as well as with the recruitment of individuals into the programs.
- **Expansion of OMEP's Smart Talent program.** OMEP has demonstrated the success of its Smart Talent program that it developed and refined with the support of OTC. One of the key outcomes of the program is employers' ability to shorten onboarding and training time for new employees. The program also allows employers to refine their minimum entry requirements by strengthening the training infrastructure within the company, which in turn grows the applicant pool and helps address the industry's talent shortfall. The scaling up of this program can have a widespread, positive impact on addressing the talent needs of the industry as a whole. Fortunately, the program is now poised to be rolled out on a larger scale.
- **Regional employer consortiums.** As part of the OTC's investment in the BioPro and BioCatalyst training programs, Oregon Bio developed a playbook for industry engagement in the creation of industry-specific, agile training modules. This playbook should be made accessible to the various manufacturing associations across the state. Technical assistance could be offered to assist in building the capacity of the industry associations to fully leverage the playbook's content.
- **Industry-supported training and awareness programs.** Programs like the Pipeline at Linn-Benton Community College or the Baker Technical Institute in Eastern Oregon are examples of programs where industry has taken an active role in developing and delivering training and providing broader outreach and awareness campaign to reach students and potential workers in order to change negative perceptions about manufacturing, build awareness of the career opportunities in the sector, and attract people into the industry-related training programs. To encourage more programs like these, CTE funding needs to include resources for more comprehensive industry engagement and for adequate marketing.

INFORMATION TECHNOLOGY & DIGITAL SERVICES

The Information Technology and Digital Services (IT) sector includes software publishing, data processing and hosting, computer system design, and other such information services. In Oregon, the sector employs almost 35,000 people and consists of 4,274 establishments. The largest segment is computer system design, which accounts for just over half of the sector's employment.

Over the last decade, Oregon's IT sector has kept pace with the nation's. Between 2011 and 2016, the sector added almost 5,000 jobs. Over the next five years, Oregon's IT sector is expected to grow by another 14 percent, which is slightly slower than the US growth rate of 15 percent.

TRENDS AFFECTING TALENT

The shortage of tech talent continues. In the most recent CIO survey conducted by KPMG and Harvey Nash, 64 percent of US respondents reported that a lack of talent will prevent them from keeping up with the pace of change—the highest level since the Great Recession. Big data/analytics is the top skill in short supply, followed by project management.[38] (See Figure 60).

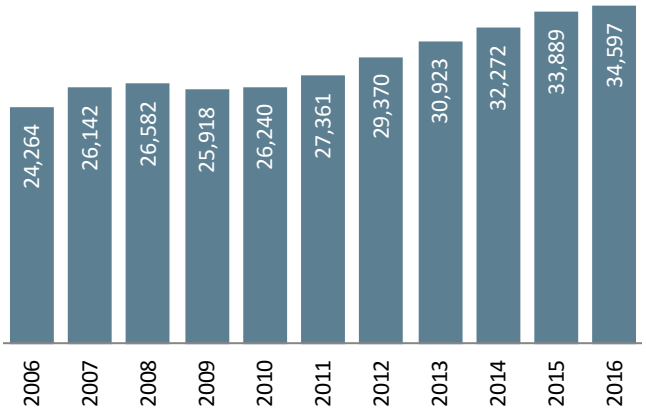
Rapid technological change is straining formal learning methods. The pace of new skill acquisition in response to technological change makes traditional credentials and years of experience less relevant for IT talent. Continuous learning, hands-on capabilities, and accomplishments often prove more important than credentials. In this context, IT talent must be able to demonstrate their ability to learn new skills and their knowledge of new technologies.[39]

Multi-skill, results-oriented teams, rather than functional silos, are the new normal. Traditionally, project teams in this sector have been organized by function and contribute to projects in a rigid sequence. This approach is often slow and encourages team members to focus only on small pieces of the project. The new model of multi-skill teams is focused on delivery desired outcomes rather than on a specific development step. This more holistic approach breaks down the functional silos and gives decision-making authority to the team, which ultimately preserve project momentum and

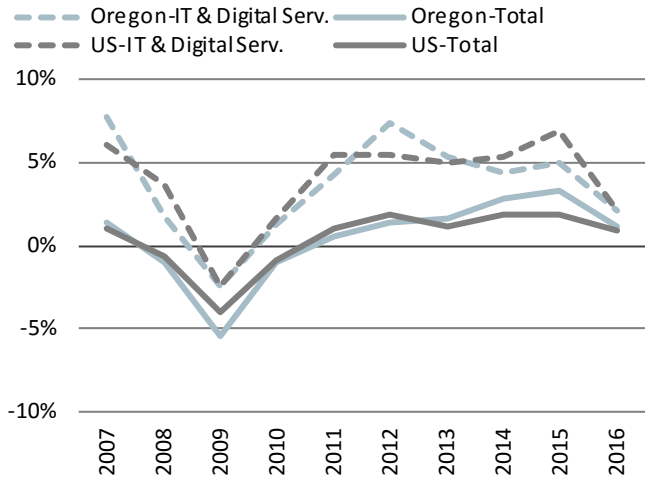
INDUSTRY SNAPSHOT

OREGON	TOTAL
# of Establishments (2016)	4,274
Number of Jobs (2016)	34,597
% Change 2011-2016	26%
Employment Growth Outlook (2016-2021)	
Oregon	14.3%
US	15.4%

EMPLOYMENT TRENDS, 2006-2016



COMPARATIVE GROWTH



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

[38] Harvey Nash/KPMG. CIO Survey 2016: the Creative CIO. Fall 2016
[39] Deloitte. IT Worker of the Future. Jan 2015.

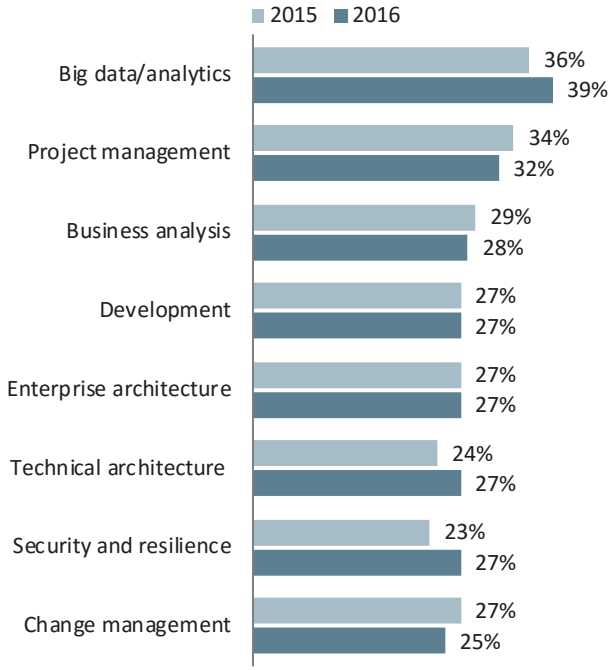
INFORMATION TECHNOLOGY CONTINUED

speeds up time to project completion.[40] This transformation means that today's IT talent must have strong communications skills as well as the ability to work in teams.

Widespread automation in the IT space will continue to accelerate. In the IT sector, DevOps and autonomic platforms are actively automating tasks by applying new technologies to increase IT workers' abilities to handle complex workloads. The approaches to automation are varied and include robotic process automation, bots, cognitive automation, intelligent automation, and even cognitive agents.[41] This trend creates demand for workers with skills that can manage automation while replacing workers whose functions were repetitive or work-flow driven.

Cybersecurity has risen to the forefront of organizations' core functions. After years on the periphery, the rise of cloud computing has inadvertently thrust cybersecurity into high demand—a pattern that is likely to continue. While cyber-defense will remain important, a greater number of organizations are expected to go on the offensive with penetration testing, external audits, and investment in new security training platforms.[42] The cybersecurity threat landscape requires not only technological solutions, they require defensive and offensive solutions that involve a great deal of specialized talent and draw in more traditional players in the risk management space, including insurance companies.

FIGURE 60. TOP IN-DEMAND SKILLS, 2015-2016
CIO PERCEPTIONS



Source: Harvey Nash/KPMG. CIO Survey 2016

FIGURE 61. KEY FINDINGS – FORCES SHAPING THE TECH LANDSCAPE

Source: CompTIA. Cyberstates 2016.

[40] Deloitte. IT Unbounded: The Business Potential of IT Transformation. Feb 2017.
[41] IBID.
[42] CompTIA. Cyberstates 2016.

INFORMATION TECHNOLOGY CONTINUED

EMPLOYER INPUT

Oregon IT employers noted the following trends and their impact on the state's talent.

- **IT talent continues to be in short supply.** With rapidly evolving skills and emerging demand, IT occupations in areas such as cyber-security, data science, and even programming are difficult to fill both within the state and outside of the state.
- **The competition for key IT talent remains fierce with Silicon Valley remaining the top talent magnet.** Although Oregon has its share of top notch tech employers, the state's employers still report difficulty attracting the talent they need to fill certain key positions.
- **The speed at which IT skills are evolving requires an even more agile talent base that can quickly learn new skills.**
- **Specific skills that are hard to find include:**
  - Business intelligence skills that drive the ability to transform data into useable knowledge that drives business planning
  - Networking skills that create interconnected systems across devices and platforms
  - Cybersecurity workers who can assess and develop risk management plans and protocols, mitigate risk, repair breaches, and develop multi- faceted security interfaces
  - Customer interfacing development sills that cross mobile platforms

OCCUPATIONAL ANALYSIS

Of the 307 occupations identified in the Oregon Talent Plan, 45 occupations are employed in information technology companies. These occupations account for about 68 percent of total employment for IT-centric industries. Figure 62 lists the top industry clusters for the sector by share of industry employment. Programmers and developers is the top cluster, followed by systems and data administration, and systems architects and analysts.

FIGURE 62. TOP OCCUPATIONAL CLUSTERS
BY SHARE OF INDUSTRY EMPLOYMENT

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Systems and Data Administration	16,651	1.4%	504	45%	55%	15%	
Systems Architects and Analysts	13,334	2.1%	415	54%	46%	18%	
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Digital Media and Design	6,746	1.2%	216	25%	75%	21%	
Human Resource Managment	12,408	1.9%	493	32%	68%	23%	
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀
Data Scientist	3,136	2.9%	138	56%	44%	21%	
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Above average growth highlighted in blue, wages premiums above 10% of US average highlighted in gray, more than 25% of workforce 55 years old or great marked with red triangle, top 10% of demand categories highlighted in orange.

INFORMATION TECHNOLOGY CONTINUED

The fastest growing occupations highlight the emerging trends – cybersecurity, data-enabled analysis, and the skills needed to deploy networks of interconnected devices.

FIGURE 63. FASTEST GROWING OCCUPATIONS

SOC Code	Description	Share of Industry Employment	2016 Jobs	% Change (2016-21)	LQ (US= 1.00)	Median Hourly Earnings	Relative to US (US=1.00)
17-2072	Electronics Engineers, Except Computer	0.3%	1,406	44%	0.77	44.14	0.92
15-1122	Information Security Analysts	0.0%	695	35%	0.58	43.63	1.00
15-2031	Operations Research Analysts	0.1%	991	34%	0.73	35.74	0.93
13-1161	Market Research Analysts & Mktng. Specialist	0.6%	5,527	34%	0.77	26.83	0.88
15-1121	Computer Systems Analysts	0.4%	5,532	32%	0.72	38.82	0.94
13-1051	Cost Estimators	0.0%	3,717	31%	1.23	27.97	0.96
17-1021	Cartographers & Photogrammetrists	0.0%	439	30%	2.64	28.30	0.94
15-1111	Computer & Info. Research Scientists	0.0%	413	29%	1.15	62.90	1.18
17-2071	Electrical Engineers	0.5%	2,491	28%	1.05	40.49	0.89
15-1134	Web Developers	0.1%	3,801	26%	1.72	26.60	0.90

Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Above average growth highlighted in blue, wages premiums above 10% of US average highlighted in gray, more than 25% of workforce 55 years old or great marked with red triangle, top 10% of demand categories highlighted in orange.

These 45 occupations were then analyzed based on multiple factors affecting the demand for jobs:

- The overall number of jobs
- The growth rate of jobs as measured by the past two-year growth and projected 10-year growth
- The number of projected annual openings
- The percent of workers over age 55
- The location quotient or concentration of jobs as compared to the national average
- The demand of an occupation due to the growth of Oregon's industry as compared to the national growth of the industry

These factors were combined and weighted to develop a total demand score for each occupation. Occupations were then grouped into related jobs. These groupings were then verified through employer input throughout the state. The final step was to group jobs into related clusters of occupations within one of three categories:

- **Emerging and Evolutionary Occupations.** Those occupations experiencing new to market or rapidly changing skills along with high growth rates. High demand due to competitive pressures with less defined skills due to the evolutionary nature of the job.
- **Competitive and Steady Demand Occupations.** Those occupations that have steady demand (average growth rates) with more consistently defined skills likely requiring some level of upskilling and a blend of new and replacement jobs.
- **Transitional and Mission-Critical Occupations.** Those occupations that have lower than average growth rates, higher retirement exposure and other factors that lead to more replacement jobs than new jobs.

INFORMATION TECHNOLOGY CONTINUED

EMERGING AND EVOLUTIONARY OCCUPATIONS

Systems Architects and Analysts. The systems architect and analysts occupational cluster is one of the largest and most rapidly growing segments of the IT talent base.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
Systems Architects and Analysts		3,613	2.1%	415	54%	46%			18%
15-1111	Computer & Info. Research Scientists	203	2.0%	13	55%	45%	68.66	1.18	16%
15-1121	Computer Systems Analysts	1,866	2.8%	242	65%	35%	39.84	0.94	20%
15-1122	Information Security Analysts	195	2.8%	30	65%	35%	46.65	1.00	20%
15-1199	Computer Occupations, All Other	1,349	1.4%	130	30%	70%	39.33	0.92	16%

Digital Media and Design. A smaller occupational cluster, yet rapidly growing (outside of graphic design) is the digital media and design cluster.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
Digital Media and Design		534	1.1%	205	25%	75%			21%
27-1014	Multimedia Artists & Animators	313	2.7%	44	41%	59%	26.97	0.99	19%
27-1024	Graphic Designers	209	0.6%	142	19%	81%	21.66	0.94	21%
27-3099	Media & Communication Workers, All Other	12	1.9%	18	34%	66%	20.26	0.85	21%
27-4032	Film & Video Editors	10	5.7%	23	76%	24%	22.36	0.66	13%

COMPETITIVE AND STEADY DEMAND OCCUPATIONS

Programmers and Developers. At the heart of the IT sector is the programmers and developers occupational cluster. This is the largest cluster in the sector. It also has the greatest need for talent. This need is exacerbated by the fact that this cluster has become one of the key cross-industry clusters as well.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
Programmers and Developers		10,895	2.3%	790	51%	49%			13%
15-1131	Computer Programmers	1,783	0.7%	113	20%	80%	35.25	0.91	18%
15-1132	Software Developers, Applications	5,916	2.6%	394	55%	45%	46.93	0.96	13%
15-1133	Software Developers, Systems Software	1,671	1.9%	128	50%	50%	48.52	0.94	13%
15-1134	Web Developers	1,526	3.2%	156	64%	36%	28.04	0.90	8%

INFORMATION TECHNOLOGY CONTINUED

Systems and Data Administration. The second largest cluster is systems and data administration. This cluster has a fairly even split between new demand and replacement demand.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
Systems and Data Administration		4,014	1.4%	504	45%	55%			15%
15-1141	Database Administrators	241	2.5%	50	44%	56%	41.01	1.03	18%
15-1142	Network & Computer Systems Admin.	713	1.9%	112	50%	50%	35.16	0.91	14%
15-1143	Computer Network Architects	319	1.4%	38	45%	55%	55.75	1.07	13%
15-1151	Computer User Support Specialists	2,263	1.3%	249	43%	57%	24.28	0.96	16%
15-1152	Computer Network Support Specialists	479	0.8%	55	41%	59%	28.99	0.92	16%

TRANSITIONAL AND MISSION-CRITICAL OCCUPATIONS

Human Resource Management has become a more critical occupational cluster as the talent shortage in the sector has become more acute. In addition, the workforce within certain occupations in the **Business Finance and Compliance** cluster are potentially facing a wave of retirements and these occupations are critical to the management of IT companies.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Human Resource Managment		509	2.2%	456	36%	64%			22%	
13-1071	Human Resources Specialists	262	2.0%	262	33%	67%	28.07	0.92	20%	
13-1141	Compensation & Benefits Specialists	32	2.6%	46	43%	57%	30.69	0.98	23%	
13-1151	Training & Development Specialists	214	2.3%	148	39%	61%	28.44	0.94	24%	
Business Finance and Compliance		480	2.4%	997	38%	62%			29%	
13-1041	Compliance Officers	50	1.9%	91	49%	51%	31.83	0.97	30%	◀
13-2011	Accountants & Auditors	384	2.6%	717	38%	62%	30.33	0.88	28%	◀
13-2099	Financial Specialists, All Other	35	1.8%	40	55%	45%	33.10	0.98	22%	

EDUCATION AND TRAINING RECOMMENDATIONS

IT skills and occupations are among the most rapidly changing, and much of the continued skill development can be described as a "learn by doing model." Tech-based employers and industry association have recommended the following types of training investments.

- **Support the capacity of learning labs.** Learning labs are places where companies, new technologies and workers come together to refine the deployment of technologies while simultaneously identifying key skills. Organizations like Oregon Story Board provide a dynamic and real-time training environment applied to projects and problems. Companies with new technologies use organizations like this to test applications of their products while building the skills of people doing the testing. Industry would like to see matching grants and scholarships provided to learning labs.

INFORMATION TECHNOLOGY CONTINUED

- **Encourage cross-fertilization of training programs.** Tech workers tend to think about ongoing skill development as part of their job, and often work through peer groups and informal methods to learn new technologies. IT, data analytics, and programming skills are being taught by an array of educational providers, industry groups and vendors. Yet, there is not one information portal where workers can find out who is doing what in terms of training or peer groups. Workers in this industry would like to see, at a minimum, better cross-linking of events and training programs among the key industry and professional groups.
- **Actively recruit diversity.** Tech workers do not tend to be diverse, yet the products and apps they develop serve a wide array of cultures. The Technology Association of Oregon, along with three metro-area workforce boards, are embarking on a three-part strategy to increase the diversity of the tech workforce. Efforts from this project may showcase efforts that can cost-effectively scale across other parts of Oregon.
- **Increase apprenticeships for IT.** Apprenticeships can be a cost-effective way for workers to receive an applied education and employers to foster and retain new hires. Oregon's tech industry is interested in piloting apprenticeship programs as an alternative path to an entry-level technology jobs.

ENERGY

The Energy sector includes renewables, other utilities, and energy-related services. In Oregon, the sector employs about 19,000 people and consists of 1,700 establishments. The largest segment is energy-related services, which includes engineering services and accounts for three-quarters of the sector's employment.

During the first half of the last decade, Oregon's energy sector mirrored that of the nation. However, since 2012, the state's sector has largely outperformed the nation's. Between 2011 and 2016, the sector added about 1,700 jobs. Over the next five years, Oregon's energy sector is expected to grow by another 8 percent, which is higher than the US growth rate of 6 percent. In Oregon, the vast majority of the power generation capacity is hydroelectric, producing 3,488 MWh. Natural gas accounts for the next largest share at 1,523 MWh. Other renewables currently account for slightly less than coal-fired capacity.

Oregon's energy sector is a key component of the state's g competitive advantage in manufacturing, and its renewable energy resources enables the growth of smart cities and the deployment of clean technologies. According to a study by Power Oregon, the state spends $800 per biennium on energy policy with no associated talent strategy to guide and implement those expenditures.

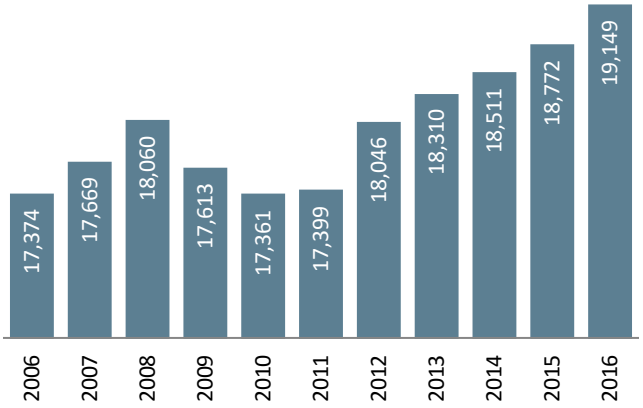
TRENDS AFFECTING TALENT

Generation is continuing to shift towards natural gas and renewables. Most of the new generation assets coming online are solar, natural gas, or wind. As these new installations come online, existing coal and nuclear assets are devaluing. The shift is likely to continue even in the face of uncertain federal policies because of the shift in consumer interest in renewable resources, the continued low price of natural gas, and the rapidly declining installed costs of renewables.[43] In Oregon, natural gas, solar and wind are all expected to add considerable capacity over the next five year.[44,45,46]

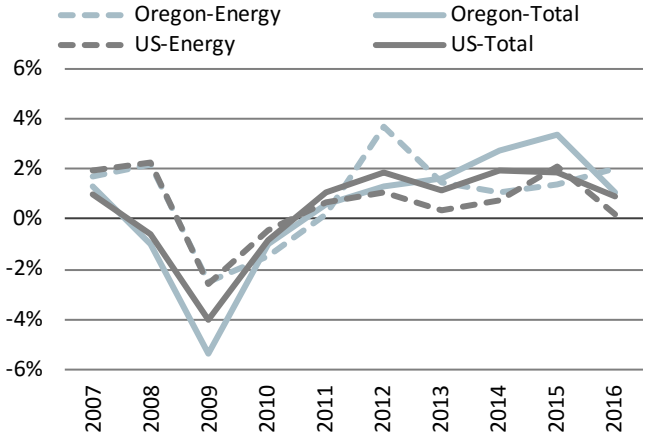
INDUSTRY SNAPSHOT

OREGON	TOTAL
# of Establishments (2016)	1,708
Number of Jobs (2016)	19,149
% Change 2011-2016	10%
Employment Growth Outlook (2016-2021)	
Oregon	7.8%
US	6.0%

EMPLOYMENT TRENDS, 2006-2016



COMPARATIVE GROWTH



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

[43] Navigant. "Take Control of your Future Part IV: Power Generation Shift." May 2016
[44] Northwest Gas Association. 2016 Outlook.
[45] SEIA. Oregon State Profile. Q4 2016
[46] American Wind Energy Association. Oregon State Profile. 2016

ENERGY CONTINUED

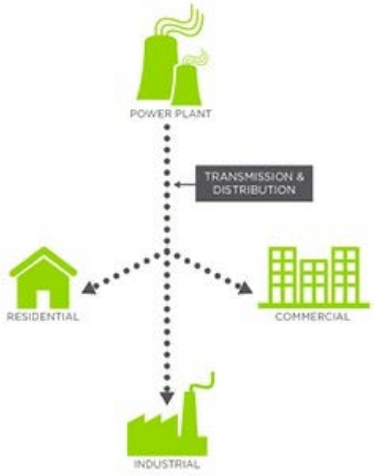
Distributed generation (DG) is reaching critical mass. Navigant estimated DG installations to reach 19 GW by 2016. In fact, distributed generation is growing faster than central station generation. Between 2015 and 2019, DG in the US grew almost twice as fast as central generation.[47] The growth of distributed generation necessitates greater flexibility in the power grid, requiring new equipment, more complex market transactions, and a decentralized model for managing the grid.[48]

Sophisticated energy management requires networks of intelligent and connected devices. Business and residential customers alike are increasingly interested in managing their energy use patterns.[49] The practical implication of this means new technology adoption and the associated Big Data. Both utilities and business customers are using data to more accurately predict demand and uncover more granularity in consumption patterns. These insights are changing how the demand-side manages consumption and how the supply-side manages generation, distribution, and transmission. These activities require complex digital systems-monitoring and maintenance as well as data storage, management and analytics increasing the need for IT talent in the sector.

The Energy Cloud is emerging. As DG and Smart Grid technologies take hold, a new energy cloud is emerging. The energy cloud is a platform with two-way power flows and intelligent grid architecture. This transformation is fueling innovation in the energy sector and dramatically changing the workforce needs of the industry on many fronts.

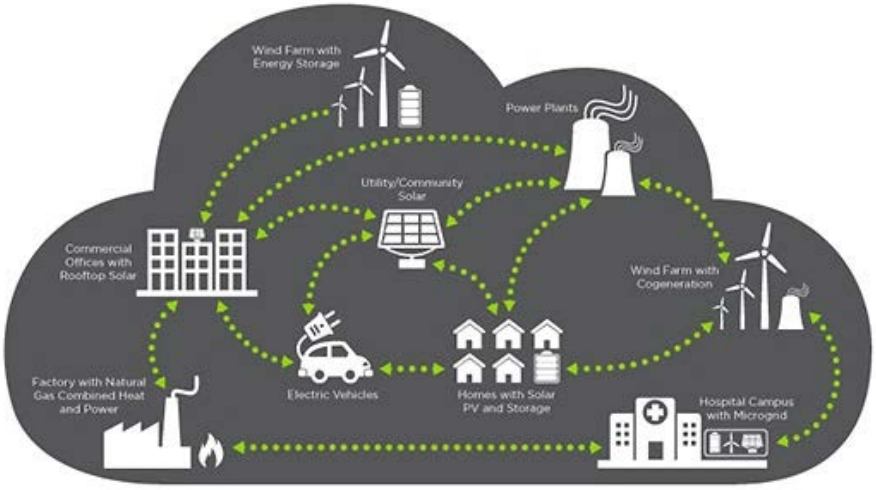
FIGURE 64. THE EMERGING ENERGY CLOUD

TODAY: ONE-WAY POWER SYSTEM



- Large, centrally located generation facilities
- Designed for one-way energy glow
- Utility controlled
- Technologically inflexible
- Simple market structures and transactions
- Highly regulated (rate base) and pass through

EMERGING: ENERGY CLOUD



- Distributed energy resources
- Multiple inputs and users, supporting two-way energy flows
- Digitalization of the electric-mechanical infrastructures-smart grid and behind the meter energy management systems
- Flexible, dynamic and resilient
- Complex market structures and transactions
- Regulation changing rapidly around renewables, distributed generation (solar, microgrid, storage), net metering, etc.

Source: Navigant Consulting. ©2016 Navigant Consulting, Inc.

[47] Navigant.
[48] GE Power. 5 Energy Trends in 2017.
[49] PWC. 2017 Power and Utilities Trends.

ENERGY CONTINUED

The greater acceptance of energy efficiency, advances in power technology, and the retailization of the power grid necessitate a new service-based business model in the utility segment. Smart grid, distributed power, energy storage, analytics software, and intelligent substations are among the new technologies fundamentally changing the way utilities serve their customers. To capitalize on emerging market opportunities, utilities will need to provide such services as alternative generation sources, energy storage, equipment replacement, sensor-based energy monitoring systems, software-based data analytics, facilities management services, and the infrastructure to support all of these innovations.[50] This transformation will significantly influence the workforce needs of the energy sector. Although many of the basic competencies will change, additional competencies will be required.[51] Influential changes include transitions from mechanical to digital, from industrial process management to dynamic systems monitoring, from technician to technologist, and from meter reader to customer service representative. These transitions will require a skills reboot or upskilling for the incumbent energy workforce.

The utility workforce is getting younger (finally!) but a large number of retirements will heighten demand. The aging workforce has long been a concern for utilities as key jobs face a tidal wave of retirements. Deliberate talent pipeline development over the past decade and the fact that many retirements have already taken place has led to a notable decrease in the average age of utility workers. While this trend is positive, an estimated 34 percent of key jobs are likely to need filling by 2019 based on projected attrition and retirements.[52]

EMPLOYER INPUT

Oregon's energy employers noted the following trends and their impact on the state's talent.

- The wave of retirements facing utility companies remains a critical issue.
- The demand for workers with networking, data science, and data analytics skills is high and rising.
- The solar segment is gaining momentum in the state, necessitating an emergent talent base of installers, technicians, and maintenance workers capable of supporting a wide range of residential and commercial solar arrays.

OCCUPATIONAL ANALYSIS

Of the 307 occupations identified in the Oregon Talent Plan, 130 occupations are employed in energy companies. These occupations account for about 69 percent of total employment in the industry. Figure 65 lists the top industry clusters for the sector by share of industry employment. Interdisciplinary engineering is the top cluster, followed by data-enabled analysts, and plant and field technicians.

Figure 66 shows the sector's fastest growing industries. This list includes occupations related to wind-energy, statisticians, and a range of different scientists.

[50] PWC. 2017 Power and Utilities Trends.
[51] Center for Energy Workforce Development. The Smart Grid Evolution: Impact on Skilled Utility Technician Positions.
[52] Center for Energy Workforce Development. 2015 Survey

ENERGY CONTINUED

FIGURE 65. TOP OCCUPATIONAL CLUSTERS
BY SHARE OF INDUSTRY EMPLOYMENT

	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
Description	2016 Jobs	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Interdisciplinary Engineering	17,532	1.6%	606	21%	79%	22%	
Data-Enabled Analysts	33,089	2.3%	1,117	53%	47%	25%	◀
Plant and Field Technicians - Energy	1,696	2.1%	100	30%	70%	23%	
Engineering Technicians	7,309	1.5%	225	18%	82%	25%	
Bioscientists and Engineers	3,511	0.1%	123	18%	82%	18%	
Programmers and Developers	22,417	2.3%	790	51%	49%	13%	
Engineering Support	2,305	1.3%	35	14%	86%	25%	◀
Environmental Engineering and Science	2,336	2.4%	129	37%	63%	25%	
Medical and Life Sciences	2,773	-0.8%	127	16%	84%	18%	
Business Finance and Compliance	22,559	2.4%	997	38%	62%	29%	◀

FIGURE 66. FASTEST GROWING OCCUPATIONS

SOC Code	Description	Share of Industry Employment	2016 Jobs	% Change (2016-21)	LQ (US= 1.00)	Median Hourly Earnings	Relative to US (US=1.00)	
49-9081	Wind Turbine Service Technicians	0.0%	65	44%	0.79	21.99	0.97	
19-2012	Physicists	0.0%	73	35%	0.34	60.64	1.11	●
19-1021	Biochemists & Biophysicists	0.2%	122	34%	0.29	30.89	0.76	×
51-8031	Water/WW Treatment Plant Operators	0.0%	1,199	34%	0.80	26.11	1.16	●
15-2041	Statisticians	0.1%	509	32%	1.18	32.57	0.84	
19-4031	Chemical Technicians	0.6%	328	31%	0.38	19.01	0.88	
19-2031	Chemists	1.1%	685	30%	0.61	30.18	0.87	
17-2011	Aerospace Engineers	0.1%	171	29%	0.19	40.90	0.77	×
49-2022	Telecomm. Equip. Install./Repair, Exc. Line Ins	0.0%	2,934	28%	0.99	28.81	1.09	
19-2032	Materials Scientists	0.0%	55	26%	0.60	38.56	0.88	

Source (both figures on this page): Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Above average growth highlighted in blue, wages premiums above 10% of US average highlighted in gray, more than 25% of workforce 55 years old or great marked with red triangle, top 10% of demand categories highlighted in orange.

These 130 occupations were analyzed based on multiple factors affecting the demand for jobs:

- The overall number of jobs
- The growth rate of jobs as measured by the past two-year growth and projected 10-year growth
- The number of projected annual openings
- The percent of workers over age 55
- The location quotient or concentration of jobs as compared to the national average
- The demand of an occupation due to the growth of Oregon's industry as compared to the national growth of the industry

ENERGY CONTINUED

These factors were combined and weighted to develop a total demand score for each occupation. These occupations were then grouped into related jobs. These groupings were then verified through employer input throughout the state. The final step was to group jobs into related clusters of occupations within one of three categories:

- **Emerging and Evolutionary Occupations.** Those occupations experiencing new to market or rapidly changing skills along with high growth rates. High demand due to competitive pressures with less defined skills due to the evolutionary nature of the job.
- **Competitive and Steady Demand Occupations.** Those occupations that have steady demand (average growth rates) with more consistently defined skills likely requiring some level of upskilling and a blend of new and replacement jobs.
- **Transitional and Mission-Critical Occupations.** Those occupations that have lower than average growth rates, higher retirement exposure and other factors that lead to more replacement jobs than new jobs.

EMERGING AND EVOLUTIONARY OCCUPATIONS

The Energy IT Team. The deployment and management of the energy cloud, smart grid technologies, and demand management require a robust IT team. These teams must be able to connect devices, warehouse data, extract and analyze information, and develop user-friendly platforms to enable the advanced analytics that underpin data-driven decision-making.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Data-Enabled Analysts		1,031	2.3%	1,117	53%	47%			25%	
13-1111	Management Analysts	491	2.6%	316	56%	44%	34.40	0.86	35%	◀
13-1161	Market Research Analysts & Mktng. Specialists	147	3.5%	247	68%	32%	30.25	0.88	15%	
13-1199	Business Operations Specialists, All Other	315	1.8%	366	48%	52%	32.29	0.90	25%	◀
13-2031	Budget Analysts	24	1.5%	31	29%	71%	33.58	0.94	24%	
13-2041	Credit Analysts	<10	1.6%	44	22%	78%	35.57	0.98	14%	
13-2051	Financial Analysts	53	2.2%	112	46%	54%	44.77	0.96	13%	
Programmers and Developers		510	2.3%	790	51%	49%			13%	
15-1131	Computer Programmers	55	0.7%	113	20%	80%	35.25	0.91	18%	
15-1132	Software Developers, Applications	233	2.6%	394	55%	45%	46.93	0.96	13%	
15-1133	Software Developers, Systems Software	184	1.9%	128	50%	50%	48.52	0.94	13%	
15-1134	Web Developers	38	3.2%	156	64%	36%	28.04	0.90	8%	
Systems Architects and Analysts		308	2.1%	415	54%	46%			18%	
15-1111	Computer & Info. Research Scientists	37	2.0%	13	55%	45%	68.66	1.18	16%	
15-1121	Computer Systems Analysts	134	2.8%	242	65%	35%	39.84	0.94	20%	
15-1122	Information Security Analysts	32	2.8%	30	65%	35%	46.65	1.00	20%	
15-1199	Computer Occupations, All Other	105	1.4%	130	30%	70%	39.33	0.92	16%	
Systems and Data Administration		292	1.4%	504	45%	55%			15%	
15-1141	Database Administrators	29	2.5%	50	44%	56%	41.01	1.03	18%	
15-1142	Network & Computer Systems Admin.	94	1.9%	112	50%	50%	35.16	0.91	14%	
15-1143	Computer Network Architects	36	1.4%	38	45%	55%	55.75	1.07	13%	
15-1151	Computer User Support Specialists	104	1.3%	249	43%	57%	24.28	0.96	16%	
15-1152	Computer Network Support Specialists	29	0.8%	55	41%	59%	28.99	0.92	16%	

ENERGY CONTINUED

Environmental Engineering and Science. The environmental engineering and science cluster plays a small yet critical role in the energy sector, particularly in the renewables and energy technologies segments. This cluster is growing rapidly, but the demand is weighted toward replacement jobs.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Environmental Engineering and Science		361	2.4%	129	37%	63%			25%	
17-2081	Environmental Engineers	163	2.6%	35	38%	62%	41.30	1.01	22%	
17-3025	Environmental Engineering Techs.	50	2.3%	11	38%	62%	27.35	1.15	23%	
19-2041	Environmental Scientists & Specialists, Incl. Health	111	2.4%	61	39%	61%	34.13	1.00	27%	◀
19-4091	Env. Science & Protection Techs., Incl. Health	38	2.1%	22	28%	72%	23.77	1.13	23%	

COMPETITIVE AND STEADY DEMAND OCCUPATIONS

Interdisciplinary Engineering. This group of interdisciplinary engineers is a key component of the rapidly evolving energy sector. In fact, the sector is increasingly demanding a base of mechanical and electrical engineers with cross-functional knowledge.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Interdisciplinary Engineering		1,817	1.6%	606	21%	79%			22%	
17-2061	Computer Hardware Engineers	133	0.8%	74	0%	100%	62.06	1.08	15%	
17-2071	Electrical Engineers	491	1.9%	86	32%	68%	43.10	0.89	24%	
17-2072	Electronics Engineers, Except Computer	101	1.6%	46	29%	71%	44.69	0.92	23%	
17-2112	Industrial Engineers	127	2.2%	154	30%	70%	48.31	1.15	24%	
17-2141	Mechanical Engineers	637	1.8%	168	23%	77%	42.10	1.02	22%	
17-2199	Engineers, All Other	328	1.4%	77	25%	75%	44.47	0.93	28%	◀

TRANSITIONAL AND MISSION-CRITICAL OCCUPATIONS

Plant Operators and Field Technicians. Most of the different types of plant operators and field technicians are facing the challenge of an aging workforce.

ENERGY CONTINUED

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	PROJECTED OPENINGS: New jobs	PROJECTED OPENINGS: Replacement	WAGE ENVIRONMENT: Average Hourly Wages	WAGE ENVIRONMENT: Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years	
Plant and Field Technicians - Energy		771	2.0%	94	29%	71%			22%	
49-9051	Electrical Power-Line Installers & Repairers	453	2.5%	65	26%	74%	42.04	1.31	18%	
49-9081	Wind Turbine Service Technicians	17	2.4%	8	80%	20%	22.33	0.97	28%	◀
51-8013	Power Plant Operators	230	0.4%	17	23%	77%	34.47	1.01	30%	◀
51-8092	Gas Plant Operators	72	1.4%	4	4%	96%	35.18	1.12	40%	◀
Plant and Systems Operators		139	0.9%	69	18%	82%			33%	
51-8021	Stationary Engineers & Boiler Operators	16	0.8%	16	13%	87%	26.56	0.92	36%	◀
51-8031	Water/WW Treatment Plant Operators	107	0.9%	43	25%	75%	26.12	1.16	33%	◀
51-8099	Plant & System Operators, All Other	16	1.0%	10	1%	99%	24.31	0.88	28%	◀

Engineering Technicians. The need for engineering technicians is driven by replacement demand, though not because of an aging workforce.

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	PROJECTED OPENINGS: New jobs	PROJECTED OPENINGS: Replacement	WAGE ENVIRONMENT: Average Hourly Wages	WAGE ENVIRONMENT: Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years	
Engineering Technicians		610	1.5%	225	18%	82%			25%	
17-3021	Aerospace Eng. & Operations Techs.	60	1.1%	8	11%	89%	31.99	1.00	29%	◀
17-3023	Electrical & Electronics Eng. Technicians	310	1.6%	122	17%	83%	31.56	1.03	24%	
17-3024	Electro-Mechanical Technicians	35	1.2%	15	5%	95%	30.97	1.21	24%	
17-3026	Industrial Engineering Technicians	12	1.5%	27	27%	73%	28.69	1.03	24%	
17-3027	Mechanical Engineering Technicians	79	1.6%	19	28%	72%	25.06	0.94	25%	
17-3029	Engineering Techs., Except Drafters, All Other	114	1.1%	34	15%	85%	27.13	0.90	26%	◀

EDUCATION AND TRAINING RECOMMENDATIONS

Utilities have long used the industry consortia model to address its workforce needs, especially when addressing the pending waves of retirement. The industry is seeing the success of its collective and persistent efforts, especially in the training of linemen—one of its most at-risk occupations. Yet, the utilities segment suffers from some of the same negative perception issues that manufacturing suffers from while the renewables segment has garnered a lot of "buzz" in recent years.

As the energy sector works to develop its talent pipeline to address its current workforce challenges, the sector is on the brink of transformation as distributed energy models become more viable and energy companies reinvent themselves. The sector will need to be diligent about its forward-looking incumbent worker training to be prepared for this transformation at the same time it works to fill existing positions vacated by retiring workers.

- **Regional employer consortiums.** The Center for Energy Workforce Development (CEWD) has a network of state energy workforce consortia. Oregon's Energy Consortium is currently inactive, but is evaluating working with Washington on a regional consortium. In any case, the CEWD has developed many different curricula to support the development and advancement of the nation's energy workforce. Re-activating the consortium and evaluating

ENERGY CONTINUED

the curricula to identify any training gaps should be a starting place. In addition, using the BioPro training model and industry engagement playbook could help establish a training program to promote new skills, such as IT skills, now needed for the energy workforce.

- **Apprenticeship programs.** Apprenticeship programs are an effective means of transferring knowledge in the workplace. Promote the use of apprentices in the energy sector to assist cultivating a pipeline of talent as aging workers transition out.
- **Spotlight on solar.** Oregon is among the states with the highest reported difficulty in hiring qualified solar workers. The Solar Training Network provides training resources and a directory of solar training providers and maintains an online platform: SolarTrainingUSA.org. Focusing on this specific talent gap using agile training models will support this emerging sector's growth in the state.

BIOSCIENCE

With almost 19,000 jobs and over 1,250 firms, the Oregon bioscience industry is growing at a rate higher than the state's overall economic growth and higher than bioscience across the US. The projected outlook for the next five years in that Oregon's bioscience industry will continue to outpace the nation, and Oregon's bioscience talent will be in high demand given the industry's accelerated growth.

TRENDS AFFECTING TALENT

The bioscience industry continues to be one of innovative advancements amid a regulatory framework. Leading-edge technologies such as artificial intelligence, virtual reality, and data analytics alongside advancements in materials and sensors are fundamentally changing bioscience across the board—from pharmaceutical to medical device companies. The following are key trends noted by industry to have significant impact on the industry and its workforce.

Gene-editing tools (e.g., CRISPR) and DNA-copying technology are on the rise.[53] The recent advancements in technologies that allows permanent modification of genes within organisms are opening new doors to a variety of applications in research, disease treatment and plant biotechnology.

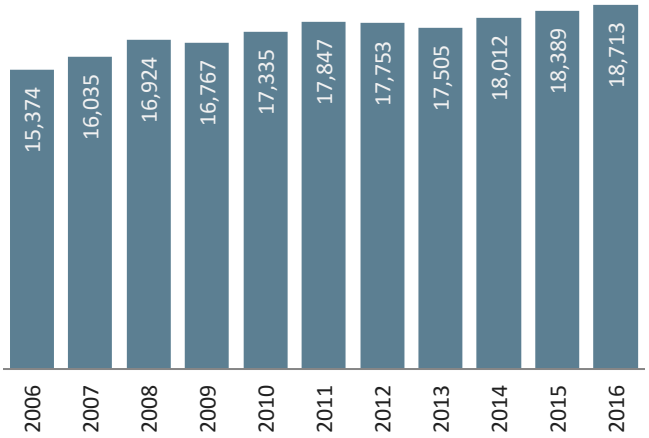
Immuno-oncology (I-O) uses drugs known as immunotherapies that uses your body's immune system to help fight cancer instead of chemotherapy and radiation. The use of I-O is said to be one of the fastest growing areas of cancer research and treatment.[54]

3-D printing or additive manufacturing goes to a new level. 3-D printing is already playing an important role when it comes to prototyping and providing anatomical models of patient anatomy to help surgeons prepare. Increasingly it is being used all across the development cycle. Johnson & Johnson has forged 3-D printing partnerships with Hewlett Packard, as well as Google-backed Carbon and its high-speed CLIP (Continuous Liquid Interface Production) process in which objects rise out of ultra high-performance urethanes.[55] A breakthrough at the University of Bristol has allowed for

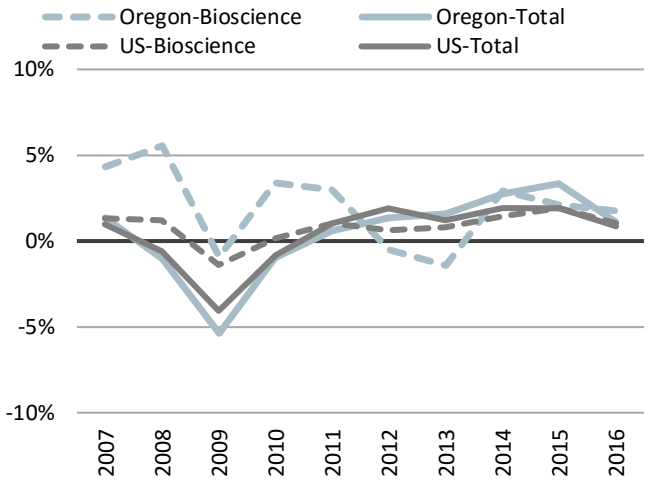
INDUSTRY SNAPSHOT

OREGON	TOTAL
# of Establishments (2016)	1,262
Number of Jobs (2016)	18,713
% Change 2011-2016	5%
Employment Growth Outlook (2016-2021)	
Oregon	9.0%
US	6.8%

EMPLOYMENT TRENDS, 2006-2016



COMPARATIVE GROWTH



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

[53] Becker's Information, Written by Mackenzie Bean, January 05, 2017
[54] Investing News Network: Bioscience
[55] Newmaker, Chris, QMed, "10 hot MedTech Industry Trends" August 30, 2016

BIOSCIENCE CONTINUED

printing with living cells to create human tissue--a major medical technology goal that had been a complex challenge to solve.

The use of surgical robots and sensors continue to expand as instruments translate a surgeon's hand movement into precise movements inside the body or provide real-time feedback during procedures. Such advances require developers of these tools to have an understanding of anatomy and biology as well as robotics and artificial intelligence

Advances in material science and implant technologies expand across diagnostic and therapeutic applications. According to the University of Illinois at Urbana-Champaign and the Washington University School of Medicine in St. Louis, tiny sensors made from thin sheets of silicon are able to monitor temperature and pressure inside the skull, then melt away after they've done their job. the trend indicates implantable rice-grain-sized sensors that they can remain functional during a healing and recovery period—then dissolve and disappear, eliminating the need for additional surgeries.

Using devices instead of drugs to manage pain. The use of electroencephalogram (EEG) and transcranial current stimulation to help diagnose and improve brain function in patients with various conditions, such as those suffering from chronic pain or recovering from a stroke. In efforts to limit pharmaceutical painkillers like opioids, the use of electrical stimulation is gaining new ground.

Software enabled detection enabling mobile diagnostics. Software is allowing for more on-demand and cost-effective detection for issues like Traumatic Brain injury where expensive, complex medical equipment used to diagnose TBIs—like CT or MRI scanners—is not easily accessible in many situations. New software used with common, portable ultrasound equipment can produce 3-D images of accurate brain scans.

Digital Health. Healthcare reforms have incentivized health providers to be more concerned about how efficiently and effectively they manage patient populations, leading to a rapid growth in digital health analytics. In fact, venture capital database CB Insights reported in June that digital health startups brought in $2.03 billion during the first quarter of 2016.[56] Digital health is not just used to target treatment, new uses include technologies for tracking whether patients are taking their meds.

Cybersecurity in all its forms. Cybersecurity is no longer just about protecting personal data. As Daniel Mooradian, PhD, of the University of Minnesota's Technological Leadership Institute Medical states, "devices have become increasingly vulnerable to hacking as they've become network aware". There is a significant unmet need for medical device manufacturers to design security into their medical devices, in part by inadequate basic cybersecurity knowledge of researchers and the lack of cybersecurity specialists as part of R&D teams.

Drug and device companies are getting into the service business—combining the right medicines with digital devices/sensors and human coaching to help people effectively conquer their illnesses and unhealthy habits. Users and clinicians are increasingly demanding more than just a product from medical device companies. According a PriceWaterhouse Health Research report, half of the 10 largest medtech companies are now selling services beyond their actual devices, and more have made a transition toward "services-based offerings." All of the ten companies provide customers with education and training.

[56] Ibid

BIOSCIENCE CONTINUED

EMPLOYER INPUT

Oregon bioscience employers in medical devices, digital health, and therapeutics noted the following trends and their impact on the state's talent.

- In all areas of bioscience, cybersecurity, software and big data are the new foundation skills.
- Advances in robotics, sensors and human-machine interfaces are driving the need for engineers and technicians with both biology/life science knowledge and mechatronics skills. Employers that hire engineers and engineering technician have reported an increasing need for workers that have a strong foundational knowledge of artificial intelligence, robotics and machine learning, alongside sensor connectivity and communication.
- Niche jobs in material sciences and biochemistry will be in high demand as diagnostics and therapeutics move to individualized and self-correcting solutions. Such major transformations in bioscience will not only require workers to have updated knowledge of these solutions, they will also need to have sharp critical and adaptive thinking skills.
- Traditional scientists will need updated skills in areas like applied data analytics along with medical ethics as genotyping and DNA copying advances. Not only will the industry need more data scientists with bio backgrounds, most scientists will need the ability to apply data in various aspects of their job (data-enabled decision making). This is compounded by a need to understand the implications of genomics on society, requiring not only a need for medical ethics knowledge but new jobs like genetic counselors.
- Demand for lab technicians will continue to be steady. While strong biology knowledge is a given, those with quality assurance, regulatory compliance, and applied IT skills will be at the top of the list for jobs. Employers noted that their strong desire for applied skills is why many seek lab technicians from community colleges over some of the state's four year programs.

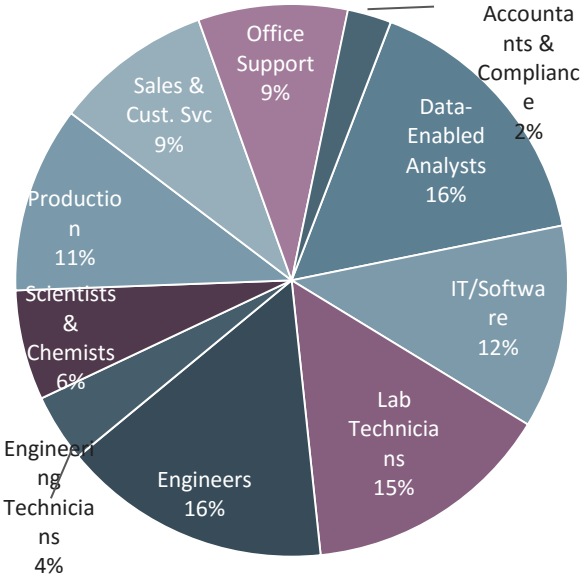
OCCUPATIONAL ANALYSIS

The following data analyzes key occupations in the Bioscience industries: Scientists and engineers, professional and IT occupations, and production and operational support positions.

Looking at the top 35 jobs that account for almost 60 percent of the industry's employment, the trend toward data-enabled occupations is clear. Operation positions that are data dependent (marketing analysts, management analysts, business operations specialists, etc. account for as many jobs as all types of engineers combined (mechanical, electrical, computer hardware, biomedical, etc.). Lab technicians and software and IT jobs round out the top list.

The jobs projected to grow the most over the next five years are overwhelmingly related to data and software. Figure 68 denotes the top 10 occupations with the highest projected growth rate.

FIGURE 67. DISTRIBUTION OF THE TOP 35 BIOSCIENCE JOBS



Source: Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.

BIOSCIENCE CONTINUED

FIGURE 68. FASTEST GROWING OCCUPATIONS
EXCLUDES EMPLOYMENT IN HOSPITALS AND UNIVERSITIES

SOC Code	Description	Share of Industry Employment	2016 Jobs	% Change (2016-21)	LQ (US= 1.00)	Median Hourly Earnings	Relative to US (US=1.00)	
15-2031	Operations Research Analysts	0.1%	991	44%	0.73	35.74	0.93	
41-3099	Sales Reps., Services, All Other	0.4%	8,462	35%	0.67	22.07	0.88	
15-2041	Statisticians	0.1%	509	34%	1.18	32.57	0.84	
19-1021	Biochemists & Biophysicists	0.2%	122	34%	0.29	30.89	0.76	✕
13-1161	Market Research Analysts & Mktng. Specialists	0.6%	5,527	32%	0.77	26.83	0.88	
29-2071	Medical Records & Health Info. Technicians	0.2%	2,779	31%	1.07	19.56	1.07	
19-2041	Environmental Scientists & Specialists, Incl. Healt	0.1%	1,065	30%	0.89	33.51	1.00	
17-2081	Environmental Engineers	0.1%	683	29%	0.97	41.27	1.01	
15-1134	Web Developers	0.1%	3,801	28%	1.72	26.60	0.90	
15-1141	Database Administrators	0.1%	1,134	26%	0.73	40.98	1.03	

FIGURE 69. TOP OCCUPATIONAL CLUSTERS
BY SHARE OF INDUSTRY EMPLOYMENT

Description	CRITICAL MASS	GROWTH	DEMAND FACTORS			RETIREMENT EXPOSURE	
	Estimated Jobs in Industry (2016)	Weighted Average Growth Rate	Projected Annual Openings (2016-21)	New jobs	Replacement	% 55+ Years	
Bioscience							
Lab Technicians	248	1.4%	177	34%	66%	27%	◀
Interdisciplinary Engineering	641	1.6%	606	21%	79%	22%	
Bioscientists and Engineers	103	0.1%	123	18%	82%	18%	
Engineering Technicians	157	1.5%	225	18%	82%	25%	
Data-Enabled Analysts	674	2.3%	1,117	53%	47%	25%	◀
Advanced Materials and Chemicals	42	1.6%	87	19%	81%	23%	
Diagonostic Technicans	69	2.1%	135	42%	58%	21%	
Programmers and Developers	408	2.3%	790	51%	49%	13%	
Medical and Life Sciences	38	-0.8%	127	16%	84%	18%	
Systems and Data Administration	203	1.4%	504	45%	55%	15%	

Source (both charts on this page): Oregon Employment Department and EMSI 2017.1–QCEW Employees, Non-QCEW Employees, & Self-Employed.
Note: Above average growth highlighted in blue, wages premiums above 10% of US average highlighted in gray, more than 25% of workforce 55 years old or great marked with red triangle, top 10% of demand categories highlighted in orange.

There are 74 healthcare occupations that met the base criteria of the Oregon Talent Plan. The Oregon Talent Plan analyzed these occupations based on multiple factors affecting the demand for jobs:

- The overall number of jobs
- The growth rate of jobs as measured by the past two-year growth and projected 10-year growth
- The number of projected annual openings

BIOSCIENCE CONTINUED

- The percent of workers over age 55
- The location quotient or concentration of jobs as compared to the national average
- The demand of an occupation due to the growth of Oregon's industry compared to the national growth of the industry

These factors were combined and weighted to develop a total demand score for each occupation. These occupations were then grouped into related jobs. These groupings were then verified through employer input throughout the state. The final step was to group jobs into related clusters of occupations within one of three categories:

- **Emerging and Evolutionary Occupations**. Those occupations experiencing new to market or rapidly changing skills along with high growth rates. High demand due to competitive pressures with less defined skills due to the evolutionary nature of the job.
- **Competitive and Steady Demand Occupations.** Those occupations that have steady demand (average growth rates) with more consistently defined skills likely requiring some level of upskilling and a blend of new and replacement jobs.
- **Transitional and Mission-Critical Occupations.** Those occupations that have lower than average growth rates, higher retirement exposure and other factors that lead to more replacement jobs than new jobs.

EMERGING AND EVOLUTIONARY OCCUPATIONS

Bioinformatics Specialists and Data Scientists. Data underscores trends and projection by industry leaders indicating that the fastest growing aspect of bioscience is in the analysis of both product development and business operations.

		CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE	
SOC Code	Description	Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years	
Data Scientist		41	2.5%	82	52%	48%			19%	
13-1081	Logisticians	29	2.1%	42	49%	51%	34.00	0.90	18%	
15-2011	Actuaries	0	2.4%	11	46%	54%	43.47	0.83	16%	
15-2041	Statisticians	11	3.5%	27	60%	40%	33.62	0.84	20%	
15-2099	Mathematical Science Occupations, All Other	0	0.4%	2	36%	64%	30.72	0.90	26%	◀
Data-Enabled Analysts		274	2.3%	1,041	55%	45%			25%	
13-1111	Management Analysts	43	2.6%	316	56%	44%	34.40	0.86	35%	◀
13-1161	Market Research Analysts & Mktng. Specialists	82	3.5%	247	68%	32%	30.25	0.88	15%	
13-1199	Business Operations Specialists, All Other	125	1.8%	366	48%	52%	32.29	0.90	25%	◀
13-2051	Financial Analysts	24	2.2%	112	46%	54%	44.77	0.96	13%	

Bio-based software developers and computer specialists. Data indicates that between 4-5 percent of all computer occupations are employed in the bioscience industry, with growth rates or demand for these jobs higher than other sectors.

BIOSCIENCE CONTINUED

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	PROJECTED OPENINGS: New jobs	PROJECTED OPENINGS: Replacement	WAGE ENVIRONMENT: Average Hourly Wages	WAGE ENVIRONMENT: Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years
Programmers and Developers		257	2.3%	790	51%	49%			13%
15-1131	Computer Programmers	24	0.7%	113	20%	80%	35.25	0.91	18%
15-1132	Software Developers, Applications	133	2.6%	394	55%	45%	46.93	0.96	13%
15-1133	Software Developers, Systems Software	80	1.9%	128	50%	50%	48.52	0.94	13%
15-1134	Web Developers	20	3.2%	156	64%	36%	28.04	0.90	8%

COMPETITIVE & STEADY DEMAND OCCUPATIONS

Engineers. Data indicates that there are more engineers than scientists employed in Oregon's bioscience industry: almost 60 percent of bioengineers and approximately 8-9 percent of other engineers. Demand for these jobs are steady, with employers wanting engineers that have knowledge of bioscience and nano- and micro-scale systems.

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	PROJECTED OPENINGS: New jobs	PROJECTED OPENINGS: Replacement	WAGE ENVIRONMENT: Average Hourly Wages	WAGE ENVIRONMENT: Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years
Bioscientists and Engineers		413	0.1%	123	18%	82%			18%
17-2031	Biomedical Engineers	80	1.9%	19	41%	59%	42.89	0.91	20%
19-1021	Biochemists & Biophysicists	25	1.8%	7	48%	52%	37.93	0.76	19%
19-1022	Microbiologists	22	1.1%	7	35%	65%	32.07	0.89	20%
19-1029	Biological Scientists, All Other	35	-1.0%	22	0%	100%	30.84	0.84	17%
19-4021	Biological Technicians	251	0.0%	68	14%	86%	18.96	0.87	17%
Interdisciplinary Engineering		516	1.6%	606	21%	79%			22%
17-2061	Computer Hardware Engineers	62	0.8%	74	0%	100%	62.06	1.08	15%
17-2071	Electrical Engineers	65	1.9%	86	32%	68%	43.10	0.89	24%
17-2072	Electronics Engineers, Except Computer	37	1.6%	46	29%	71%	44.69	0.92	23%
17-2112	Industrial Engineers	130	2.2%	154	30%	70%	48.31	1.15	24%
17-2141	Mechanical Engineers	140	1.8%	168	23%	77%	42.10	1.02	22%
17-2199	Engineers, All Other	82	1.4%	77	25%	75%	44.47	0.93	28%

Engineering technicians. Oregon's growing medical device industry and manufacturing components of bioscience continues to push the need for engineering technicians. Similar to engineers, approximately 8-9 percent of all engineering technician are employed in biosciences.

BIOSCIENCE CONTINUED

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	New jobs	Replacement	WAGE ENVIRONMENT: Average Hourly Wages	Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years	
Engineering Technicians		245	1.5%	218	18%	82%			25%	
17-3023	Electrical & Electronics Eng. Technicians	98	1.6%	122	17%	83%	31.56	1.03	24%	
17-3024	Electro-Mechanical Technicians	33	1.2%	15	5%	95%	30.97	1.21	24%	
17-3026	Industrial Engineering Technicians	25	1.5%	27	27%	73%	28.69	1.03	24%	
17-3027	Mechanical Engineering Technicians	27	1.6%	19	28%	72%	25.06	0.94	25%	
17-3029	Engineering Techs., Except Drafters, All Other	62	1.1%	34	15%	85%	27.13	0.90	26%	◀

TRANSITIONAL & MISSION-CRITICAL OCCUPATIONS

Lab Technicians. Data indicates that growth for lab technicians will be slower than other occupations, yet replacement jobs will be needed. Employers note the growing importance of applied data skills and quality assurance knowledge as foundation skills alongside life science knowledge.

SOC Code	Description	CRITICAL MASS: Estimated Jobs in Industry 2016	GROWTH: Weighted Average Growth Rate	PROJECTED OPENINGS: Annual Openings	New jobs	Replacement	WAGE ENVIRONMENT: Average Hourly Wages	Wage Premium over US	RETIREMENT EXPOSURE: % 55+ Years	
Lab Technicians		785	1.4%	177	34%	66%			27%	
29-2011	Medical & Clinical Laboratory Technologists	343	1.5%	88	33%	67%	31.79	1.11	27%	◀
29-2012	Medical & Clinical Laboratory Technicians	228	1.7%	66	40%	60%	20.26	1.03	26%	◀
51-9081	Dental Laboratory Technicians	213	0.2%	23	18%	82%	21.01	1.08	27%	◀

Scientists and Chemists. Data indicates that approximately one-third of medical scientists, chemists and biochemists are employed in the bioscience's private sector, with the majority employed in public sector R&D. While the projected growth is less than other bioscience jobs, they are mission-critical.

BIOSCIENCE CONTINUED

SOC Code	Description	CRITICAL MASS	GROWTH	PROJECTED OPENINGS			WAGE ENVIRONMENT		RETIREMENT EXPOSURE
		Estimated Jobs in Industry 2016	Weighted Average Growth Rate	Annual Openings	New jobs	Replacement	Average Hourly Wages	Wage Premium over US	% 55+ Years
Bioscientists and Engineers		413	0.1%	123	18%	82%			18%
17-2031	Biomedical Engineers	80	1.9%	19	41%	59%	42.89	0.91	20%
19-1021	Biochemists & Biophysicists	25	1.8%	7	48%	52%	37.93	0.76	19%
19-1022	Microbiologists	22	1.1%	7	35%	65%	32.07	0.89	20%
19-1029	Biological Scientists, All Other	35	-1.0%	22	0%	100%	30.84	0.84	17%
19-4021	Biological Technicians	251	0.0%	68	14%	86%	18.96	0.87	17%
Medical and Life Sciences		189	-0.8%	127	16%	84%			18%
19-1041	Epidemiologists	<10	1.3%	2	35%	65%	28.78	0.83	22%
19-1042	Medical Scientists, Except Epidemiologists	116	-0.3%	49	26%	74%	37.04	0.80	19%
19-1099	Life Scientists, All Other	<10	-1.3%	5	13%	87%	30.59	0.82	18%
19-4099	Life, Physical, & Social Science Techs., All Other	73	-1.2%	70	8%	92%	22.57	0.99	17%
Food Science		97	0.7%	82	22%	78%			23%
19-1012	Food Scientists & Technologists	<10	2.8%	18	34%	66%	31.00	0.94	21%
19-1013	Soil & Plant Scientists	64	0.2%	29	16%	84%	27.92	0.97	22%
19-4011	Agricultural & Food Science Technicians	33	0.3%	35	20%	80%	19.29	1.01	25%

EDUCATION AND TRAINING RECOMMENDATIONS

Oregon's bioscience industry appears to be at the forefront of developing systematic models for upskilling the workforce for skills that are over and above most educational credentials, are new to market and require additional standardization, or need rapid deployment. Since 2007, the Oregon Bioscience Association has developed various training efforts which have evolved into two different, yet synergistic, models: BioPro and BioCatalyst (See Best Practice Appendix for further detail). These models were developed because a) industry could not find qualified Oregon graduates and employers were individually having to provide considerable amounts of training to enable new hires to be productive, and b) new regulations or technologies were being implemented that were yet to be a part of education curriculum.

These models utilized national best practices to develop rapid-response training based on:

- Being a core skill identified by employers as critical, yet missing in workers
- Having training content tightly tied to industry credential or regulations that are recognized by employers
- Having competency-based curriculum taught by industry leaders that are vetted through their BioPro advisory committee
- Gathering an array of performance data that helps to continually refine and refresh the program

Bioscience training needs, like most industries, tend to change depending on the mix of employers within a specific region. The association, through the support of the Oregon Talent Council, expanded and customized programs in central Oregon and the South Willamette Valley starting in 2016 and has already exceeded training goals in less than 12 months. This model is also being examined by other industry segments for adaptation.

While the bioscience industry may have one of the more advanced training systems, there is still much more that can be done to ensure the rapid growth can be supported by Oregon hires. Training recommendations for bioscience include the following:

BIOSCIENCE CONTINUED

- **Support periodic expansions or refinements of training models.** While BioPro/BioCatalyst can be close to self-sufficient once up and running, like all training programs, the bubble of initial development costs requires additional support. This is where public has and can continue play a pivotal role.
- **Support learning labs for new to market or unique industry skills.** Segments such as digital health play at the intersection of multiple industries, the unique combination of skills require a "learn by doing" environment that can quickly pull together expertise from different fields to identify and refine skills sets needed to grow the industry.
- **Strengthen Oregon's higher education curriculum related to bioscience.** Many employers note that some Oregon educational institutions do not seek or welcome engagement by industry, especially when compared to other states in which they recruit graduates. Because of this, Oregon programs tend to lack key employability skills that include:
    - Strong documentation skills and a basic knowledge of federal regulatory environment
    - More applied data analytics skills
    - Professional workplace skills including team communication, customer services, and project management skills

APPENDIX C. PROMISING PRACTICES

Keeping skills up to date after someone enters the workforce is perhaps the greatest talent challenge faced by employers and workers alike. Across the country, state and local governments, alongside industry and education, are taking a more proactive and focused role in continuous skills training. Learning from existing programs and models provides valuable insights into what works and what doesn't work in talent development. A scan of national and Oregon-based models, many of which are OTC grantees, reveals a clear set of characteristics about what makes training models successful. These characteristics are described below:

- **Industry-led.** Industry is involved in a meaningful way to ensure program relevancy, real buy-in to the process, and a vested interest in program success.
- **Applied.** Learning objectives are directly applied to job performance; the goal of the program is not just completing training, but understanding how training benefits the bottom line for both workers and organizations.
- **Competency-based.** Learner performance and knowledge acquisition are measured by demonstrated skill mastery, not just program completion.
- **Flexible.** Training program scheduling is flexible to accommodate needs of employees.
- **Culture of learning.** Company cultures are created that value continuous learning.

MEASURABLE IMPACT OF SKILLS TRAINING

BENEFITS TO EMPLOYERS

- Measurable quality and/or revenue improvements
- Reduced time to fill open vacancies
- Decreased ramp-up time to productivity
- Improved ROI in capital investments (more proficiency on new equipment)

BENEFITS TO WORKERS

- Increased wages
- Increased job satisfaction
- Increased career/upward mobility options

BENEFITS TO EDUCATION & WORKFORCE PARTNERS

- Having cutting-edge skills attracts students and faculty
- Identifying new, critical skills and providing standardization that
  - Reduces curriculum development time
  - Enhances the quality and relevance of curriculum
  - Is directly related to employability skills

Different models are being used depending on factors such as the skill set is new to market, there is a sudden bubble due to a changing regulation, or an occupation is facing significant succession planning issues (see Figure 10). This section outlines examples of promising practices within these different categories, highlighting efforts in other states as well as those in Oregon.

TRAINING MODELS FOR EVOLUTIONARY OCCUPATIONS

BIOPRO & BIOCATALYST:
PARTNERING TO DEVELOP THE BIOSCIENCE WORKFORCE

BioPro and BioCatalyst are programs developed by Oregon Bioscience Association aimed at enhancing the competitiveness of the industry through talent development and strengthening the talent pipeline. The lynch pin of this model is the involvement of the steering committee, which is made up of human resources and quality management experts from Oregon Bio's member companies. The steering committee plays an active role in determining the curriculum of each program and selecting instructors.

The BioPro program, launched in 2007, is aimed at workers already in the industry and those interested in entering the industry. BioPro offers a robust selection of classes in both technical areas (FDA and Quality; Manufacturing and R&D) and general business (Leadership and Management; Communications and Marketing). Classes cover a wide range of topics from "Biotech Basics for the Non-Scientist" to good documentation practices and design of experiments. More than 1,600 students have graduated from this program.

BioCatalyst Advanced Training, launched in 2014, enhances the skills of un- and under-employed management professionals, engineers, and project managers in the state seeking career transitions and qualifying them for the advanced job requirements of Oregon's companies. The program has been very successful, with a 78 percent placement rate.

GREENFIG:
UPGRADING DEGREES WITH LEADING-EDGE INDUSTRY APPLICATIONS

Nano- and micro-degrees are terms being used to described specified skills training aligned with specific industry needs. These abbreviated programs are typically six months or less and are positioned to be complementary to two- and four-year degree programs. GreenFig, started in Oregon, is expanding its footprint nationally. It is an outgrowth of BendPoly in Central Oregon. BendPoly provided higher-education students, workers seeking new employment opportunities, and returning veterans with applied business marketing skills that used the most current application software for marketing, sales, service, and support. It was an eight-week course with "intensive, immersive, short form programs" designed to provide practical application skills that are in high demand and difficult for higher education to provide due to the fact they change rapidly and are not well-suited to traditional academic learning formats. This pilot program became the basis for GreenFig.

Currently, the GreenFig program offers a micro-degree in digital marketing, developed and taught by industry experts in five modules. As the GreenFig website notes, "We combine real-time, hands-on instruction with market-leading business application software, mentorship from industry experts and practical experience on real projects with real companies." In 200 hours, students learn how to set up and run digital marketing applications that companies use to convert marketing strategy into operational execution. Students spend the first part of the course in a classroom setting, engaging with and learning from instructors and guest speakers. The second part is spent working with industry experts applying what students have learned on a project for a real company where teams compete for the company's business by presenting their final concepts, just as any other bidder would. At the end, students take the Marketo Certification exam (an industry-leading application), and GreenFig actively promotes degree earners to companies currently hiring. To show employers that the quality of students meets industry standards, degrees are awarded only if students pass the course content with a score of at least 80 percent, they obtain their Google Analytics Individual Certification, and they receive a positive rating from the project mentor(s)/client.

MANPOWER'S POWERYOU:
IN THE AGILE TALENT MARKETPLACE, STAFFING AGENCIES SERVE AS TRAINING INTERMEDIARIES

As companies move to agile staffing models, they are relying more on staffing agencies to fulfill both their hiring and workforce development needs. For example, Manpower has launched the powerYOU training platform, which provides its associates with free, online access to a wide variety of courses that cover skills important to employers: basic computer skills, business skills, and even programming. This kind of skills acquisition makes Manpower associates more marketable in the talent marketplace. In addition, Manpower provides its employer clients with access to customized training courses for the candidates they hire through Manpower. Samsung Semiconductor uses Manpower not only to assess candidates but also to provide a two-week customized training program for manufacturing specialists and technicians. This approach to training provides a flexible solution that dovetails with company's over-all human resource strategy and provides entry-level and incumbent workers alike with greater access to quick training modules.

OREGON STORY BOARD:
USING LEARNING LABS TO BRING NEW SKILLS TO MARKET

Bringing new technologies to markets, especially those that can significantly increase the accessibility to education or applied learning, requires initial innovation settings to establish standards, work out kinks, and otherwise de-risk the value of new tools. This is why investments in structured learning labs can be beneficial.

Oregon Story Board (OSB) and Clackamas Community College (CCC) teamed up and were awarded one of Microsoft's five Academic Research grants (alongside Carnegie Mellon, Dartmouth, Virginia Tech, and UC Berkeley). This opportunity provided a unique setting for a new HoloLens technology to be explored for its use in training for traditional jobs. A main objective of this grant was to embed the HoloLens technology within an academically-structured, competency-based, exploratory environment. HaloLens technology is part of the fast-growing virtual reality (VR)/mixed reality (MR) industry with applications across several markets.

Many academic institutions express interest in bringing emerging technologies to their institutions; however, such interest is often derailed due to lack of technical understanding, clear student learning outcomes, and/or the ability to demonstrate a clear value in the initial investment. This project provided skill development for people wanting to learn the latest technologies not yet taught in schools, while developing a real product. In this case, the two organizations created "project-centered, studio classes," which allowed students from various Portland-area schools to work with industry professionals in cross-disciplinary teams to develop content for HoloLens. The final HoloLens project created by the class would then be used as a supplemental teaching tool and curriculum enhancement within the Automotive Services Training program at CCC. The goals were to build an experience that:

- Helps students better understand and imagine the inner workings of a car
- Helps instructors explain the front-wheel transmission without creating new curriculum
- Increases comprehension without the need for more instruction hours

While this exploratory grant was not without challenges, there were obvious lessons and benefits from the learn-by-doing environment and the industry-academic partnership. These lessons have been applied to three new VR/MR pathways for both beginners and professionals, expanding new-to-market skills training for students and incumbent workers alike. Like other learning labs, OSB encourages a diverse mix of students to be more representative of all types of consumers and, through partnerships with public programs and industry, can offer scholarships and keep tuition low.

TRAINING MODELS FOR STEADY-DEMAND OCCUPATIONS

LINN-BENTON SURGICAL TECHNOLOGY PROGRAM:
SCALING UP TRAINING CAPACITY TO RESPOND TO NEW STATE REGULATIONS

In June 2015, Oregon passed a law that prohibits hospitals and ambulatory surgery facilities from allowing persons without certain qualifications to function as surgical technologists in their facilities. This requirement went into effect for most of the state in July 2016, but for rural or medically underserved communities, the effective date is July 2017. As a result of this new regulation, there was an increased need for certified surgical technologists and surgical technology certification programs over a short time frame.

In response, Linn-Benton Community College (LBCC) developed a statewide surgical technology program to address the shortage of professionals in rural Oregon and meet the new state legislative requirements. The new program uses a distance-learning model to provide greater access and greater scale to the program, which is especially helpful for rural and under-served communities. Up to this point, the only other program in the state offered face-to-face learning only, and rural and coastal employers were having difficulty recruiting talent in their communities. In February 2017, the Higher Education Coordinating Commission approved LBCC's certificate program, and the program is scheduled to launch in Fall 2017.

PARTNERS HEALTHCARE:
UPSKILLING INCUMBENT WORKERS THROUGH ONLINE TRAINING

Partners HealthCare is a network of approximately 15 Massachusetts hospitals and partners, founded by Brigham and Women's Hospital and Massachusetts General Hospital. They offer training opportunities to existing staff in a variety of ways, with an online learning opportunity offered through College for America, a subsidiary of Southern New Hampshire University.

What makes this program[57] stand out from others is the support for participants that greatly increases the likelihood they will complete their program. Aspects of that support include the following:

- **Helping participants get the most out of on-line learning.** Potential enrollees must complete an "online readiness" course before enrolling in the program.
- **Providing industry and education mentors/coaches.** The hospitals provide mentors for those enrolled, and the college assigns each student a learning coach.
- **Offering competency- and project-based learning.** The courses offered online are competency-based Associate and Baccalaureate degree programs featuring project-based learning that is self-paced.
- **Deferring payment.** The hospitals reimburse employees for successful completion of training, and the college offers deferred payment for those approved for the tuition reimbursement, solving the problem for employees needing to pay up front.

CAREERSTAT:
UPSKILLING FRONTLINE HEALTHCARE WORKERS

CareerStat, a national network of healthcare leaders, has focused considerable attention on building qualified frontline workers (e.g., CNAs, patient representatives, medical assistants, nurses, and others), who make up approximately 50 percent of the industry's workers. Oregon healthcare employers underscored the increasing difficulty in finding qualified frontline workers. CareerStat includes all but 18 states (Oregon is not a member) and provides a series of best practices for effective training. Examples include: Penn Medicine in Philadelphia, using an on-the-job apprentice style training model to increase

[57] See http://www.partners.org/For-Employees/Workforce-Development/Our-Employees/Default.aspx
[57] See https://nationalfund.org/learning-evaluation/publications/guide-to-investing-in-frontline-health-care-workers/

the number and quality of their patient service representatives; Jersey City Medical Center, using a structured in-house training program to take people in entry-level jobs and move them up the career ladder, increasing loyalty and quality while reducing turnover; East Boston Neighborhood Health Center, using on-site classes developed by working with the local community college to locate a satellite campus at the health center.[58]

PIPELINE PROGRAM:
REBUILDING INTEREST IN MIDDLE-SKILL JOBS CONNECTED TO REGIONAL EMPLOYERS

Pipeline is an industry-led initiative in Albany, OR, that helps create a pipeline of middle-skill workers in manufacturing and healthcare. It was created to "help students, employers, and educators discover a path that puts young people on the most direct line from school to a rewarding job with a bright future."

The Albany Area Chamber of Commerce began this initiative by convening the Workforce Development Taskforce to define the needs of local business and industry. The committee developed a plan to combine its efforts with local education to provide more comprehensive training options for local students, especially around the projected 1,100 manufacturing jobs needed over the next five years. Linn-Benton Community College now runs the manufacturing pipeline program, with a recent expansion into healthcare. The program hosts career events for high school students and actively recruits industry to engage in outreach, career fairs, job shadows, internships, and other efforts to show students the pathway to middle-skill jobs. Industry not only helped define the need for pipeline, they also made the contributions necessary to launch the program, along with financial and advisory assistance from Greater Albany Public Schools, LBCC, and Linn County.

BAKER TECHNICAL INSTITUTE:
CAREER AND TECHNICAL EDUCATION (CTE) FOR THE COMMUNITY AS WELL AS STUDENTS

Finding qualified workers in rural areas can be difficult, and recruitment in such areas is extremely challenging. Community partnerships between business and education are critical to ensure that the local community can maximize their resources to grow their own. Baker Technical Institute in Eastern Oregon partners with regional employers and industry experts to provide hands-on education in agriculture, drafting/engineering, building construction, health services, and welding and manufacturing technology fields. Students receive certifications recognized by industry and are prepared for additional post-secondary education if they choose. The faculty has industry experience, and program offerings and curriculum are developed in collaboration with regional businesses. While the programs initially served high school students, the infrastructure now in place allows certification programs and technical training to be offered to graduates and adults looking for newer employable skills (bringing back the ways in which vocational education programs of decades past served the broader community).

TRAINING MODELS FOR TRANSITIONAL OCCUPATIONS

CENTER FOR ENERGY WORKFORCE DEVELOPMENT (CEWD):
STANDARDIZING AND PROMOTING TRAINING ACROSS AN INDUSTRY

According to recent estimates, up to 62 percent of the energy workforce may need to be replaced over the next ten years. In response to this large national need, the Center for Energy Workforce Development (CEWD) came together in 2006 to build the alliances, processes and tools to develop the energy workforce needed to address this transition. As part of their effort to build a stronger pipeline of talent, the CEWD has developed a competency-based model of stackable credentials to support the development of a skilled workforce. The first certificate program, called Energy Industry Fundamentals, ensures that workers gain an understanding of the energy industry overall and an understanding of the careers available in the industry as a pre-requisite to occupation-specific training. After earning this certification, workers can pursue additional training through apprenticeships, accelerated degree programs, and boot camps that have been developed by, or in partnership with, the CEWD. The CEWD supports state energy consortia across the US and works with member companies

to implement these education programs in their states. As of 2016, there are 54 active Energy Industry Fundamentals approved course providers. Since inception, 1,876 credentials have been awarded.

OMEP SMART TALENT:
BUILDING A CULTURE OF LEARNING

Oregon Manufacturing Extension Partnership (OMEP) used the Training Within Industry (TWI) model to develop their Smart Talent program. With staff trained in TWI, OMEP added a structured approach to the methodology to develop a training process for employers that is systematic and repeatable. It combines job-skills training with continuous improvement techniques to address a company's talent needs and bottom line at the same time. Through a six-month consulting engagement, OMEP helps companies map out career pathways and training requirement within the organization. Some employers also align salary structure with training completion and skills acquisition. Overall, the project reduces the onboarding process for new employees by ramping them up quickly. It also embeds training into the culture of the company and provides greater transparency into career pathways. OMEP has documented impressive results from the Smart Talent program. One client saw a 90 percent reduction in training time for new employees, $134,000 in cost savings, and $2.2 million in sales growth.

BCBS APPRENTICESHIPS:
APPRENTICESHIP PROGRAMS AS A TOOL FOR KNOWLEDGE TRANSFER

BlueCross BlueShield of South Carolina (BCBSSC) has more than 6,000 employees at their Columbia, South Carolina office. A robust information technology division is among the functions located in Columbia, employing over 2,000 IT professionals who develop, execute, and monitor health care claims and online transactions. Staffing this unit proved to be difficult, as the competition for skilled IT talent was often fierce nationally and the regional talent pool was limited. In 1997, in response to this challenge, BCBSSC developed an apprenticeship program and later registered the program with the US Department of Labor in 2009. The program was developed in partnership with Midlands Technical College and Alpha Training Services and covers seven different IT occupations, including information security, database management, and programming. The program includes 16 to 20 weeks of classroom training followed by 42 to 48 months of on-the-job apprenticeship.

Since 1997, 528 people have participated in the program and 300 are still active employees of BCBSSC. In 2016, program participants represented 21 percent of all new hires as the company became more aggressive about recruiting to replace their retiring workforce over the next five to ten years.

The retention rate for apprentices is 68 percent over a five-year period. In fact, only four percent of apprentice graduates left the firm over the course of a year (against an industry average of 13 percent), and 22 percent of currently-employed grads rose to leadership positions since program completion. Executives at BCBSSC view the program as an important component of the company's talent pipeline – bringing on new employees, training them, and using the knowledge and skills of experienced employees to groom successors.

ROGUE COMMUNITY COLLEGE MILLWRIGHT PROGRAM:
TRANSFERING KNOWLDEGE OF RETIRING MANUFACTURING WORKERS

With a large number of millwrights expected to retire over the next ten years, there is a need to facilitate the transfer of knowledge from these experienced millwrights to their replacements. To address this need, Rogue Community College (RCC) proposed the Knowledge and Skills Transfer Project for Manufacturing and Millwrights for OTC funding. This project, which was funded in late 2016, is an industry-led effort in Southern Oregon to pilot and learn from a small model how to transfer the wisdom, experience, and skills of retiring workers to the next generation of incumbent and emerging workers through a mentorship and pre-apprenticeship program. The project is a fast-track model that will reduce the training time required for a millwright by approximately one year, without compromising the quality of training. RCC will develop a report on the model and the lessons learned from the perspective of the companies, college, mentors, and mentees in this pilot effort.

ENCORE FELLOWS:
HARNESSING THE KNOWLEDGE AND TALENT OF RETIRING WORKERS

The Encore Fellows program is a national program that matches seasoned professionals with mission-driven organizations for limited-engagement, high-impact projects. The Encore Program serves as a bridge to retirement and a way to transfer knowledge from the retiree to a broader community. It also provides opportunities for retirees to be introduced to new career possibilities post-retirement. Typically, the projects are 1,000 hours over the course of 12 months.

Since 2012, Intel has offered its employees the opportunity to serve as an Encore Fellow as part of their retirement package and has paid for 1,000 fellowships. The fellowship is viewed very positively by retirees and it builds goodwill among current employees. For the mission-driven organizations that are hosts, the Encore Fellows play a crucial role. Over 80 percent of the organizations experienced sustained positive impact on their organization through the implementation of new and useful tools, staff development, and/or new and useful approaches to work.

APPENDIX D. TALENT NEEDS ASSESSMENT METHODOLOGY

The following methodology outlines the steps used to conduct a needs assessment and categorize occupational gaps into potential investment categories in support of the Oregon Technology Council Strategic Plan Update. This document includes:

- Baseline assumptions used to develop filters and steps used in the analysis.
- Steps to conduct various occupational assessments.
- Tasks to gain insight from national & international industry trends, as well as direct employer input.
- The combination of occupational data and industry input to define talent gaps and corresponding training models.

DATA ANALYSIS

The methodology for assessing targeted occupational data for the Oregon Talent Council consisted of the following steps.

STEP 1. CREATION OF A MASTER LIST OF OCCUPATIONS AND ASSEMBLY OF RAW DATA

Pull the following data for all five-digit (detailed) standard occupation codes (SOCs):

- Jobs in latest year available: the base year (2016)
- Jobs in two years previous (2014)
- Projected jobs in ten years (2026)
- Ten-year projected change in number of jobs (2016-2026)
- Ten-year projected change in percent of job
- Total annual openings for next ten years (2016-2026)
- Annual openings of new job
- Annual openings from replacement jobs
- Average hourly earnings of the base year (2016)
- Average hourly earnings vs US average hourly earnings (base year)
- Location quotient of the base year (2016)
- Location quotient projected in 10 years (2026)
- Age data: the number of jobs by age categories (base year)
- Shift share analysis data:
  - Occupational mix effect: the growth or share of jobs due to the growth of key industries for that occupation
  - National growth effect: the growth or share of jobs due to the overall growth of the national economy
  - Competitive effect: The growth or share of jobs due the region/state's competitive position

Note: we used the EMSI 2017.1 dataset that includes Quarterly Census of Employment and Wages (QCEW) employees, non-QCEW employees, and self-employed. This results in data with current and projected jobs that are slightly higher than Oregon Employment Department calculations. Either data source could be used since the important aspect of the analysis is a comparison of relative needs among different occupations, rather than the specific projected job numbers for an occupation.[59]

[59] Typically job projections, especially for emerging or changing occupations, are inaccurate since there are differences in how employers code jobs (e.g., a computer analyst or a computer specialist), and projections are based on past performance which does not account for disruptive industry trends.

STEP 2. DEVELOPMENT OF A TARGETED OCCUPATION LIST BY FILTERING THE LIST OF KEY OCCUPATIONS

Filter occupations most common to the five traded and high-impact sectors within the Oregon Talent Council's focus: Advanced manufacturing, bioscience, energy, healthcare, and IT & software.

- Narrow the list of standard occupation codes (SOCs) to those under SOC 13, 15, 17, 19, 21, 29, 31, 49, and 51, and including media and design occupations within SOC 27 and electricians under SOC 47. Not included in this list are private sector jobs in retail, food services, lodging, personal services, etc., and public sector jobs such as teaching and postal workers.

  This provides a list of approximately 390 SOC codes.

Narrow occupations by characteristics key to competitiveness

- Occupations must require some form of post-secondary or moderate on-the-job training. This indicates occupations likely to need either work- and/or classroom-based learning for new entrants.
- Occupations must have a median wage of at least $17.00/hour. This indicates jobs that are likely to pay livable wages and are associated with a potential career pathway.

  This provides a list of 307 SOC codes.

STEP 3. ANALYSIS OF DEMAND FACTORS OF TARGETED OCCUPATIONS

Analyze the targeted list of approximately 300 occupations by overall demand and demand type.

Using input from employers and analysis of industry trends, we developed formulas to measure overall demand and specific demand types.

- Overall demand: a weighted score to understand the relative needs across industries.
- Demand type: a weighted score unique to each type:
  - Evolutionary or new-to-market occupations where agile training is required,
  - Steady-demand occupations where scalable and cost-effective training models are needed, and
  - Mission-critical or transitional occupations (with high retirement or succession exposure) where bubbles of training needs are likely to occur.

Calculate the overall weighted score

To calculate the overall weighted score, we developed weights from 1 (low) to 5 (high) for the following demand factors:

A. *Overall number of jobs*: (Is there a critical mass?)

B. *Annual growth* (Are jobs growing fasters than the overall economy?): calculated from taking the past two-year actual and the projected ten-year growth.

C. *Annual openings* (Are projected openings at a level that can sustain a training investment?)

D. *Location quotient* (Is there a competitive advantage in Oregon to this job?): calculated by taking averaging the current location quotient score and the location growth score (the projected change in ten years).

E. *Retirement exposure* (Are mission-critical jobs likely to face a sudden bubble of retirement in which experienced replacements are needed?): calculated using the percent of the workforce 55 and older.

F. *Shift-share or competitiveness score* (Is the growth of the relevant industries and the state's competitive position within them likely to put additional demand pressures on a job?): calculated by averaging the score from share of jobs from industry mix effect with the score from the share of jobs from the region's competitive effect.

G. In addition, we added a *wage premium score* of an additional two points for jobs with an average wage of $30/hour or more.

The overall demand formula applies different weights to the above demand factors with a total score of 32.5.

Overall score = A + (B*1.5) + (C*1.5) + (D*.5) + (E*.5) + F + (G*.5)

Calculate scores for each demand type to identify occupations likely to have specific training needs or require similar training models

In addition to the overall demand factors listed above, a more specific set of demand factors were included in the next phase of analysis.

H. *Replacement job ratio*: the percent of annual openings projected to come from the replacement of existing jobs. (In 2016, this rate was 63 percent for the 300 occupations analyzed)

I. *New job ratio*: the percent of annual openings projected to come from new jobs.

J. *Industry mix effect score*: the part of the shift-share score (F) contributed to the growth of the industry as compared to the overall growth of the economy.

K. *Competitive effect score*: the share of job growth that comes from the region/state having a competitive advantage in industries driving the employment of the occupation.

EVOLUTIONARY OR NEW-TO-MARKET (RAPIDLY CHANGING) OCCUPATIONS WHERE AGILE TRAINING IS REQUIRED

In this category of occupations, employers are concerned about new skills where competencies are not well established and therefore training is continually changing as more standardization takes place. To get an understanding of occupations likely to be in early stages of adoption, we calculated the potential need by analyzing the following factors:

- High annual growth,
- Higher ratio of new jobs compared to replacement jobs, and
- High levels of industry mix effect where the share of jobs from growth in targeted industries is much higher than the share of jobs from overall growth in the economy.

The formula used to calculate this score was:

Evolutionary score = (B*1.5) + I + J

STEADY-DEMAND OCCUPATIONS WHERE SCALABLE AND COST-EFFECTIVE TRAINING MODELS ARE NEEDED

In this category of occupations, employers are concerned about rapid adoption or retooling of skills that have a proven set of competencies or standards. This is especially important in occupations with high demand that cut across industries. These occupations are ones where cost-effective and scalable incumbent worker training is needed alongside higher education's need to quickly adapt new skills into curriculum so graduates are current with industry needs. This group of occupations is characterized by:

- Higher than average growth rates,
- High number of projected openings, and
- High shift-share score where both the industry mix and the state's competitive advantage have a positive impact on occupational demand.

The formula used to calculate this score was:

Steady-Demand score = A + C + (J*.5)

TRANSITIONAL OCCUPATIONS (WITH HIGH RETIREMENT OR SUCCESSION EXPOSURE) WHERE BUBBLES OF TRAINING NEEDS ARE LIKELY TO OCCUR

For these jobs, employers are concerned with occupations with a significant portion of their workforce over 55 years of age, were replacement jobs are high, and where the job is mission-critical to Oregon's advantage. This group of occupations is characterized by:

- Retirement exposure is high,
- The ratio of replacement opening to all openings was very high, and
- There is a positive share of job growth that comes from the state having a competitive advantage in the industries of employment.

The formula used to calculate this score was:

Transitional score = E + H + (K*.5)

Sort by score to identify the top occupations by demand type

INDUSTRY INPUT

In addition to analyzing data, two levels of industry input are used to verify data and to provide actionable insights that inform the quality and quantity of training investments. These include understanding national and global industry and technology trends that impact talent in high-growth, high impact industries, and surveying Oregon employers to gain insights on how trends and data projections play out in this state.

STEP 1. EVALUATING INDUSTRY TRENDS IMPACTING TALENT

Below is a list of sources that can be used to gain insights into national and global trends that will influence the future demand for talent.

GENERAL SOURCES

EMERGING INDUSTRY AND ECONOMIC TRENDS

- McKinsey Global Institute: www.mckinsey.com/mgi/overview
- National Governor's Association Center for Best Practices: www.nga.org
- Global Insights – IHS Markit sector information on manufacturing, engineering, IT & media, energy, defense, and other sectors: www.ihs.com

TRENDS IN OCCUPATIONAL CLUSTERS

- Randstad Technologies publishes an annual workforce trends report and various detailed assessments of occupational sectors including engineering, accounting and business operations, IT/media sectors, and others: www.ranstadusa.com
- Accenture: Insights on future workforce trends and practices: www.accenture.com/us-en/insight-future-workforce-trends

SECTOR-SPECIFIC SOURCES

HEALTHCARE

- National Health Career Association: www.nhanow.com
- Health Leaders Media: a think tank on healthcare industry intelligence reports: www.healthleadersmedia.com
- Oregon Health Authority
- Oregon Healthcare Workforce Institute

MANUFACTURING

- National Association of Manufacturers research center: www.nam.org/Data-and-Reports/Center-for-Manufacturing-Research/
- Association for Manufacturing Excellence: www.ame.org
- Industry Week www.industryweek.com

IT & DIGITAL SERVICES

- Cyberstates by CompTIA: www.comptia.org/resources/cyberstates-2017
- Randstad USA Information Technologies Workforce Trends report
- Accenture Technology Trends: www.accenture.com/t20170321T032507__w__/us-en/_acnmedia/Accenture/next-gen-4/tech-vision-2017/pdf/Accenture-TV17-Full.pdf?la=en

ENERGY

- Advanced Energy Economy
- CleanTechnica, a research site with information on various segments of energy: www.cleantechnica.com
- Clean Edge, providing benchmarking and data on multiple aspects of the clean tech economy: www.cleanedge.com

BIOSCIENCE

- National Center for biotechnology workforce: www.biotechworkforce.org
- Oregon Bioscience Association: www.oregonbio.org/bio-in-oregon/resources/
- Battelle report on Oregon's biosciences industry

STEP 2. SURVEYING OREGON EMPLOYERS

Since the majority of industry associations associated with the OTC had recently surveyed their members, our existing methodology did not include a standard survey across industries. We did, however, conduct interviews using the following protocol. It is our recommendation, however, that in the future the OTC, in collaboration with workforce and education partners, develop a standard survey tool to be distributed to industry every two years that asks more specific questions.

Employers acknowledge that different demand factors affect which types of training models can be effective. For example, jobs with high rates of retirement will need experienced workers to back-fill people with 30+ years of knowledge, which will likely require work-based or on-the-job training models. On the other hand, occupations being impacted by sudden disruptions or advancement in technologies may need very flexible learning lab models to identify how to apply new standards. For this reason, the interview protocol that follows includes questions the drill down into the types of training needed by demand type.

EVOLUTIONARY JOBS

- What current occupations are rapidly changing or undergoing the most disruption in terms of the skills and technology tools needed?

- What training tools are you likely to use to address these changing skill sets?
- What occupations do you anticipate hiring in the next three years at rates much faster than in the past three to five years?

Answers to these questions will help identify where to focus investments and resources in industry-led learning labs and training models that help to standardize new skill competencies (first question), and identify skills and occupations in early adoption stages so higher education partners can proactively begin developing necessary changes to degree and certification curriculum (second question).

STEADY-DEMAND JOBS

- What occupations are in high demand that require retooling of your existing workforce to keep skills current and competitive?
  - What are the top three skills within these occupations for which available training will be essential?
- What occupations are in high demand in which you expect to hire new graduates or workers with less than three years of experience?
  - What are the top three skills that will differentiate one applicant from another?

Answers to these questions help to define which industry skills will require rapid retooling and highly scalable models (first question), and what current degree and certification programs are likely to see an increase in near-term demand (second question).

TRANSITIONAL JOBS

- What occupations have the greatest exposure to retirement and where is there a gap in the number or qualification of workers to replace these jobs?
- What types of training is needed to effectively transfer knowledge from one worker to another?
- What occupations have a high percent of workers near retirement, yet you are not likely to replace workers due to technology advances or the displacement of that job due to other factors?

Answers to these questions help to identify targeted areas for work-based learning models (first question) and to understand which higher education degree or certification programs are likely to see a decline in demand and which could be likely candidates for consolidation (second question).

The table below summarizes how different categories of questions inform areas of focus for both industry-led and higher education programs.

	EVOLUTIONARY QUESTIONS	STEADY DEMAND QUESTIONS	TRANSITIONAL QUESTION
Industry-led	Insights into skills and occupations that are undergoing rapid change that require industry collaboration to help bring to market.	Insights into where retooling investments are most effective and where scale will be a key concern for the near-term.	Insights into where repeatable knowledge transfer models will have significant impact.
Higher Education	Proactive insights into occupations and skills on the uptake, which are likely to require changes in curriculum.	Insights into where near-term demand in degrees and certifications is likely to increase.	Insights into where work-base models are needed most, and what degree or certifications are likely to be in less demand.

FINAL NEEDS ASSESSMENT

The final step in the needs assessment is to overlay occupational data with industry trends and input from Oregon employers to develop a short list of targeted occupational clusters and potential investment focus areas. We used the following steps:

STEP 1. DEVELOP OCCUPATIONAL CLUSTERS.

Since many occupation codes have a high degree of skill overlap with other occupations, we first grouped occupations with a high level of shared skills to form occupational clusters (e.g., software application developer with software systems developer and computer systems specialist). Figure 70 shows the results of these groupings.

FIGURE 70. OCCUPATIONAL CLUSTER DEFINITIONS

SOC Code	Description
Advanced Materials and Chemicals	
17-2131	Materials Engineers
19-2031	Chemists
19-2032	Materials Scientists
19-4031	Chemical Technicians
Bioscientists and Engineers	
17-2031	Biomedical Engineers
19-1021	Biochemists and Biophysicists
19-1022	Microbiologists
19-1029	Biological Scientists, All Other
19-4021	Biological Technicians
Business Finance and Compliance	
13-1041	Compliance Officers
13-1051	Cost Estimators
13-2011	Accountants and Auditors
13-2099	Financial Specialists, All Other
Care Specialties	
29-1064	Obstetricians and Gynecologists
29-1066	Psychiatrists
29-1069	Physicians and Surgeons, All Other
Community Health and Social Services	
21-1021	Child, Family, and School Social Workers
21-1022	Healthcare Social Workers
21-1029	Social Workers, All Other
Conservation and Resource Biology	
19-1023	Zoologists and Wildlife Biologists
19-1031	Conservation Scientists
19-1032	Foresters
19-4093	Forest and Conservation Technicians
Data Scientist	
13-1081	Logisticians
15-2011	Actuaries
15-2031	Operations Research Analysts
15-2041	Statisticians
15-2099	Mathematical Science Occupations, All Other

SOC Code	Description
Data-Enabled Analysts	
13-1111	Management Analysts
13-1161	Market Research Analysts and Marketing Specialists
13-1199	Business Operations Specialists, All Other
13-2031	Budget Analysts
13-2041	Credit Analysts
13-2051	Financial Analysts
Diagnostic Technicians	
29-2031	Cardiovascular Technologists and Technicians
29-2032	Diagnostic Medical Sonographers
29-2033	Nuclear Medicine Technologists
29-2034	Radiologic Technologists
29-2035	Magnetic Resonance Imaging Technologists
Digital Media and Design	
27-1014	Multimedia Artists and Animators
27-1019	Artists and Related Workers, All Other
27-1024	Graphic Designers
27-1029	Designers, All Other
27-3099	Media and Communication Workers, All Other
Digital Media Technicians	
27-4011	Audio and Video Equipment Technicians
27-4014	Sound Engineering Technicians
27-4031	Camera Operators, Television, Video, and Motion Picture
27-4032	Film and Video Editors
27-4099	Media and Communication Equipment Workers, All Other
Engineering Support	
17-3012	Electrical and Electronics Drafters
17-3013	Mechanical Drafters
17-3031	Surveying and Mapping Technicians
Engineering Technicians	
17-3021	Aerospace Engineering and Operations Technicians
17-3023	Electrical and Electronics Engineering Technicians
17-3024	Electro-Mechanical Technicians
17-3026	Industrial Engineering Technicians
17-3027	Mechanical Engineering Technicians
17-3029	Engineering Technicians, Except Drafters, All Other
Environmental Engineering and Science	
17-2081	Environmental Engineers
17-3025	Environmental Engineering Technicians
19-2041	Environmental Scientists and Specialists, Including Health
19-4091	Environmental Science and Protection Technicians, Including Health
Equipment and Machinery Repair	
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
49-9062	Medical Equipment Repairers
49-9069	Precision Instrument and Equipment Repairers, All Other
First-Line Supervisors	
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers
51-1011	First-Line Supervisors of Production and Operating Workers

SOC Code	Description
Food Science	
19-1012	Food Scientists and Technologists
19-1013	Soil and Plant Scientists
19-4011	Agricultural and Food Science Technicians
Healthcare Educators	
21-1091	Health Educators
Human Resource Management	
13-1071	Human Resources Specialists
13-1075	Labor Relations Specialists
13-1141	Compensation, Benefits, and Job Analysis Specialists
13-1151	Training and Development Specialists
Industrial Machinists and Operators	
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic
51-4041	Machinists
Industrial Mechanics and Service Technicians	
49-2091	Avionics Technicians
49-3011	Aircraft Mechanics and Service Technicians
49-3042	Mobile Heavy Equipment Mechanics, Except Engines
49-9041	Industrial Machinery Mechanics
49-9043	Maintenance Workers, Machinery
49-9044	Millwrights
Interdisciplinary Engineering	
17-2061	Computer Hardware Engineers
17-2071	Electrical Engineers
17-2072	Electronics Engineers, Except Computer
17-2112	Industrial Engineers
17-2141	Mechanical Engineers
17-2199	Engineers, All Other
Lab Technicians	
29-2011	Medical and Clinical Laboratory Technologists
29-2012	Medical and Clinical Laboratory Technicians
51-9081	Dental Laboratory Technicians
Medical and Life Sciences	
19-1041	Epidemiologists
19-1042	Medical Scientists, Except Epidemiologists
19-1099	Life Scientists, All Other
19-4099	Life, Physical, and Social Science Technicians, All Other
Medical Records and Information Management	
29-2071	Medical Records and Health Information Technicians
Mental and Behavioral Health	
21-1011	Substance Abuse and Behavioral Disorder Counselors
21-1013	Marriage and Family Therapists
21-1014	Mental Health Counselors
21-1015	Rehabilitation Counselors
21-1019	Counselors, All Other
21-1023	Mental Health and Substance Abuse Social Workers
29-2053	Psychiatric Technicians

SOC Code	Description
Nursing and Nurse Specialties	
29-1141	Registered Nurses
29-1161	Nurse Midwives
29-2061	Licensed Practical and Licensed Vocational Nurses
Oral Health	
29-1021	Dentists, General
29-1022	Oral and Maxillofacial Surgeons
29-1023	Orthodontists
29-1029	Dentists, All Other Specialists
29-2021	Dental Hygienists
31-9091	Dental Assistants
Other Medical Specialties	
29-1041	Optometrists
29-1081	Podiatrists
29-1181	Audiologists
Pharmacy and Medication Management	
29-1051	Pharmacists
29-2052	Pharmacy Technicians
Physical Scientists and Engineers	
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers
19-2012	Physicists
19-2021	Atmospheric and Space Scientists
19-2042	Geoscientists, Except Hydrologists and Geographers
19-2043	Hydrologists
19-2099	Physical Scientists, All Other
19-4041	Geological and Petroleum Technicians
Plant and Field Technicians - Energy	
49-9051	Electrical Power-Line Installers and Repairers
49-9081	Wind Turbine Service Technicians
51-8013	Power Plant Operators
51-8092	Gas Plant Operators
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers
Plant and Systems Operators	
51-8021	Stationary Engineers and Boiler Operators
51-8031	Water and Wastewater Treatment Plant and System Operators
51-8091	Chemical Plant and System Operators
51-8099	Plant and System Operators, All Other
Primary Care	
29-1062	Family and General Practitioners
29-1063	Internists, General
29-1065	Pediatricians, General
29-1071	Physician Assistants
29-1171	Nurse Practitioners
Programmers and Developers	
15-1131	Computer Programmers
15-1132	Software Developers, Applications
15-1133	Software Developers, Systems Software
15-1134	Web Developers

SOC Code	Description
Rehabilitation Therapy	
29-1122	Occupational Therapists
29-1123	Physical Therapists
29-1126	Respiratory Therapists
29-1127	Speech-Language Pathologists
29-2054	Respiratory Therapy Technicians
31-2011	Occupational Therapy Assistants
31-2021	Physical Therapist Assistants
Specialty Engineering	
17-2011	Aerospace Engineers
17-2041	Chemical Engineers
17-2161	Nuclear Engineers
17-2171	Petroleum Engineers
Supply Chain, Purchasing, and Logistics	
13-1021	Buyers and Purchasing Agents, Farm Products
13-1022	Wholesale and Retail Buyers, Except Farm Products
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products
Surgical and OR Specialists	
29-1061	Anesthesiologists
29-1067	Surgeons
29-1151	Nurse Anesthetists
29-2055	Surgical Technologists
Systems and Data Administration	
15-1141	Database Administrators
15-1142	Network and Computer Systems Administrators
15-1143	Computer Network Architects
15-1151	Computer User Support Specialists
15-1152	Computer Network Support Specialists
Systems Architects and Analysts	
15-1111	Computer and Information Research Scientists
15-1121	Computer Systems Analysts
15-1122	Information Security Analysts
15-1199	Computer Occupations, All Other
Welders and Skilled Trades	
47-2111	Electricians
47-2152	Plumbers, Pipefitters, and Steamfitters
51-4121	Welders, Cutters, Solderers, and Brazers
51-4122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders
Wellness Occupations	
29-1031	Dietitians and Nutritionists

Source: TIP Strategies, Scruggs & Associates.

STEP 2. IDENTIFY KEY DEMAND FACTORS FOR THE OCCUPATION CLUSTERS:

Define the primary demand characteristics of various cluster and map where along the skill development curve those characteristics fall.

	INDUSTRY DRIVERS	DEFINING DATA FACTORS
Evolutionary	Is industry defining a key skill or technology as an up-and-coming trend or a potential disruptive influence on the industry? Do Oregon employers note a lack of repeatable standards making it hard to find training?	Does data show a prevalence of new jobs along with high growth rates in Oregon and for key industries?
Steady-Demand	Do industry leaders talk about the occupation or technology trend as a growing need that has proven value— "the next wave"? Do Oregon employers see a significant rise in future demand? Do employers note training options but not enough scale or nearby accessibility?	Does data show a combination of high growth rates, significant openings, and a competitive advantage for Oregon?
Mission-critical	Are industry trends talking about the widening gap for companies not adopting or addressing certain issues— "a rude awakening"? Do Oregon employers note a growing urgency in not being able to fill mid-level jobs?	Does data indicate a sudden loss of experienced workers along with a competitive advantage for the occupation to remain in Oregon?

STEP 3. MAP NEEDS ACROSS THE CATEGORIES OF INVESTMENT

	KEY CLUSTERS	POTENTIAL INVESTMENT MODELS	WORKING EXAMPLES
Evolutionary	Occupation cluster groupings from step 2	Learning labs and consortiums	Story Board's development of virtual reality training headsets for Clackamas Community College's Auto repair program
Steady-Demand	Occupation cluster groupings from step 2	Incumbent refresh and rapid retooling models	LBCC's surgical technology program Manpower's PowerYou training platform nationwide
Mission-critical	Occupation cluster groupings from step 2	Knowledge transfer/On-the-job training models	BCBSSC Apprenticeship Program in South Carolina

APPENDIX E. DATA & METHODOLOGY

CLASSIFICATION SYSTEMS

Much of the analysis presented in this report relies on three separate classification systems. A brief overview of each is presented below.

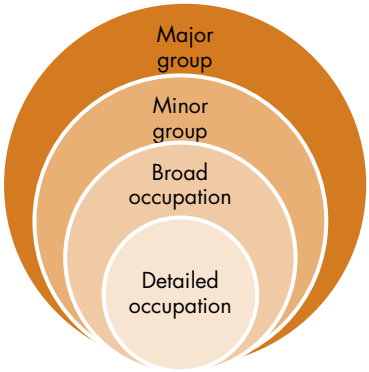
The **Standard Occupational Classification (SOC)** system is used by federal statistical agencies to classify workers into categories for the purpose of collecting, calculating, or disseminating data. This system groups all occupations in which work is performed for pay or profit according to the type of work performed and, in some cases, on the skills, education, or training needed to perform the work at a competent level. Under the 2010 SOC system, workers are classified into one of 840 detailed occupations, which are combined to form 461 broad occupations, 97 minor groups, and 23 major groups.

The **North American Industry Classification System** (NAICS, pronounced *Nakes*) was developed under the direction and guidance of the Office of Management and Budget (OMB) as the standard for use by Federal statistical agencies in classifying business establishments for the collection, tabulation, presentation, and analysis of statistical data describing the US economy. The classification system was developed jointly with government agencies in Canada and Mexico to allow for a high level of comparability in business statistics among the North American countries.

The version of NAICS currently in wide use was released in 2007 and classifies industries into 20 sectors based on production processes. These sectors are broken into subsectors, industry groups, and individual industries. An additional level of detail is provided to accommodate industry codes specific to the three countries. The classification system is updated every five years. The 2012 NAICS structure was finalized in August 2011. Federal statistical agencies were directed to begin using the new system for data published for reference years beginning on or after January 1, 2012.

STANDARD OCCUPATIONAL CLASSIFICATION SYSTEM

SOC STRUCTURE



SOC EXAMPLE

Major group 51-0000 Production occupations

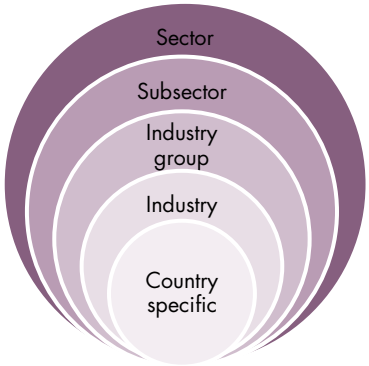
Minor group 51-2000 Assemblers & fabricators

Broad occupation 51-2090 Miscellaneous assemblers & fabricators

Detailed occupation 51-2092 Team assemblers

NORTH AMERICAN INDUSTRIAL CLASS. SYSTEM

NAICS STRUCTURE



NAICS EXAMPLE

Sector 31-33 Manufacturing

Subsector 336 Transportation equipment manufacturing

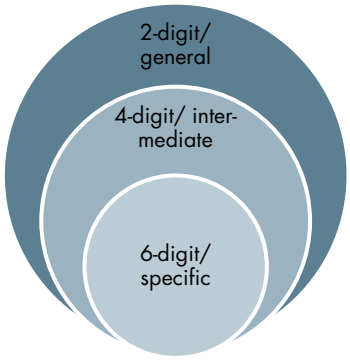
Industry group 3361 Motor vehicle manufacturing

Industry 33611 Automobiles & light duty motor vehicles, incl. chassis

Country-specific 336111 Automobiles & light duty motor vehicles, incl. chassis

CLASSIFICATION OF INSTRUCTIONAL PROGRAMS

CIP STRUCTURE



CIP EXAMPLE

General 14. Engineering

Intermediate 14.08 Civil engineering

Specific 14.0802 Geotechnical engineering

Source: US Bureau of Labor Statistics (SOC); US Census Bureau (NAICS); National Center for Education Statistics; TIP Strategies

The **Classification of Instructional Programs** (CIP) is the accepted federal government statistical standard on instructional program classifications. Developed in 1980 by the National Center for Education Statistics, the CIP is used by state agencies,

national associations, academic institutions, and employment counseling services for collecting, reporting, and analyzing instructional program data.

The CIP titles and program descriptions are intended to be generic categories into which program completions data can be placed, and are not exact duplicates of specific major or field of study titles used by individual institutions. The vast majority of CIP titles correspond to academic and occupational instructional programs offered for credit at the postsecondary level. These programs result in recognized completion points and awards, including degrees, certificates, and other formal awards. The CIP also includes other types of instructional programs, such as residency programs in various dental, medical, podiatric, and veterinary specialties that may lead to advanced professional certification, personal improvement and leisure programs, and instructional programs that lead to diplomas and certificates at the secondary level only.

DATA SOURCES

OREGON EMPLOYMENT DEPARTMENT

The Oregon Employment Department's Workforce and Economic Research Division is the state's primary source of occupational information and provides a variety of employment and industry sector data at the state and regional level. (www.qualityinfo.org) The division tabulates, among other data, employment and wages of establishments in the state which report to the Unemployment Insurance program. This information is then reported to the Bureau of Labor Statistics' Quarterly Census of Employment and Wages, (QCEW). Other programs, such as the Census Bureau's Local Employer-Household Dynamics (LEHD) and Quarterly Workforce Indicators, also merge this information with data collected from other states to construct national datasets.

In addition to this basic labor market information, the division does a wide range of custom analyses and in-depth research on various labor market topics. One such analysis is a comprehensive Job Vacancy Survey for the state and nine workforce regions. In this plan, the Oregon Employment Department provided various occupational data sets and vacancy survey information.

EMSI

The industry and occupational data presented in this report were prepared using EMSI's Complete Employment series. EMSI gathers and integrates economic, labor market, demo-graphic, and education data from over 90 government and private sector sources, creating a comprehensive and current database that includes both published data and detailed estimates with full coverage of the United States.

The company's core data consists of jobs (historical and projected) and earnings (current year) by industry and occupation for every ZIP code and county in the United States. EMSI data are annual averages of jobs (not workers); full- and part-time jobs are counted equally.

MAJOR SOURCES USED FOR EMSI's DATA RELEASES

DATA SOURCE	ABBRV.	AGENCY
State Personal Income	SPI	BEA
Local Area Personal Income	LPI	BEA
Industry Economic Accounts	IEA	BEA
American Community Survey	ACS	Census
County Business Patterns	CBP	Census
ZIP Code Business Patterns	ZBP	Census
Nonemployer Statistics	NES	Census
Quarterly Census of Employment and Wages	QCEW	BLS
Current Employment Statistics	CES	BLS
Natl. Employment Projections (Industry Occupation Matrix)	EP	BLS
Occupational Employment Statistics	OES	BLS
Railroad Retirement Board Tables, State/County	RRB	RRB
Long-term state industry projections		Individual states
LEHD/Quarterly Workforce Indicators	QWI	Census

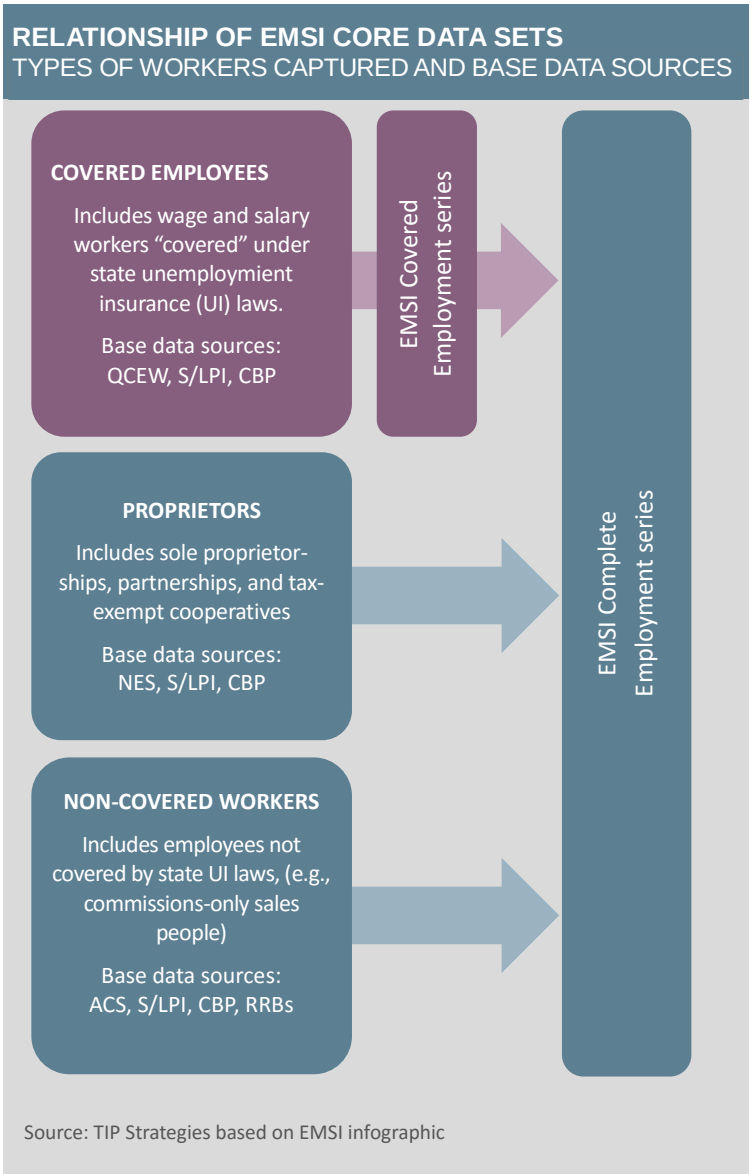
Source: EMSI data release notes * Indicates release date, not data reference period

EMSI produces industry and occupation datasets with two different types of coverage. Coverage refers to the types of jobs counted.

EMSI Covered: This dataset primarily counts "payroll" jobs that are covered by unemployment insurance (UI); the primary source is the Quarterly Census of Employment and Wages (QCEW). However, EMSI also includes some jobs excluded from QCEW, such as railroad jobs (which have their own UI program), all wage and salary agriculture jobs, and military. These additional categories are based on figures from State and Local Area Personal Income (S/LPI) reports produced by the Commerce Department's Bureau of Economic Analysis (BEA), and state and county railroad retirement boards (RRBs). Data from the Census-produced County Business Patterns (CBP) are also used.

EMSI Complete: This dataset includes all jobs in EMSI Covered, plus additional types of noncovered jobs, such as the self-employed (proprietors), commissions-only salespeople, and various types of non-UI-covered wage and salary workers. Major sources of self-employment data include Nonemployer Statistics (NES), the American Community Survey (ACS), and the S/LPI.

The relationship between EMSI Covered Employment and EMSI Complete Employment is diagrammed to the right.



Source: TIP Strategies based on EMSI infographic

For each data set, EMSI creates long-term, 10-year industry projections starting from the current year. These projections are based on a combination of the following:

- Recent trends in all industries for every local geography,
- National industry projections produced by the US Bureau of Labor Statistics (BLS),
- State and sub-state regional projections produced by individual states.

The company's methodology is designed to capture the expertise embodied in federal and state agencies. However, since official projections produced through the state-federal partnership typically have a base year that lags two to three years behind the current year, EMSI projections are also informed by the most recent data and trends available.

The first step in the process is to track recent local trends using a linear regression function. Taking into account the previous base data from 15, 10, and 5 years prior to the base year, EMSI's analysts plot a line as a function of year and employment. This line is dampened (flattened) to smooth out the effects of any volatility. Once this is done, state and local government industries (as well as the US Postal Service) are projected based on the growth or decline of local economies rather than projected

through linear regression. Federal government and military, however, are projected through linear regression at the national level and their growth rate is then applied to the states and counties. Next, EMSI adjusts the projections for all counties so they sum to state- and national-level numbers.

After these initial projections are completed, EMSI's analysts begin a series of controls and adjustments to other data sources. The first of these is an adjustment to the BLS staffing patterns. Essentially the company's projected national growth rate is changed to match the growth rate of the BLS numbers. This adjusts the curve up or down while staying as close to our projected values as possible. Following this, county and state-level projections are adjusted to the state-produced state and sub-state regional projections. County values are controlled to the regional data and state projections are controlled to the reported state data. Once these adjustments and controls are completed, the final state-level numbers are aggregated to determine the final national projections. This causes EMSI data to match state projections very closely, but it also means EMSI projections can stray from the national projections.

The company has incorporated workforce demographics in the latest release of its analytical tools. This data is drawn from the relatively new Local Employment Household Dynamics series produced through a partnership of several federal agencies led by the US Census Bureau. One of its primary data sources, Quarterly Workforce Indicators, provides the basis for EMSI's estimates of occupations by age and gender.