



2020
STATE OF THE
TRANSPORTATION AND
MOBILITY WORKFORCE
REPORT

SWTWC
Southwest Transportation Workforce Center





2020 State of the Transportation and Mobility Workforce Report

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Empowering Transportation and Mobility Professionals in Unprecedented Times

This State of the Transportation and Mobility Workforce report presents a data-driven approach to benchmarking and assessing top priorities for transportation and mobility professionals responsible for all aspects of the systems that move people and goods in predictable and unpredictable times.

The impact of the Coronavirus Disease of 2019 (COVID-19) on U.S. communities is unprecedented and there are many lessons that leaders in industry, education, and government can learn from the recovery and response to the pandemic. During the 2020 recovery and in the years ahead, it is incumbent on leaders in transportation and mobility to build new levels of resiliency and responsiveness into the interconnected transportation and mobility systems that move people and goods to keep communities and economies healthy and strong. Meeting these new standards for mobility of people and goods will require empowering the professionals who design, develop, operate, and maintain those systems.

The COVID-19 experience has cast a spotlight on workforce and mobility issues that have always existed and that will be more relevant than ever in the years ahead. A scoping paper for the 7th European Union-United States Research Symposium stated that: *“There are a number of essential transportation workers during a pandemic needed to support supply chains and public transportation and shared mobility. What are best practices for maintaining their physical and mental well-being? For example:*

- **Employees supporting or enabling transportation functions, including truck drivers, bus drivers, dispatchers, maintenance and repair technicians, warehouse workers, truck stop and rest area workers, Department of Motor Vehicle (DMV) employees, towing/recovery services, roadside assistance workers, intermodal transportation personnel, and workers who maintain and inspect infrastructure (including those that require cross-jurisdiction travel).**
- **Workers and drivers supporting the distribution of food, pharmaceuticals (including materials used in radioactive drugs) and other medical materials, fuels, chemicals needed for water or water treatment and energy maintenance and operation of essential highway infrastructure, including roads, bridges, and tunnels (e.g., traffic operations centers and moveable bridge operators).**
- **Mass transit workers and providing critical transit services and/or performing critical or routine maintenance to mass transit infrastructure or equipment.**
- **Employees supporting personal and commercial transportation services – including taxis, delivery services, vehicle rental services, bicycle maintenance and car-sharing services, and transportation network providers.**
- **Workers responsible for operating and dispatching passenger, commuter and freight trains and maintaining rail infrastructure and equipment.**
- **Maritime transportation workers, including dredgers, port workers, mariners, ship crewmembers, ship pilots and tug boat operators, equipment operators (to include maintenance and repair, and maritime-specific medical providers), ship supply, chandler, and repair companies.”**

In addition to these vital frontline transportation and mobility jobs, system and infrastructure planners, engineers, supply chain and logistics experts, and wide range of other blue, white, and green collar professionals will require workforce development resources and training. This report focuses on transportation and mobility workforce priorities for California, Arizona, Texas, Colorado, Nevada, New Mexico, Utah, and Oklahoma. The next issue of this report will address the most critical needs and priorities facing the professionals responsible for our nation’s transportation and mobility systems. In the aftermath of COVID-19, leaders in transportation and mobility will navigate a new era when transportation resilience of all mobility systems matters more than ever before. Resilient mobility systems require a resilient workforce. This report and all future editions seeks to empower this essential workforce.

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Introduction

I. Introduction

The mobility of people and the goods they need to survive and thrive determines the success of communities around the world; it is a term that reflects not only the hardware and software driving the systems, but also the socioeconomic mobility of the people those systems serve. Given the importance of the transportation and mobility systems to the United States of America, critical benchmarking and evaluation of the workforce that maintains these systems is essential. This report seeks to introduce a methodology for providing a “State of the Transportation and Mobility Workforce Report” for the nation. This report applies that benchmark- and evaluation-based methodology to the Southwest Transportation Workforce Center footprint: California, Arizona, Nevada, Utah, Colorado, New Mexico, Texas, and Oklahoma. Subsequent iterations of this research and report methodology will be applied to every U.S. state and territory. Those reports will be presented by the National Network for the Transportation Workforce and hosted on its website: www.nntw.org.

This report seeks to introduce a methodology for providing a “State of the Transportation and Mobility Workforce Report” for the nation.

Twenty-first century transportation networks are simultaneously driven by human and machine systems. That reality marks a new era where modern mobility has as much to do with tires, roads, and rails as it does digital information streams, wireless connectivity, predictive analytics, and machine-learning algorithms. Those transformational technological and socioeconomic trends are redefining the systems that move people and goods. Those trends are reshaping individual mobility choices, the economy, and the very notion of what transportation means.

During this period of rapid change, it is incumbent upon leaders in industry, education, and government to view this “transformational moment” as an opportunity to recruit and train a new mobility workforce. These future professionals will be equipped with a wide breadth of adaptable knowledge, skills, and abilities that enable them to harness emerging technologies to better design, develop, operate, and maintain the mobility systems of the future.

During this period of rapid change, it is incumbent upon leaders in industry, education, and government to view this “transformational moment” as an opportunity to recruit and train a new mobility workforce.



In 2012, the Council of University Transportation Centers partnered with the U.S. Departments of Education, Labor, and Transportation and other public/private sector leaders, to host the influential National Transportation Workforce Summit (NTWS). That summit and its subsequent 2015 report, *“Strengthening Skills Training and Career Pathways Across the Transportation Industry,”* elevated four transportation workforce development issues as national priorities:

- **Demographic changes, particularly retiring baby boomers;**
- **Career awareness and recruitment;**
- **New technologies and the need for operators and managers who can use them; and**
- **Rising demands on transportation organizations and its workforce.**

These national priorities are more critical in 2020 than they were back in 2012. Sharp demographic changes are increasing as baby boomers retire and other industries compete to recruit incoming generations. According to the 2015 NTWS report, “53 percent of current workers within the six subsectors are 45 years or older, 9 percent more than the national average.” The 2015 report also forecast that “transportation industry employers will need to hire approximately 4.6 million workers, an equivalent of 1.2 times the current transportation employment from 2012 to 2022.”



The 2012 summit and related report functioned as a state of the transportation workforce for the nation. Given the national importance of the systems that move people and goods throughout every community in every U.S. state, the NNTW will deliver an updated “State of the Transportation and Mobility Workforce Report” on an annual basis. In addition to providing essential data benchmarks on the state of the workforce, the annual reports will also identify outreach strategies to recruit underrepresented populations. Such recruitment will empower women, veteran, tribal, rural, and inner-city demographics to join the transportation and mobility workforce. Said another way, the U.S. needs a transportation and mobility workforce that reflects the demographics of the entire country.

This report provides industry benchmarks and related commentary that are a product of five years of comprehensive research on the transportation and mobility workforce. The report highlights important findings and affords readers an opportunity to consider priorities for the coming decade. The year of publication for this report, 2020, affords an opportune time to consider what the mobility workforce will look like in 2030.

The methodology used to develop this report began with a review of quantitative and qualitative information from federal, state, and private sector research, peer-reviewed articles, white papers, technical reports, conference presentations, case studies, and HR documents (*e.g., position descriptions, job advertisements, career ladders, trainings, strategic plans*). Using that review of current and historical transportation industry data established a framework with which to identify employment trends both in the Southwest and nationally.



This report provides industry benchmarks and related commentary that are a product of five years of comprehensive research on the transportation and mobility workforce.



This report is also a product of intellectual contributions from leaders in industry, education, and government who have shared their expertise about transportation systems and the professionals who design, develop, operate, and maintain them. During the many interviews, focus groups, and advisory meetings, NNTW members have researched a wide range of topics that include, but are not limited to:

- **Work environments**
- **Critical job functions**
- **Challenges created by transformational technology**
- **Workforce impacts created by government regulation**
- **Reliance on contracted staff**
- **Outsourcing of staff functions**
- **Anticipated workforce trends over the next 5 to 10 years**
- **Recruitment and retention challenges faced within an agency**
- **Solutions used to successfully address workforce challenges**

Members of the NNTW would like to thank the countless contributors to the network’s many research programs and products!

One of the greatest constraints in compiling this report was the availability of relevant, recent data. For example, much of the labor market analysis in this report focuses on Bureau of Labor Statistics (BLS) data to determine future employment needs for transportation-related jobs in the region. Disparities in state-by-state versus national occupational and employment data models tend to favor a national analysis over the regional. The next State of the Transportation and Mobility Workforce report has the advantage of drawing from the 2020 U.S. Census and fully updated BLS statistics to document these trends and their workforce priorities.



The FHWA selected METRANS as one of five Regional Surface Transportation Workforce Centers.

Report Objectives

This report builds on SWTWC’s previous *“Job Needs and Priorities Report”* research to define a series of priorities that will address transportation workforce needs in the region. By supplementing traditional labor market data with strategic workforce research and action planning, we share guidance to move the industry into the future while providing explanations regarding the need for these actions.

29%

The region contains approximately 29% of the US population, which includes the nation’s two most populous states, 12 of the nation’s 25 most populous cities (Census, 2018), and 10 of the nation’s 15 fastest growing cities (Census, 2019).

II. Benchmarking Mobility

Housed at the Center for International Trade & Transportation (CITT) at California State University, Long Beach (CSULB), the Southwest Transportation Workforce Center (SWTWC) serves a region with some of the most extensive public and private-sector passenger and freight transportation networks in the world. The Southwest region includes eight states – California, Nevada, Arizona, New Mexico, Colorado, Utah, Texas, and Oklahoma – representing a vast geographic expanse that includes diverse urban, suburban, and agricultural workforce settings, as well as several globally significant ports, numerous international and domestic airports, and an international border shared with Mexico.

The Southwest region covers approximately 29% of the United States and approximately 28% of the U.S. population, including the nation's two most populous states (*U.S. Census Bureau, 2019*), 12 of the nation's 25 most populous cities (*U.S. Census Bureau, 2018a*), and 10 of the nation's 15 fastest growing cities (*U.S. Census Bureau, 2018b*).

The region contains 70% of U.S. cities with populations more than 1 million residents, including Los Angeles, Houston, Phoenix, San Antonio, San Diego, Dallas, and San Jose (*U.S. Census Bureau, 2018a*). Of the nation's cities with populations exceeding 1 million, these southwest cities are also experiencing the highest levels of growth (*U.S. Census Bureau, 2018b*). This growth drives the development and restructuring of the workforce in the Southwest region.

Further, the region contains five of the seven largest states in terms of area: Texas, California, New Mexico, Arizona, and Nevada. Aside from California and Texas, no state in the Southwest is ranked in the top 35 states in terms of population density. This growth drives the development and restructuring of the workforce in the Southwest region.

Figure 1 illustrates the Southwest region's county-by-county population density. While most states in the region have fairly low population densities overall, California in particular contains population-dense areas within and surrounding Los Angeles and San Francisco (*Figure 2*). This interregional variation in density is valuable when thinking about the composition of the mobility workforce.

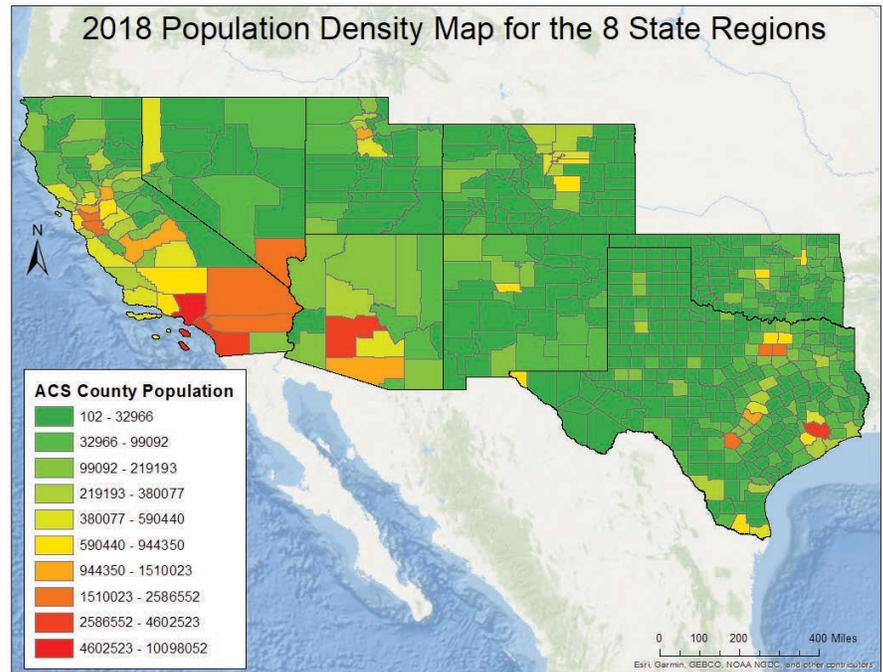


Figure 1: Southwest Region Population Density (per square mile)

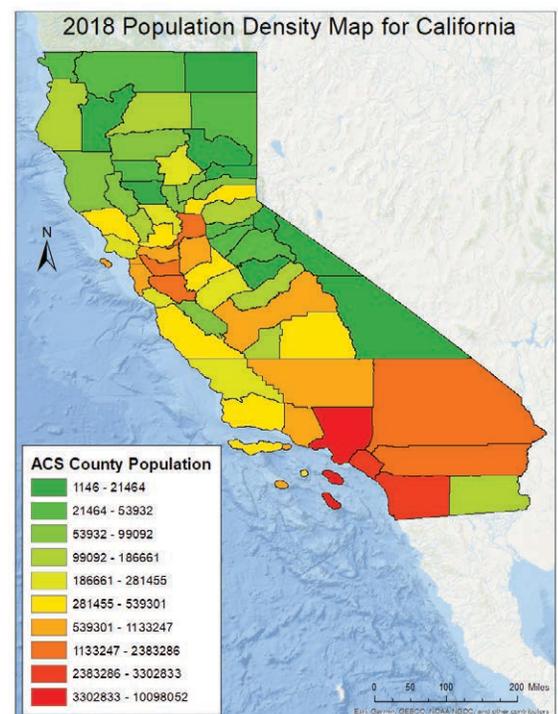


Figure 2: California Population Density (per square mile)

Along with population density, understanding the Southwest's transportation infrastructure and commuter profile is an essential aspect of the mobility workforce. For example, the percentage of commuters using public transit in every southwest state is less than or equal to the national average of 5.0%, likely due to their extensive public road networks. By contrast, California has the fewest public road miles per person in the region and the highest percentage of commuters using public transit, meaning that more commuters use transit in states with densely populated areas. Exhibit 1 below shows these statistics and others by state.

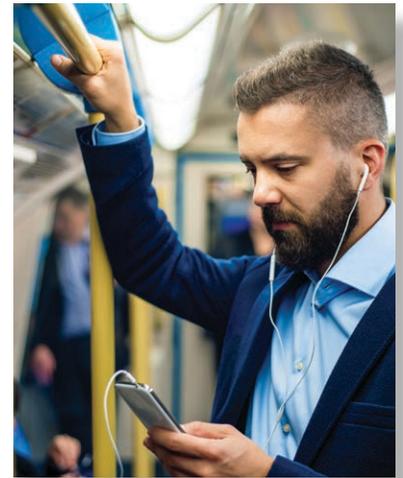
Exhibit 1: Overview of Population and Transportation By State for the Southwest Region (Census, 2019; US DOT Bureau of Transportation Statistics, 2019)						
STATE	POPULATION	AREA	PUBLIC ROAD MILES	COMMUTERS USING PUBLIC TRANSIT	FREIGHT RAILROAD MILES	PUBLIC ROAD MILES PER 1,000 PEOPLE
Arizona	7,278,717	113,594.08	65,558	1.80%	1,820	9.01
California	39,512,223	155,779.22	176,214	5.00%	4,828	4.46
Colorado	5,758,736	103,641.89	88,818	3.20%	2,427	15.42
Nevada	3,080,156	109,781.18	48,234	3.10%	1,193	15.66
New Mexico	2,096,829	121,298.15	77,205	1.10%	1,879	36.82
Oklahoma	3,956,971	68,594.92	112,865	0.30%	3,158	28.52
Texas	28,995,881	261,231.71	314,319	1.40%	10,506	10.84
Utah	3,205,958	82,169.62	49,290	2.30%	1,386	15.37
Southwest Total	93,885,471	1,016,091	932,503	0.182	27,197	136.1

Among public transit commuters in the Southwest, buses are the preferred method of transportation. In some states, such as Texas and Colorado, light rail is also heavily used by those who use public transit to get to work. Outside of California, commuters in the Southwest do not use heavy or commuter rail to get to work. Exhibit 2 below shows the percentage of public transit commuters by mode and state in the region.

Exhibit 2: Public Transit Commuters, by Mode, in the Southwest Region (US DOT Bureau of Transportation Statistics, 2013)				
STATE	BUS	HEAVY RAIL	LIGHT RAIL	COMMUTER RAIL
Arizona	82.9%	0.0%	14.2%	0.0%
California	65.2%	12.3%	12.1%	2.3%
Colorado	76.5%	0.0%	21.7%	0.0%
Nevada	86.1%	0.0%	0.0%	0.0%
New Mexico	90.5%	0.0%	0.0%	6.6%
Oklahoma	76.9%	0.0%	14.7%	0.7%
Texas	45.7%	0.0%	40.6%	8.2%
Utah	82.9%	0.0%	14.2%	0.0%

Amtrak provides long distance or corridor service in every state within the Southwest region, and 20 of the 50 busiest Amtrak stations in the United States are in the region. Three of the corridors in the region have more than a million passengers per year: the Pacific Surfliner (San Diego to Los Angeles to San Luis Obispo: 2,654,808); Capital Corridor Service (San Jose to Oakland to Sacramento to Auburn: 1,696,338); and San Joaquin Service (Oakland/Sacramento to Bakersfield: 1,065,362). California contributes the vast majority of this infrastructure in the region, and 9 million people used Amtrak in California in 2014. Oklahoma and Texas also provide state funding to Amtrak in support for the Heartland Flyer route. Exhibit 3 shows total ridership for each of the busiest stations in the Southwest.

Exhibit 3: Busiest Passenger Rail Stations in the Southwest (Amtrak, 2014)			
CITY	TOTAL RIDERSHIP	CITY	TOTAL RIDERSHIP
Los Angeles, CA	1,551,090	Fullerton, CA	336,265
Sacramento, CA	1,022,322	Santa Barbara, CA	319,245
San Diego, CA	700,107	Oakland, CA	303,431
Emeryville, CA	578,386	Stockton, CA	292,818
Bakersfield, CA	521,423	Anaheim, CA	254,066
Irvine, CA	406,451	Richmond, CA	241,962
Fresno, CA	389,543	San Juan Capistrano, CA	226,515
Solana Beach, CA	384,547	Hanford, CA	220,144
Martinez, CA	359,755	San Jose, CA	210,297
Davis, CA	358,350	San Diego-Old Town, CA	196,795



Amtrak also operates the commuter service for Metrolink in California, which services the Los Angeles and San Bernardino area. Commuter rail is different from rapid transit systems as it is larger, providing more seating (and less standing room) due to the long distances covered, and having less frequently scheduled services. The Southwest Region has 8 of the 20 largest commuter rail services, representing California, Utah, Texas and New Mexico (APTA, 2014). The strong presence of rail, both freight and passenger, in the Southwest show the need for employees who can operate, repair and maintain the cars and other infrastructure while assuring the safety of freight and passengers.

Both the Southwest and the nation are defined by densely populated urban agglomerations surrounded by sparsely populated areas. Public roads will remain central to the national transportation infrastructure and rail and buses continue to be fundamental aspects of public transit. In many respects, the future of mobility systems in the U.S. face an age-old problem: connecting the concentrated areas where people live to the locations where they work. Solving this mobility problem is a top priority for the future mobility workforce.

During this period of rapid change, it is incumbent upon leaders in industry, education, and government to view this “transformational moment” as an opportunity to recruit and train a new mobility workforce.

When it comes to solving transportation and mobility problems national and statewide work-force metrics have limited analytical value. Leveraging datasets to do more targeted analyses of specific demographics on a more localized level is important to crafting more actionable workforce policies. For example, a landmark interdepartmental report on workforce development in the transportation industry by the U.S. Departments of Labor, Education, and Transportation, identified that women represent only 20% of the nation’s transportation workforce (*U.S. DOL et al., 2015*). This is a significant finding but establishing a set of standards for data visualization and its related analyses that help to break down aggregate national figures into more manageable units will be of more use to policymakers. Figures 3 and 4 illustrate this point by helping us visualize national

Creating a platform for policymakers to better visualize workforce gaps and target investments to address them.

employment data at the state and local levels, where more meaningful comparisons can readily be made. Such visualizations “make it possible to develop new visual benchmarks that comprehensively define the new mobility workforce and create a platform for policymakers to better visualize workforce gaps and target investments to address them.”

This same benchmark approach can also be applied when evaluating targeted populations prevalent in the region, such as race, veterans, Native Americans, and other rural communities, to provide more accessible visualizations of data when considering policy-making decisions or developing specific workforce interventions.



Figure 3: Percentage of Women in Transportation & Material Movement

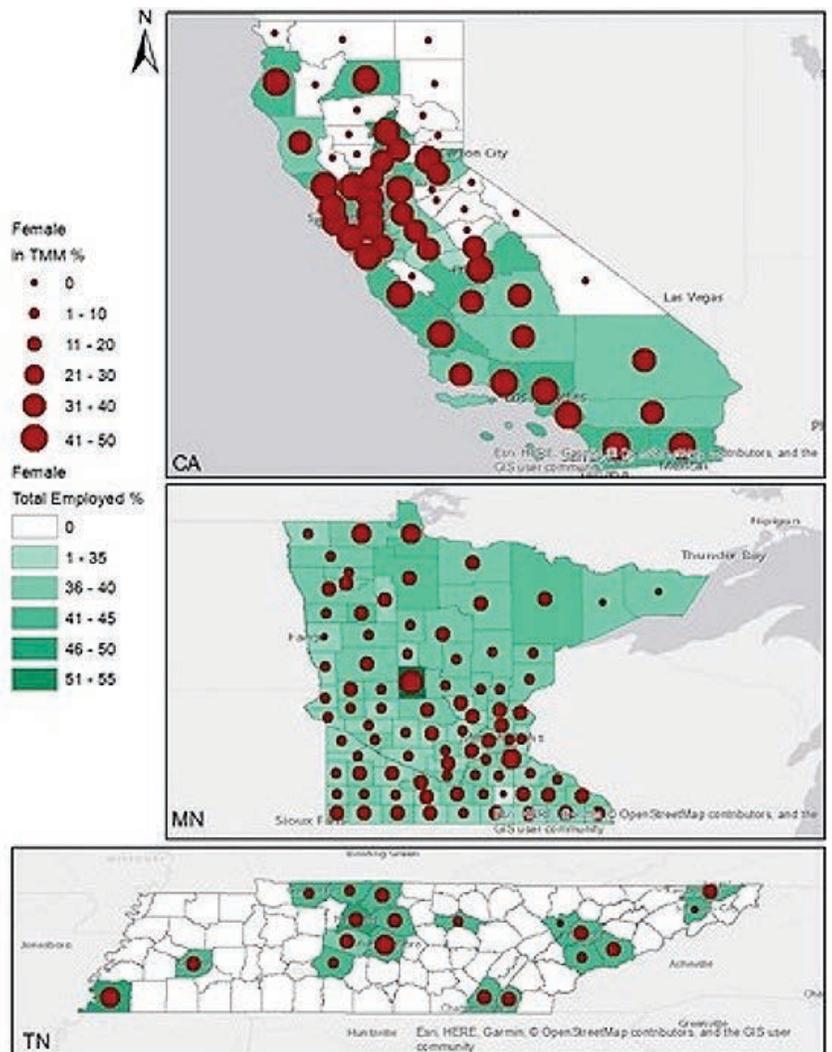


Figure 4: Percentage of Women in Transportation & Material Movement



NNTW will use methods applied in this regional report to develop future reports that represent the nation's transportation workforce.

The Southwest region offers a unique opportunity to examine workforce needs connected to urban and rural transportation services, transportation through border states, trade gateways and corridors, and states with significant Native American and Hispanic populations. Members of the National Network for the Transportation Workforce (NNTW) will use the methods applied in this regional report to develop future reports that represent the nation's transportation workforce. To empower a new mobility workforce, leaders in industry, government, and education need to work together to address transformational socioeconomic and technological trends that include:

- **Changing skillsets required for current employees;**
- **Large numbers of workers becoming eligible for retirement;**
- **Technological advancements that are changing the transportation industry and will invariably cause gaps in the workforce pipeline;**
- **Demand for more nimble service delivery amidst changing business objectives and workforce demands;**
- **Talent shortages and adjusting to the culture of a new workforce; and**
- **Increased use and efficiency of data science, curation, analytics, and business intelligence to support efficient decision making.**

III. Transportation Expenditures

To better inform the perspective of the workforce and potential jobs created through the transportation industry, it is essential to look at expenditure data in the region. The total transportation expenditures by state and local governments in the Southwest exceeds 64 billion dollars per year (BTS, 2012). This makes up approximately 25.9% of the \$249 billion spent by state and local governments within the United States. The Southwest region contributes 25.05% of funds to the United States for highways, 25.18% of the total funds for transit, 33.28% of funding for air, and approximately 31.04% of total funds for water transportation.¹ The 2021 State of the Transportation and Workforce Mobility Report will provide a more detailed state-by-state breakdown of contributions to specific modes of transportation.

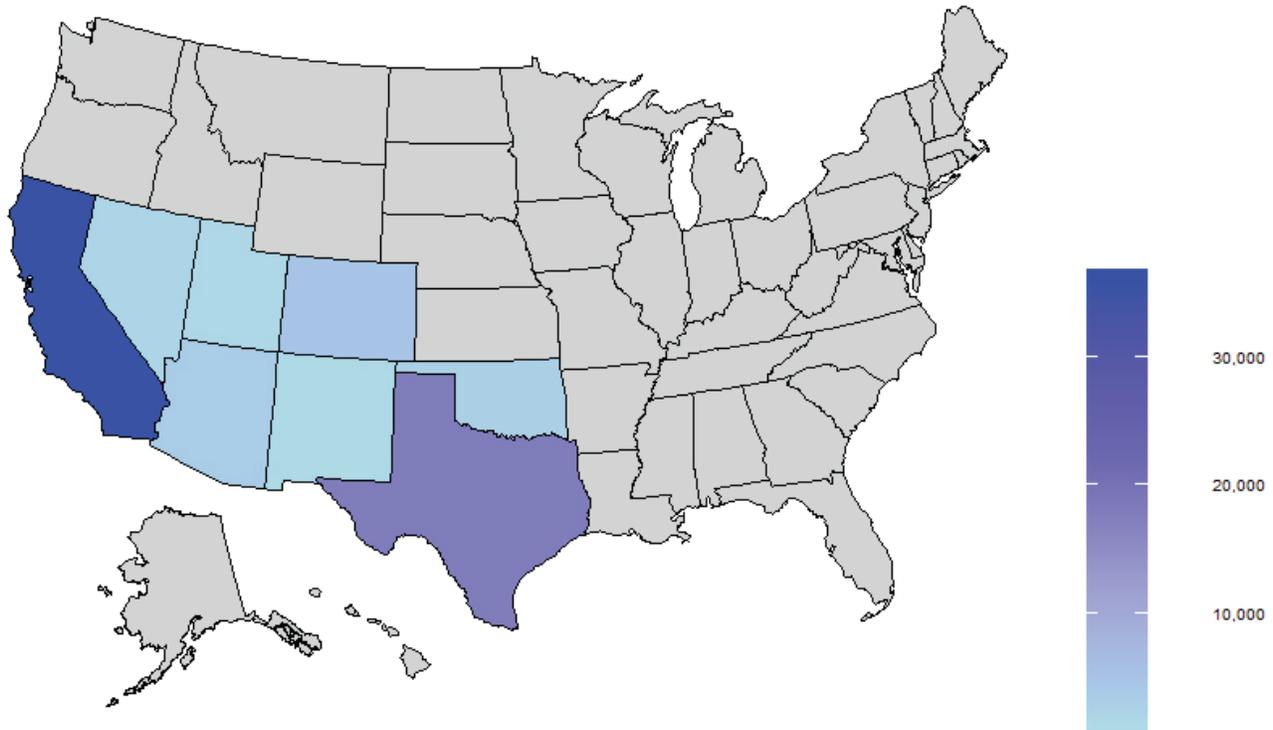


Figure 5: Total Transportation Expenditures (2012)

Exhibit 4: Transportation Expenditures by State & Local Governments					
Reported in Millions of Dollars (2012)					
STATE	HIGHWAY	TRANSIT	AIR	WATER	TOTAL
Arizona	\$2,343	\$670	\$582	n/a	\$3,595
California	\$17,080	\$10,452	\$3,519	\$1,261	\$32,312
Colorado	\$2,410	\$581	\$550	\$2	\$3,543
Nevada	\$1,686	\$361	\$651	n/a	\$2,698
New Mexico	\$1,044	\$135	\$87	n/a	\$1,266
Oklahoma	\$2,330	\$72	\$138	\$11	\$2,550
Texas	\$11,348	\$2,783	\$1,528	\$371	\$16,030
Utah	\$1,962	\$624	\$111	n/a	\$2,696
Southwest Region Total	\$40,203	\$15,678	\$7,166	\$1,645	\$64,690
United States Total	\$160,459	\$62,270	\$21,533	\$5,300	\$249,562

Note: n/a = data not available, no activity, value of zero, or value too small to report. At the time of this report, 2012 expenditure data represents the most recent statistics made available by the Bureau of Transportation Statistics (BTS)

Note 1: Considering that only four of the eight states in the region have inland waterways and report their water related expenditures, it is quite notable that this comprises nearly one-third of total expenditures.

IV. Diversity of Job Functions

The transportation industry overall contains a great variety of occupations, within which exists a wide range of job functions. To ensure that transportation organizations run effectively and efficiently, these occupations need to be filled by qualified individuals that can provide the needed services.²

Looking specifically at transportation and warehousing occupations in the Southwest, these occupations employ over one and a half million workers, as reported by the BLS (*Exhibit 5*). The majority of these employees (86%) work in private organizations, with the remaining in federal, state, or local government positions. While these individuals work in different modes of transportation and different types of organizations, this overview of the total number of positions serves to show the importance of focusing on transportation jobs and careers in the region due to the prevalence of these types of positions in the region. Furthermore, over one-quarter (27%) of transportation and warehousing employees in the US are employed within the Southwest region, signifying the importance of this region for the transportation industry.

Note 2: To identify which occupations within the Southwest transportation sector are most important, jobs were first identified using occupational codes and by pulling employment data from existing DOL and BLS databases. These databases offer a comprehensive look into each occupational category and its underlying labor market statistics.

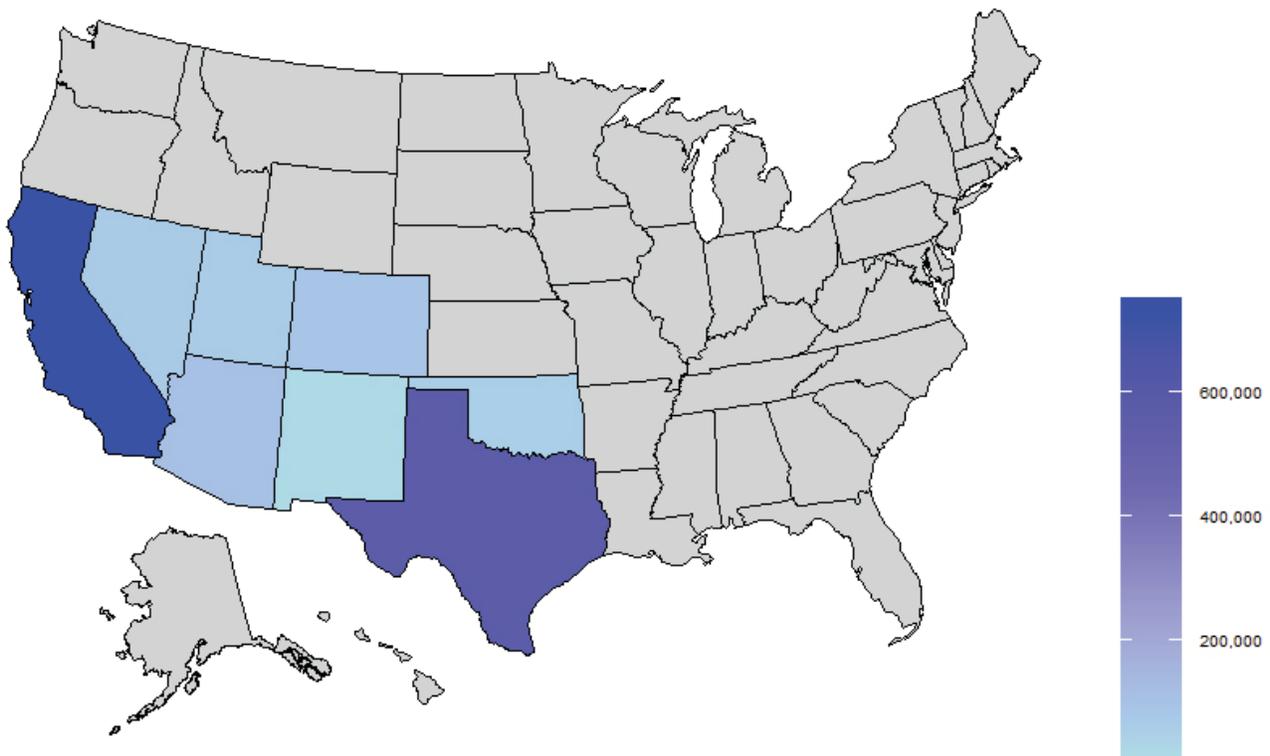
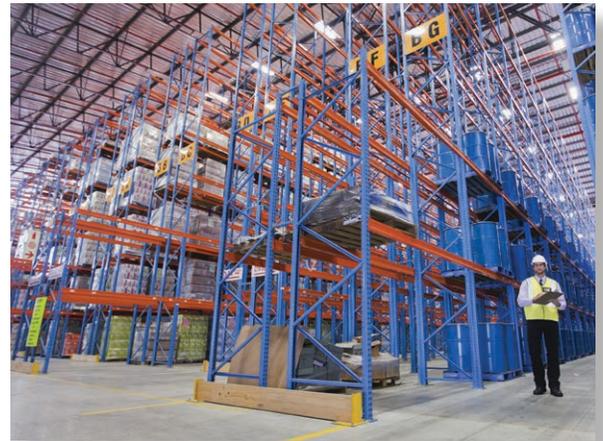


Figure 6: Total Employment in Transportation & Warehousing.

Exhibit 5: Number of Employees in Transportation & Warehousing Occupations by State
(NAICS Codes 48-49, June 2019)

STATE	EMPLOYEES IN PRIVATE ORGANIZATIONS			EMPLOYEES IN FEDERAL, STATE & LOCAL GOVERNMENT			TOTAL EMPLOYEES		
	TOTAL	SW%	US%	TOTAL	SW%	US%	TOTAL	SW%	US%
Arizona	101,377	6.73%	1.88%	11,157	4.77%	1.16%	112,534	6.46%	1.77%
California	620,583	41.17%	11.48%	114,373	48.89%	11.89%	734,956	42.21%	11.55%
Colorado	81,516	5.41%	1.51%	13,277	5.68%	1.38%	94,793	5.44%	1.49%
Nevada	69,265	4.60%	1.28%	4,487	1.92%	0.47%	73,752	4.24%	1.16%
New Mexico	19,106	1.27%	0.35%	5,152	2.20%	0.54%	24,258	1.39%	0.38%
Oklahoma	52,337	3.47%	0.97%	8,167	3.49%	0.85%	60,504	3.47%	0.95%
Texas	504,216	33.45%	9.33%	65,570	28.03%	6.82%	569,786	32.72%	8.95%
Utah	58,960	3.91%	1.09%	11,744	5.02%	1.22%	70,704	4.06%	1.11%
SW Total	1,507,360			233,927			1,741,287		
US Total	5,403,744			961,852			6,365,596		



While this snapshot of the transportation industry within the Southwest is helpful to see overall impact, it is necessary to examine specific occupations and projected changes in the number of employees to adequately plan for the future of the transportation workforce. BLS and individual state departments of labor develop 10-year predictions to help with long term planning, specifically with regard to career choice. These predictions are based on how fast employment is expected to grow or decline for each occupation and are updated every two years.



As such, data included in this report present both the number of employees in the Southwest for each occupation as well as that 10-year projection. This data is collected from the most recent BLS national projections (*i.e.*, 2016 and 2026). The analysis behind the 2021 State of the Transportation and Mobility Workforce Report will benefit greatly from the results of the 2020 U.S. Census, which will be applied on both a state-by-state and national basis.

V. Occupational Priorities

The transportation occupations that are important in the Southwest region are wide ranging.³ In terms of the number of employees projected from 2016 to 2026, those transportation occupations showing the greatest increases in the Southwest region are:

- **Laborers & Freight, Stock, & Material Movers**
- **Heavy & Tractor-Trailer Truck Drivers**
- **Light Truck or Delivery Services Drivers**
- **Industrial Truck & Tractor Operators**
- **Cleaners of Vehicles & Equipment**

Correspondingly, there will likely be several new jobs created within these occupational classifications. When looking strictly at projected demand in terms of a percentage growth increase from 2016 to 2026, the priority job classifications change to:

- **Ambulance Drivers/Attendants (except EMT)** 23.5% increase
- **Motorboat Operators** 22.2% increase
- **Taxi Drivers & Chauffeurs** 21.6% increase
- **Tank Car, Truck, & Ship Loaders** 18.9% increase
- **Airfield Operations Specialists** 18.3% increase

Of particular note, all of the occupations above present a projected growth percentage increase within the Southwest region that exceeds national projections. Future iterations of this report will look to expand the comparisons between state, regional, and national employment projections to identify occupational demand due to socioeconomic, weather, and geographic factors. When evaluating the transportation workforce as a whole, it is essential to consider that many employees are not included in occupations that are specific to transportation.

For example, engineers are often employed by transportation organizations, but they also work in other industries. While in all cases employees are expected to have the competencies required to properly perform their duties, they often do not need a background in transportation, as such employment or industry specific knowledge can be learned on the job.⁴



Note 3: When describing and analyzing occupations, federal and state agencies that collect, analyze, and share information about occupations organize data using a Standard Occupational Classification (SOC) system. In this system, each generalized occupation is assigned a unique code, which are then grouped together into similar occupational categories. Within this system there are 23 major occupational groups, such as "Transportation & Material Moving." Occupations within this group begin with the SOC designator "53." Appendix A provides data for all occupations within group "53" that were identified as relevant to the Southwest region.

Note 4: To ensure that occupations in other SOC major groups that cut across industries are appropriately evaluated, those occupations outside of the "Transportation & Materials Moving" group were also examined.

Such occupations will see an even greater boost in workforce demand due to their broader application across multiple industries. This is especially true for occupations that are expected to grow over the next 10 years. Those that play an important role in transportation are often more technical in nature, representing the fields of engineering, science, construction, and maintenance/repair. Other critical occupations in transportation serve more managerial or supporting roles. While most “Transportation & Materials Moving” jobs require a high school diploma or equivalent, those in engineering, science, construction, maintenance/repair, management, service, and supporting occupations often require a college degree. This demonstrates the importance of ensuring college students in these fields are aware of transportation as a career option, as well as demonstrating the value of working within the transportation industry.

For those occupations requiring only a high school diploma or equivalent, it is essential the required technical training or programs be available to high school students so that they can become successful in transportation careers after graduation. Appendix A presents two tables of occupational data and job growth projections for relevant occupations in the Southwest, the first presenting the fields of engineering, science, construction, and maintenance/repair; the second presenting management, service, and support-based occupations.

Priority Occupations

By analyzing projected occupational employment increases in the Southwestern states – using a combination of labor market data, employer survey, and stakeholder input – this list (*Exhibit 6*) was compiled of the recommended occupations to prioritize for this region.

Exhibit 6: Southwest Priority Occupation Job Growth, 2016 – 2026			
SOC	OCCUPATIONAL TITLE	SOUTHWEST INCREASE	NATIONAL INCREASE
49-3031	Bus & Truck Mechanics & Diesel Engine Specialists	17.2%	9.3%
53-3021	Bus Drivers, Transit & Intercity	15.8%	9.0%
11-3021	Computer & Information Systems Managers	16.5%	10.6%
17-2051	Civil Engineers	19.9%	12.0%
53-3032	Heavy & Tractor-Trailer Drivers	15.5%	5.8%
13-1081	Logisticians	13.7%	6.9%
53-7062	Laborers & Freight, Stock, & Material Movers, Hand	17.0%	7.6%
47-2073	Operating Engineers, Construction Equipment Operators	19.4%	12.3%
17-1022	Surveyors	17.4%	11.2%
17-3031	Surveying & Mapping Technicians	17.8%	10.6%
53-6041	Traffic Technicians	16.4%	9.1%
11-3071	Transportation, Storage, & Distribution Managers	15.7%	6.8%
19-3051	Urban and Regional Planners	15.8%	12.8%

WORKFORCE MEGATREND

Workforce Reductions

There are also occupations in the Southwest for which a reduced workforce is predicted. By 2026, “Aircraft Structure, Surfaces, Rigging, & Systems Assemblers” will see a 6.3% reduction job demand, while “Parking Enforcement Workers” will see a 33.1% reduction.



In considering these occupations, ongoing transportation workforce trends, and specific case studies, SWTWC has assembled a series of four research priorities that build upon the Center’s foundational work on identifying the region’s growing occupational demands, technological advancements, and resulting worker skills gaps, to develop targeted and actionable strategies and plans that will address these challenges to economic growth and industry competitiveness.

Critical to the continued success and effectiveness of the Southwest region’s transportation and supply chain industries, these research priorities look to tackle (1) the growing need to broadly deploy an apprenticeship model that better reflects the 21st century workplace, (2) providing better workforce access to and job training for the region’s more rural/tribal populations, (3) more effectively tackling the widening gap between available trucking positions and job-seeker interest, and (4) designing a better approach to attracting talent from underrepresented populations as a way to fill the growing gap between employer need and worker availability.

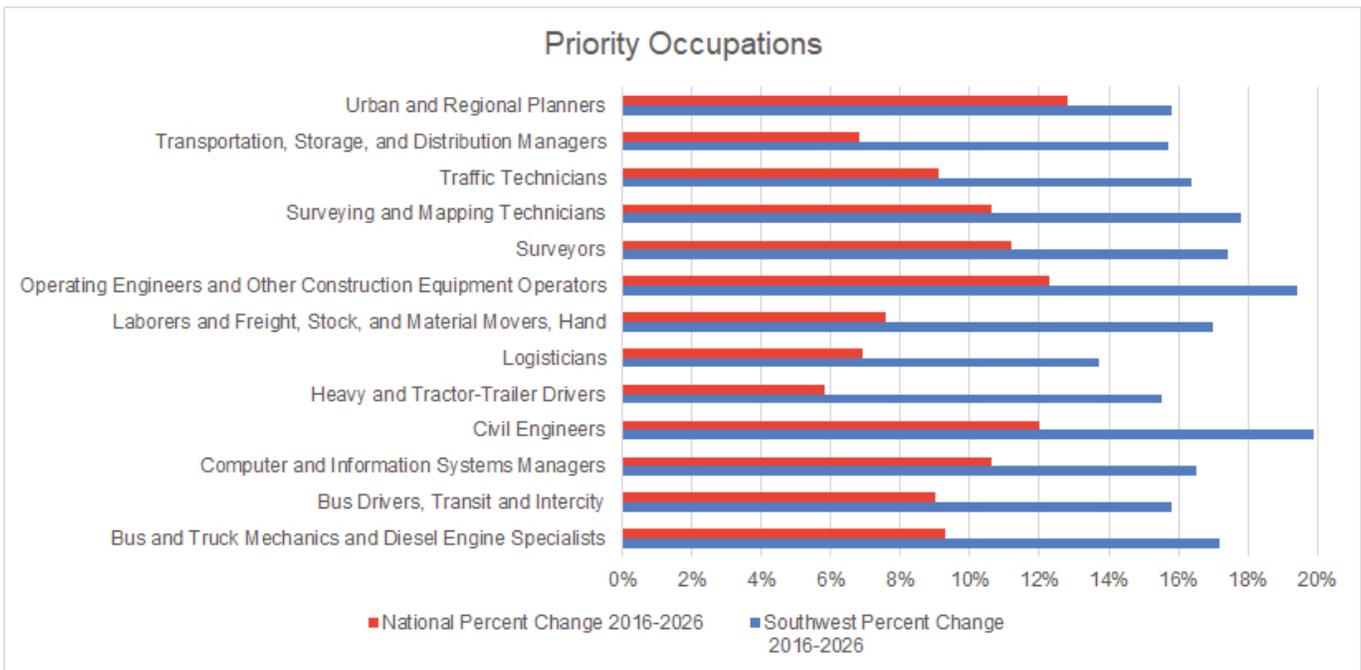


Figure 7: Southwest Priority Occupation Job Growth



VI. Concluding Thoughts

As the transportation industry moves into the new decade, its workforce needs to continue to develop and evolve in the Southwest. The demand for qualified employees is growing more than ever in both labor positions and middle management and skilled work, yet the labor market consistently lacks the skills and interest necessary to fill the gaps in the transportation industry. With the Southwest currently employing 27% of the nation's transit-related workforce and receiving 26% of all state and national transit spending, the need to creatively develop and sustain the Southwestern labor market becomes increasingly paramount.

Yet there remains a rift between industry's need for qualified workers and the current workforce itself; a rift large enough to raise concerns when looking to the future. Such concerns have led to the recommendation of recruiting populations that are not yet equitably represented within the transportation workforce, such as Native Americans, women, and veterans. These underutilized populations make up an untapped resource that may not only provide an ample labor market to pull from but will likely develop and hone the workplace through their diverse experience and expertise. Increased diversity and inclusion in the workforce have consistently been shown to predict greater profitability and cohesion in businesses (*Hunt et al., 2018*). Marketing these jobs through outreach efforts, veteran job development programs, and tribal training initiatives will provide the additional benefits of creating more wealth and industry in historically underemployed populations, creating a kind of symbiotic relationship between communities gaining employment and industry.

With the Southwest currently employing 27% of the nation's transit-related workforce and receiving 26% of all state and national transit spending, the need to creatively develop and sustain the Southwestern labor market becomes increasingly paramount.

While developing underemployed populations may fill the current gap between the Industry's needs and the workforce, there remains the issue of an aging population to consider. Up to half of the current workforce is eligible for retirement, widening the employment gap even further. In addition, this older demographic tends not to have the skillset needed to meet the technological advances that industry anticipates. A younger workforce with a more digital knowledge base needs to be attracted. Despite a continued increase in the use of technology by older generations like Baby Boomers and Generation X (*Vogels, 2019*), Generation Y (*Millennials*) and Generation Z are seen as the groups most accepting of new technology, by assimilating new technology easier than generations before them (*Taylor, 2018*).

To take advantage of the new experiences these younger generations offer, certain agencies have created training programs to attract and train a younger workforce. One example is the "Workforce Initiative Now" program, a collaboration between local colleges and the Los Angeles Metropolitan Transportation Authority (LA METRO), who stands to lose 47% of its workforce to retirement (*Cheung, 2020*). It is this fast assimilation to technology that is paramount in order for the future of the transportation industry to stay current. Baby Boomers – known for their hard work ethic, competitiveness, and goal-oriented zeal (*Kane, 2019*) – are remaining employed longer than ever anticipated. We now have five different generations within the workforce, something never heard of before (*Davidson 2019*). By comparison, Millennials are known for being connected through technology, well informed, tech savvy, and see workforce diversity as an important quality (*Abbot, 2019*). Generation Z, just now making their workforce debut and raised during the technological boom of the 2000's, are even more connected to technology and comfortable interfacing with digital devices in all aspects of life. As technological breakthroughs rapidly impact the transportation industry, the digital literacy of Millennials and Generation Z will become even more significant to transportation employers.

The future of the transportation industry workforce will also include a generation not only present for technological advance, like Millennials, but was born into technology. Working alongside their Gen Z predecessors as early as 2030 will be the Generation Alpha. Born between 2010 and 2024, this group shares the advent of the I-Pad and Instagram (*Bologna, 2019*), has had access to technology since early in their development, and has used that technology to greatly supplement their education. It is this Generation Alpha that will experience the transformative changes of automation that technology will bring about in transportation.

To take full advantage of the digital literacy of younger generations both now and in the future, there needs to be a shift in how the transportation workforce is trained. Technology is evolving faster than the labor force can adapt, such that determining workforce readiness is increasingly becoming a moving target. Today's cutting-edge technology is tomorrow's obsolete infrastructure. Developing effective means of educating the incoming workforce will rely on flexibility and adaptability by educators and hiring teams to ensure workplace readiness. Specifically, shifting a focus from formal education to on-the-job learning and other creative approaches may prove to be an essential part of this equation.

To take full advantage of the digital literacy of younger generations both now and in the future, there needs to be a shift in how the transportation workforce is trained.

Apprenticeships may well prove to be a workforce development model that supports this need. Where formal education presents information slowly to students in a sterile and stable environment, apprenticeship programs put students to work immediately in a job-focused learning environment. The training disseminated allows apprentices to learn the most up-to-date technologies as they are being applied to the workplace. Apprenticeship models hold a significant appeal for employees as well, offering an opportunity to earn wages while simultaneously receiving education and training for more advanced work. These types of programs are increasingly becoming an alternative to more formalized education, even in corporate settings. This has been demonstrated by Zurich North America and their innovative insurance provider apprenticeship (*Jones, 2018*). The benefits seen by Zurich, including a more diverse workforce whose unique perspectives has made their training better-informed on the inner workings of their organization and well-practiced at delivering the skills needed for their positions, would of course bring similar benefits to the transportation industry.

Yet apprenticeships are just a piece of the solution. While such programs may address the issue of an underprepared workforce, their solutions are too often in-house on a case-by-case basis. Traditional education tends not to focus on vocational training or the creation of multi-skilled workers, thus creating a need for more apprenticeships. Change will be required at every level of education in order to efficiently produce a workforce that is properly equipped to tackle the changing occupations of the future.

Not surprisingly, jobs in 2030 are forecast to be increasingly automated. This transition will inevitably trigger technological disruption that, in the end, will likely drive organizational leaders to seek out human-driven solutions to technological problems. This in turn will drive a new workforce balance between hands-on operational professionals and the specialists developing performance metrics, algorithms, and artificial intelligence. The workforce and productivity challenges faced by entrepreneur Elon Musk at Tesla Motors illustrates the reality that automation applied without the right human workforce can lead to inefficiencies (*Gibbs, S., 2018*).

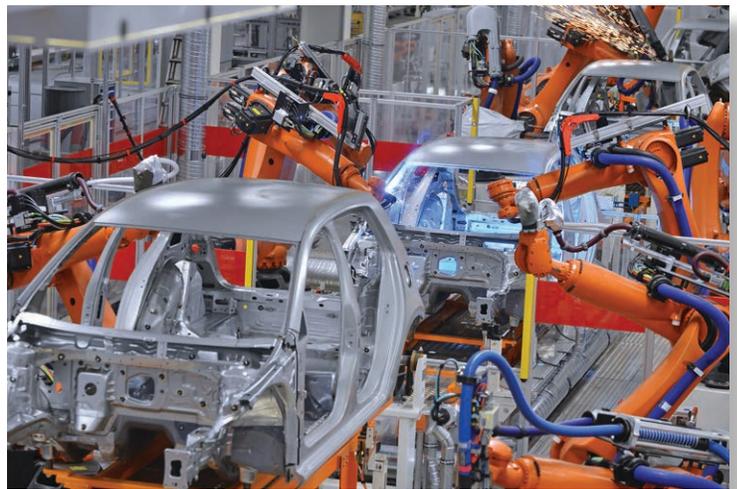


In this automated future, some jobs will remain relatively unchanged, some will require new worker competencies, and some will be replaced or reimagined. The key to understanding workforce trends, identifying skills gaps, and responding to these challenges with targeted educational and training products, is to follow the competencies and not the job titles. While a community of practice comprised of industry and education professionals could facilitate a transition to competency-driven curriculum for education and training programs, deploying this new standard will require new ways of doing business in the educational sector.

Traditional lock-step degree programs that are housed, i.e. siloed, in traditional engineering or planning programs will not meet the needs of new mobility system users or managers. Instead, programs that offer students some foundational knowledge in the overlap between transport and energy systems, between transport operations and cybersecurity, and between economic and systems security are essential to creating a resilient workforce that serves the needs of a resilient and integrated “system of systems”. If closed transport systems are becoming more open and integrated, then workforce training has to take a more open-source approach as well (O’Brien & Reeb, 2019).

Changes in professional occupations and changing requirements for skills and competencies will, in turn, require new educational and training curriculum and related instruction. Said another way: responding to transformational technological and socioeconomic change will require educators to develop new degree and certificate training programs. Certainly, some degree major and minor programs will remain the same, but the key will be to build competencies and career pathways into those programs. Communities of practice – made from discipline working groups representing leaders in industry, government, and education – can work together to ensure that courses within major and minor degree tracks include the appropriate knowledge, skills, and abilities for specific career pathways that feed into critical occupations that have been identified through comprehensive labor market analysis.

In *“From Body of Knowledge to Base-Map: Managing Domain Knowledge through Collaboration and Computation,”* Sean C. Ahearn and André Skupin note that “cutting-edge research is often slow to transition into professional practice, while educational activities and materials often do not represent the current state of research and practice.” They note that “scientific research, academic education, technical training, and professional practice are driven by seemingly disparate concerns, and there tends to be little interaction between these sub-communities.” After five years of focused workforce research and programmatic development, it is clear that SWTWC and its network of partners in the NNTW are uniquely positioned to pursue topics like the future of workplace learning, the future of apprenticeships, or the future of career pathways, by building on the knowledge management concepts that Ahearn and Skupin describe.



To get a better sense of how knowledge management could position NNTW members as leaders in workplace learning, apprenticeships, and career pathway formation, consider the following questions from Ahearn and Skupin:

- **“What if undergraduate curricula and textbooks co-existed in the same knowledge ecosystem with research publications, software documentation, job advertisements, and grant proposals?”**
- **“What if a student learning an analytical software tool could have ready access to a set of research studies in which similar tools were recently used?”**
- **“What if that emerging professional would also be shown a list of current job openings requiring mastery of associated skills, reinforcing the real-world relevance of curricular content?”**
- **“What if those students and emerging professionals could then compare their skill levels in different areas of the knowledge domain with those required by the jobs of interest, to determine how well they matched the various positions available?”**
- **“What if that knowledge ecosystem was organically changing as the field evolved?”**

If in 2030, NNTW members operated a “body of knowledge system” similar to what Ahearn and Skupin describe, the network would be viewed as an indispensable resource for public and private-sector employers to train emerging and incumbent workers with the knowledge, skills, and abilities that are most relevant to their needs. Such a trove of valuable labor market data would inform the development of targeted curriculum and education and training programs to meet the needs of the transportation and mobility workforce.

One practical step the NNTW has already taken to make career pathway and labor market information more accessible is featured in the recent launch of a career pathway web portal (<https://www.nntw.org/career-pathways/>), whose development was funded by the Federal Highway Administration. This portal features the career pathway research developed through the National Transportation Career Pathways Initiative and provides a platform for other workforce leaders to upload new pathways that meet career criteria and quality standards. While a great deal of work remains, the portal marks a positive step forward in developing a “body of knowledge system” that matches student research/education interests with career aspirations to help them better select their curricular and experiential learning options.

The remainder of this report focuses on the following four research priorities:

- 1. The Need for 21st Century Apprenticeships**
- 2. Providing Workforce Training for Rural/Tribal Populations**
- 3. Improving Access to Trucking Careers**
- 4. Building a More Diverse Workforce**

The next State of the Transportation and Mobility Workforce report will draw from the 2020 U.S. Census and the most recent BLS data in order to update these research priorities.

VII. Research Priority 1: 21st Century Apprenticeships

The transportation industry faces unique challenges in staffing due to its distinctive organizational design and required maintenance work. This makes it particularly difficult to attract a qualified workforce. Exacerbating this challenge, a considerable amount of the present workforce (40-50%) that has been employed for decades has been retiring over the last decade, causing a major loss of institutional knowledge (Nambisan et al., 2010). Additionally, the industry is facing a talent shortage that must be addressed to adapt to shifts and evolutions in the industry. To respond to the demand for more agile delivery services and changing business objectives, the necessary skills for transportation positions are expanding to include competencies such as critical thinking and communication (Fuchs & Shehadeh, 2017).

Further, anticipated changes in the transportation industry such as automation require a more advanced skillset to work alongside it (Giuliano, personal interview, October 2019). Apprenticeships can contribute to all required skill development. Due to the projected increase in six critical transportation occupations in the Southwest over the next several years, which can be seen in Figure 8, it is crucial that potential employees are made aware of opportunities in the industry and how to get involved and develop the necessary skills through an apprenticeship.

Along with the historical success of apprenticeships, present research findings indicate the importance of promoting and utilizing apprenticeship programs in the U.S. for its hands-on teaching style and fast inclusion of participants into the workforce (Carroll et al., 2019). This research coincides with the experience of a variety of U.S. industries, proving that apprenticeships have been a successful model to facilitate learning and opportunities (U.S. DOL, 2019b). The U.S. Department of Labor acknowledges that such programs play a role in closing the skills gap that is burdening many industries and is allocating over \$250 million in grants and awards to academic institutions collaborating with organizations to implement and expand apprenticeship programs (U.S. DOL, 2019).

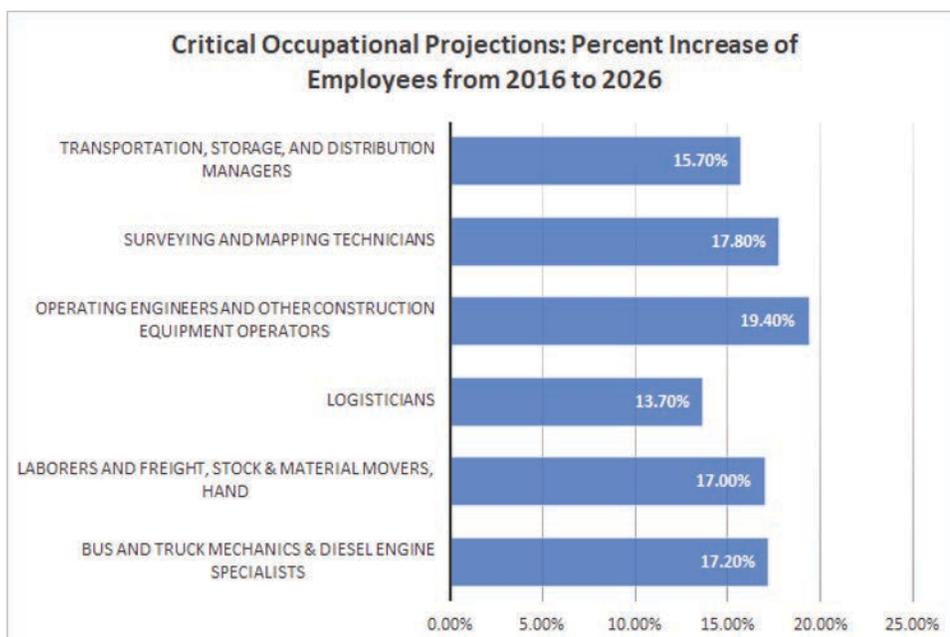


Figure 8: Southwest Critical Occupational Growth

WORKFORCE MEGATREND

Talent Shortage due to Retirement, Promotion, Turnover

A retiring workforce and fewer new hires have many agencies experiencing a personnel shortage, and unfilled positions frequently require specialized skills that are difficult to recruit for (NCHRP, 2019). Apprenticeship programs address these challenges by providing an opportunity for individuals to enter the workforce and learn necessary job skills.

Not only do these programs benefit the industry, they also benefit the participant. Apprentices develop the skills necessary to effectively perform transportation jobs while also receiving personal benefit in terms of increased compensation upon completion of their programs (Reed et al., 2012). There are also various benefits for transportation organizations that invest in and develop apprenticeship programs. For example, programs that target more diverse populations can contribute to diversity initiatives in the transportation industry (USDOT's Women & Girls in Transportation Initiative, 2018), while also providing work options to the veteran community (Hochfelder, 2018). Apprenticeships allow for a smoother and safer transition into transportation careers overall, while helping to improve productivity, increase recruitment and skill, and reduce turnover (U.S. DOL, 2019b).

As the industry changes due to advances such as automation, the necessary skills to succeed in transportation occupations will also change. Apprenticeships that are able to adapt to the changing skillsets of the current and future transportation industry are necessary. In order to create adaptable apprenticeships that stay current, program teams must consider where the current requirements should be modified to anticipate emerging occupational needs. For example, truck drivers and mechanics may soon need to learn the skills to manage automation in vehicles (Giuliano, personal interview, October 2019).

Labor Market Research

Across the country, the number of apprenticeship programs and apprentices have been rising since 2012. A variety of industries, ranging from construction to healthcare, have been utilizing apprenticeship programs to train individuals for career tasks. Exhibit 7 (below) displays the most recent information regarding apprentices and apprenticeship programs across industries in the Southwestern states and at the national level (DOLETA, 2019), while Figure 7 visualizes the distribution of active apprentices in the Southwest in FY2018. In this data, "Active Apprentices" refers to individuals who are currently involved in an apprenticeship program, "New Apprentices" are those individuals who have entered into the apprenticeship system during FY2018, and "Graduates" have completed their apprenticeship program during FY2018. Similarly, "Active Programs" are apprenticeships that are registered and "New Programs" are those that were established during FY2018.

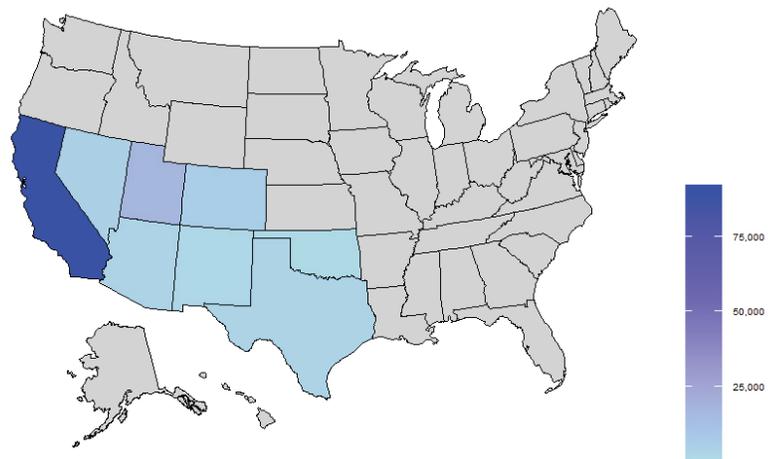


Figure 7: Active Apprenticeships in the Southwest

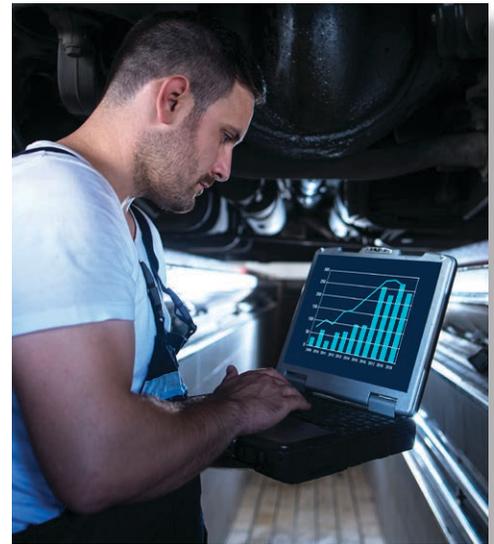
Exhibit 7: Apprenticeship Programs & Participant Counts (2018)					
STATE	ACTIVE APPRENTICES	NEW APPRENTICES	GRADUATES	ACTIVE PROGRAMS	NEW PROGRAMS
Arizona	4,111	1,976	434	181	30
California	89,949	34,303	12,584	2,984	149
Colorado	6,315	3,617	865	181	23
Nevada	4,858	2,643	552	107	27
New Mexico	2,284	831	192	75	11
Oklahoma	1,516	1,066	494	99	7
Utah	3,532	1,553	570	217	15
Texas	17,767	6,463	2,157	454	43
Southwest Total	130,332	52,452	17,848	4,298	305
National Total	585,026	238,549	71,789	23,441	3,229

Apprenticeships that are able to adapt to the changing skillsets of the current and future transportation industry are necessary.

In 2018, there were 12,335 active apprentices in the transportation and warehousing industry nationally. Based on the ratio of active southwestern apprentices to those identified nationally, this suggests approximately 2,747 transportation apprentices were in the southwestern states. Though transportation and warehousing apprenticeships rank fifth in terms of active apprentices behind construction, military (DOLETA), public administration, and manufacturing industries, they represent only 2.1% of the national active apprentices due to the high numbers in construction (166,629) and military (DOLETA) (98,435).

It is worth noting that some occupations relevant to the transportation industry that have apprenticeship programs, such as operating engineers, may have these programs classified under construction (IUOE, 2019), suggesting the percentage of transportation apprenticeships may be higher than the estimation provided here. Most other industries had under 20,000 active apprentices in 2018. In terms of specific occupations, Heavy Truck Drivers ranked fifth behind Electricians, Carpenters, Construction Craft Laborers, and Plumbers for number of active apprentices, with a total of 11,410 (DOLETA, 2019).

Of the critical occupations identified as most relevant for the Southwest region, apprenticeship programs may be most suitable for vocational and some supply chain and logistics occupations, though these programs can be applied to any target transportation occupation (SWTWC, 2015). The U.S. Department of Labor spotlights five high-demand apprenticeship occupations, most of which align with the critical transportation occupations identified for the Southwest in Phase 1. These include Diesel Mechanic, Electronic Systems Technician, Heavy Equipment Mechanic, Ship Fitter, and Truck Driver (DOL, 2019). The types of skills and systems that apprenticeship programs typically teach for these occupations through both course instruction and on-the-job learning are provided in Figure 10 (AIIA, 2019).



Diesel Mechanic	Electronic Systems Tech	Heavy Equip. Mechanic	Ship Fitter	Truck Driver
<input type="checkbox"/> Diesel Engine Repair	<input type="checkbox"/> Prepare Installations	<input type="checkbox"/> Const. Machinery	<input type="checkbox"/> Fabrication	<input type="checkbox"/> Inspections
<input type="checkbox"/> Drive Systems	<input type="checkbox"/> Wire Buildings	<input type="checkbox"/> Const. Equipment	<input type="checkbox"/> Sub-Assembly	<input type="checkbox"/> Vehicle Controls
<input type="checkbox"/> Steering Systems	<input type="checkbox"/> Trim	<input type="checkbox"/> Running Gear	<input type="checkbox"/> Erection	<input type="checkbox"/> Basic Truck Operation
<input type="checkbox"/> Brake Systems	<input type="checkbox"/> Install Components	<input type="checkbox"/> Power Train Assys	<input type="checkbox"/> Outfitting	<input type="checkbox"/> Shifting
<input type="checkbox"/> Chassis and Springs	<input type="checkbox"/> Configure Program	<input type="checkbox"/> Gas & Diesel Engines	<input type="checkbox"/> Lofting	<input type="checkbox"/> Cornering
<input type="checkbox"/> Lubrication	<input type="checkbox"/> Test & Troubleshoot	<input type="checkbox"/> Troubleshooting	<input type="checkbox"/> Total Hours: 8,000	<input type="checkbox"/> Turning
<input type="checkbox"/> Hydraulic Pumps	<input type="checkbox"/> Train Users	<input type="checkbox"/> Carburetor Repairing		<input type="checkbox"/> Mirror Use
<input type="checkbox"/> Welding	<input type="checkbox"/> Documentation	<input type="checkbox"/> Total Hours: 6,000		<input type="checkbox"/> Straight Line Backing
<input type="checkbox"/> Total Hours: 6,000	<input type="checkbox"/> Maintenance & Repair			<input type="checkbox"/> 45 Degree Backing
	<input type="checkbox"/> Total Hours: 8,000			<input type="checkbox"/> Total Hours: ~4,890

Figure 10: Required Skills & Systems for Apprenticeship Programs by Occupation

Practical Response Strategies

To address four major challenges to the transportation workforce identified by the 2012 National Transportation Summit (*i.e., demographic changes, new technologies, increasing demand for a wider range of skills and experiences, and career awareness and recruitment*), apprenticeship programs were selected as an effective method to connect technical schools, college students, and the current/incoming workforce with professional opportunities in transportation.

To efficiently promote awareness and implementation of apprenticeship programs, SWTWC recommends developing a series of presentations and webinars titled “Apprentice Programs for the 21st Century.” These in-person and online presentations would aim to educate public and private-sector organizations about the best practices in developing apprenticeships. They would provide students and those entering the workforce with information regarding transportation occupation benefits and next steps to getting involved in available programs.

A detailed explanation of the steps for implementing this plan, communication strategies, methods to obtain buy-in, and several internal and external resources are provided in the SWTWC “Job Priorities and Needs Report, Phase 2” (SWTWC, 2016).

To increase recruitment and reduce dropout from apprenticeship programs, program design should match the needs of both students and employers. Additional key considerations for establishing successful apprenticeship programs include:

- **Location:** Are both coursework and on-the-job training easily accessible to students? Is public transportation or a ride-share program an option? Due to a lack of housing support and affordable options, lower income workers are moving away from job-center hubs. This makes it more difficult for them to afford lengthy travel distances to apprenticeship programs or work (*Painter, Professor at USC interview, 2019*).
- **Partners:** Which local colleges and organizations would benefit from apprenticeship program collaboration?
- **Skill Development:** Which skills are most crucial to have ready upon job entry, from the standpoint of students and employers?
- **Program Design:** Would a time-based model (*program completion after designated number of months attended*) or skill-based model (*program completion after demonstrating required skillset*) best serve program needs? Would distributing coursework at the start or more evenly throughout best serve program needs?
- **Marketing:** Communicate how the apprenticeship addresses industry challenges. What are the most effective advertisement methods to reach potential applicants?

To efficiently promote awareness and implementation of apprenticeship programs, SWTWC recommends developing a series of presentations and webinars titled “Apprentice Programs for the 21st Century.”



Sample Initiatives

The following programs serve as examples of effective apprenticeship structures that could be used to share information about establishing new apprenticeship programs.

- **Advanced Manufacturing & Transportation Apprenticeships of California (AMTAC) Program** has collaborated with local colleges, the U.S. Department of Labor, the State of California, and many of California's transportation companies to provide a variety of transportation-related skills training programs for over 20 years. Their website clearly conveys the benefits of enrolling in one of their transportation apprenticeship programs, which involve earning while learning, working full-time for an employer, and rapid wage advancement. It also shares general program details such as the time commitment and hours per week working in the shop or in evening courses. Programs range from "Transit Bus & Body" to a variety of mechanic options, including diesel engine, maintenance, senior parts, sanitation truck, and truck trailer (AMTAC, 2016).
- **Heavy Equipment Operator Apprenticeship Program**, a three-year program divided into three terms that comprise five modules and on-the-job learning. Hosted by the Arizona Chapter of Associated General Contractors of America Apprenticeship Trust Fund, contractor organizations are encouraged to provide experience and training through this program and to submit a list of equipment used in the organization for specialized apprentice training. Applicants can indicate their desired occupation, such as construction driver, diesel mechanic, or bridge carpenter-heavy highway. The apprentice wage increases annually, and the program carries a one apprentice to one journey worker ratio. It begins with a new apprentice orientation located in one of two Arizona cities and is followed by three years of training (AZAGC, 2019).
- **Arizona Operating Engineers Apprenticeship Program**, administered by the International Union of Operating Engineers and the Associated General Contractors of Arizona, this program is aimed at providing necessary training and certification for heavy equipment operators, plant equipment operators, and heavy-duty mechanics throughout the state. It includes pre-training, over 400 hours of related course instruction, and a minimum of three years on-the-job training. The program connects a contractor seeking an apprentice with an apprentice who has completed the related training coursework, who is then added to the contractor's payroll. Every spring and fall apprentices require 72 hours of additional classwork. Applications take place in person at the training site twice a month. Health insurance is provided after the first four months, with retirement earnings after one year. Applicants graduate with a Journeyman "A" List status (IUOE, 2019).
- **Joint Apprenticeship Committee**, this LA Metro program was identified as an effective internship in an interview with Gen Giuliano, professor at USC and Director of METRANS Transportation Center (2019). A standard of program value is that both parties are satisfied with program outcomes. Student participants getting hired indicates they are well trained, and a company desiring more apprentices from the program similarly indicates success. This program includes a collaboration between LA Metro and LA Trade Technical College (LATTC). Instructors at LATTC educate apprentices on aspects of rail maintenance, who then gain practical training while interning at LA Metro.

Case Study Example: Construction Teamsters Apprenticeship Fund of Southern California

Apprenticeship programs focus on developing warehouse workers and truck drivers, heavy-duty and commercial. Programs last 36 months in duration. In order to upscale the program, permit more advanced skill development, and increase opportunities for higher future salaries, additional classes for upgrading skills of existing members are being offered. These last between five and eight weeks. (City of LA Economic & Workforce Development Dept., 2019)

Research Priorities

The successful promotion and utilization of apprenticeship programs is expected to result in numerous positive outcomes for the transportation industry overall, individual transportation organizations, and program participants. Apprenticeship programs enable the transportation industry to more effectively compete with other industries – ranging from information technology to healthcare – that are also recruiting, training, and maintaining talent through their own apprenticeships (*City of LA Economic and Workforce Development Department, 2019*).

Relatedly, apprenticeship programs promote career paths within transportation to attract and retain employees. They also increase the availability and prevalence of competent employees for priority occupations in transportation. Updating apprenticeship programs can also contribute to matching the anticipated required skillset with incoming employees and make them more attractive to applicants (*VP of Workforce Development and Strategic Partnerships for Pima Community College, interview, 2019*).

Regarding individual transportation organizations, webinars promoting apprenticeship programs provide support in addressing the pervasive challenge of attracting individuals into critical positions. By making students and the public more aware of transportation career options and how to get involved through apprenticeships, such webinars can alleviate recruitment stresses on individual organizations, as well as develop a stable pipeline of qualified employees. Employees that participated in an apprenticeship program tend to be more loyal to the organization due to the perceived investment in their training. This training also relates to increased employee productivity. Additionally, organizations utilizing apprenticeship programs tend to experience decreased turnover and absenteeism (*DOL, 2019b*).

Related to apprenticeship program efforts, potential future research ideas that would provide valuable insights to further advancing this action plan could include the following:

UPSCALING APPRENTICESHIPS

Southwest states work to secure grant funding to make apprenticeships more practical & effective

Los Angeles, CA identified logistics and related occupations as high growth jobs that would benefit from apprenticeship program upscaling, which enables higher skill development levels and permits higher future salaries.

(City of LA Economic & Workforce Development Department, 2019)

Pima County Community College, AZ received a \$150 million dollar grant to upscale apprenticeship programs.

(VP Workforce Development & Strategic Partnerships, 2019)

- **Evaluate Recent Apprenticeship Program Updates:** Collecting data on the most recent apprenticeship program updates will allow for the examination of programs and determine if programs are providing skill development on what occupations currently require, as well as what they are anticipated to require.
- **Evaluate Accessibility of Training Programs:** Collecting data regarding accessibility factors (*e.g., travel time/distance, mode of transportation, personal vehicle/public transportation*) for both classroom training and job site training will provide further information on barriers to entry.
- **Determine Effective Marketing Strategies to Promote Apprenticeship Programs:** Locating target audiences to determine effective marketing strategies will allow efficient promotion of apprenticeship programs towards those audiences.
- **Investigate Use of Grant Funding to Support Apprenticeship Programs:** Providing insight as to where to apply for funding, as well as case examples of how grant funding has been used to develop, update, or maintain apprenticeship programs will promote greater awareness and act as a resource.

Looking Forward: Focus for 2021

In order to promote the value of apprenticeship programs as a means to efficiently respond to technologies that are transforming the transportation and mobility landscape, members of the NNTW will conduct a series of presentations and webinars in 2020 that will highlight apprenticeship programs that exemplify targeted responses to disruptive technologies that empower the transportation and mobility workforce to adapt and thrive. Those presentation and webinars will also include a review of innovative certificate programs that incorporate elements from apprenticeships.

The use of webinars to promote apprenticeship programs for the transportation industry allows for a wider audience to be reached, including younger members that are not usually attained but are an important aspect to the future of the workforce. Webinars can also provide critical education to facilitate participation in apprenticeship programs, as well develop new programs. Participation is particularly important for occupations that are critical to the industry and are experiencing an increase in demand such as truck mechanics and logisticians.

VIII. Research Priority 2: Tribal Workforce Development

Across the transportation industry, there is a shift towards the more frequent use and incorporation of technology in daily tasks, and the role of data and its analysis in decision making has become both commonplace and necessary. In fact, 28% of transportation professionals report a high rate of technology adoption (*Nambisan et al., 2010*), a trend that has made data-based jobs and skills more critical to the industry. This is clearly reflected by the prominence of technology-inclusive occupations like Surveyor and Urban & Regional Planner, both identified as growing priorities for the Southwest region's transportation industry.

WORKFORCE MEGATREND

Information Management

As the transportation industry looks to develop data management skills in their employees, GIS training can provide the qualifications.

The advent of advanced mapping technology and asset geolocation also makes for promising new areas of employment within the transportation sector, where GIS-centric occupations like Surveying & Mapping Technician are already leading the way. Providing workers with technical competencies in data manipulation, data comprehension, and software programming – competencies that support GIS applications – presents a prime opportunity to advance the Southwest's transportation industry.

More specifically, as Native Americans are only marginally represented in the Southwest's four transportation priority occupations (*Surveyor, Urban & Regional Planner, Surveying & Mapping Technician, and Traffic Technician*), as based on BLS occupational ethnicity representations (*BLS, 2019*), broadening access to GIS skills in this population could substantially contribute to meeting future workforce demands. Programs like the SWTWC skills-based GIS Tribal Training Initiative are specifically designed to deliver these next generation workforce skills at the rural/tribal level, therefore enabling these communities to benefit from the growth in these occupations while also helping to close the gap in the industries looming worker shortage.

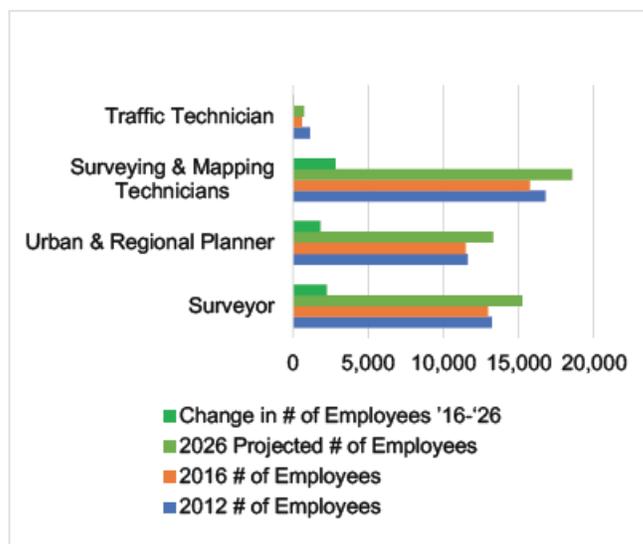


Figure 11: Occupational Projection for Priority Occupations

Further, in certain domains tribal communities have the self-determination to regulate transportation and mobility resources on their lands. It is therefore important that they have the knowledge and skills necessary to effectively implement transportation initiatives to facilitate safer transportation options and preserve the environment. Transportation practices are evolving quickly and learning how to support that development with GIS will be crucial to the success of any tribal training program. However, it is critical that any training initiative and its leadership be accepted and supported by tribal leaders. With internal support, the tribal transportation field is taking great strides (Hall, 2019).

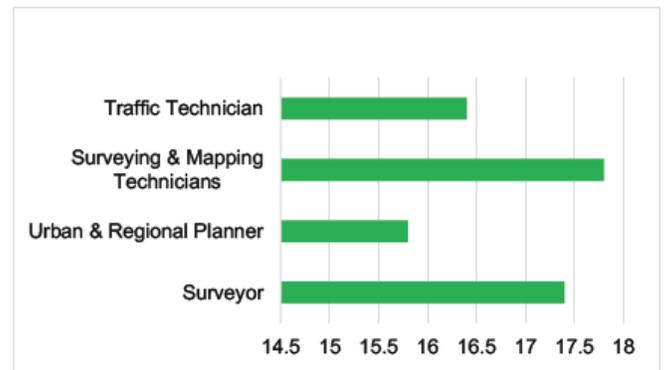


Figure 12: Percent Change in Number of Employees

To address several critical transportation positions from surveyors to mapping technicians as well as recruit an oftentimes underrepresented population in the transportation industry, the SWTWC GIS Tribal Training Initiative aims to provide southwestern tribal populations the opportunity to build relevant skills for GIS professions through training modules. Enacting this training will also contribute to data collection regarding transportation and road safety measures in tribal lands. This action plan includes collaborating with various partners to develop, promote, and implement GIS training modules.

Labor Market Research

Though Native Americans and Alaska Natives only made up 1% of the national labor force in 2017, these communities were above the national average unemployment rate of 4.4%, exhibiting 7.8% unemployment (BLS, 2018). This agrees with previous reports that in the southwestern states, the number of individuals available for work but not employed is slightly above the national average (DOI, 2014).

Relative to the national average in the same year, the percent of tribal service populations working was 14.2% less than the national average of total population working (BLS, 2019b). This suggests that providing the necessary training to such individuals may offer an opportunity to fill critical transportation positions using an available population. Indeed, many tribes have too few individuals with the appropriate technical education and training to be employed in these positions (Hall, 2019). Exhibit 7 presents the percent of tribal community members in the Southwest who are currently working and who are available to work, by state.

Exhibit 8: Estimated Tribal Community Member Employment & Availability (2010)		
STATE	% WORKING	% AVAILABLE, NOT WORKING
California	49.3%	18.0%
Nevada	54.7%	12.6%
Arizona	39.6%	27.6%
New Mexico	42.3%	24.9%
Colorado	51.1%	16.2%
Utah	41.5%	25.8%
Texas	59.3%	9.2%
Oklahoma	55.5%	11.7%
Southwest Totals	49.2%	18.3%
National Totals	49.5%	17.7%



A variety of skills are needed for employees to be successful in the GIS field, and these skills apply to the various GIS-related occupations that were identified as priority jobs in the Southwest. An overview of these skills, as described by several geospatial specialists, is provided in Figure 13.

GIS Skills	Programming Skills	Database Skills	Project Mgmt/Design	Other Skills
<input type="checkbox"/> Spatial Algorithms	<input type="checkbox"/> Basic Programming	<input type="checkbox"/> Models/Structures	<input type="checkbox"/> Translate User Needs	<input type="checkbox"/> Domain Expertise
<input type="checkbox"/> Data Conversion	<input type="checkbox"/> OO Programming	<input type="checkbox"/> Design Ability	<input type="checkbox"/> Design User Solutions	<input type="checkbox"/> Platform Portability
<input type="checkbox"/> Data Maintenance	<input type="checkbox"/> GIS Architecture	<input type="checkbox"/> Tools Knowledge	<input type="checkbox"/> Communication Skills	<input type="checkbox"/> Detail Oriented
<input type="checkbox"/> Metadata Creation	<input type="checkbox"/> Web Services	<input type="checkbox"/> SQL Knowledge	<input type="checkbox"/> Writing Skills	<input type="checkbox"/> Customer Support
<input type="checkbox"/> GIS Analysis			<input type="checkbox"/> Project Mgmt Skills	<input type="checkbox"/> Exploration Skills
<input type="checkbox"/> GIS Workflow				
<input type="checkbox"/> Model Building				
<input type="checkbox"/> Cartography				

Figure 13: Typical GIS Job Skills & Competencies

Case Study Example: Utah DOT Map Center

The “UPlan” system was developed to organize the thousands of state transportation data sets in the GIS database. This cloud-based resource allows multiple users to access and analyze GIS data, which is now available agency-wide. Employees can view important environmental attributes and other planned projects to bring into consideration and can generate a report on a project’s estimated impact using current data. Productivity improvements are remarkable, saving years of time and millions of dollars. The transportation industry is moving in the direction of data-driven decisions. To develop, implement, and work with data such as this in other states and areas, it is critical for agencies to recruit and train individuals with GIS skills. (Bills, 2019)

Practical Response Strategies

As data skills that complement modern technologies like GIS and ITS become increasingly important to maintaining a competitive transportation workforce in the Southwest, providing workers with training options to deliver these skills becomes equally important. Priority occupations like Surveyor, Urban & Regional Planner, Surveying & Mapping Technician, and Traffic Technician all require training that can be promoted throughout southwest tribal populations to address this need.

SWTWC has developed an action plan to improve the southwestern transportation infrastructure while also protecting sacred tribal lands, heavily relying on GIS as a tool to present crash data, evidence of substandard roads, and other mission critical mobility needs to state and federal decisionmakers. This plan focuses on tribal youth populations and collaborating with community colleges and incorporates collaboration with the Bureau of Indian Education to help facilitate promotion to these populations. It also addresses networking with external organizations that can contribute to developing and delivering effective skill-based training modules for students. This action plan promotes interest in these priority occupations, as well as equips students with the skills necessary to enter into and be successful in a transportation career.

WORKFORCE MEGATREND

Growth of Data Science

GIS training provides the background to tackle new workforce demands in data science, curation, analytics, and business intelligence to support efficient decision-making.

Practical Response Strategies, cont.

A detailed explanation of the steps for implementing this plan, communication strategies, potential partners, methods to obtain buy-in, and several internal and external resources are provided in the SWTWC ***“Job Priorities and Needs Report, Phase 2”***(SWTWC, 2016).

Sample Initiatives

GIS is currently being applied in a variety of ways in each of the Southwestern states. Applications include maintenance, environment, operations, planning, and asset management transportation contexts.

Sample initiatives include (FHA, n.d.):

- **Texas Department of Transportation, Environmental Protection Agency:** Applies a GIS screening to inform decision making on where to concentrate resources and prioritize environmental protection.
- **Nevada Department of Transportation, Safety Engineering:** Applies an advanced GIS crash event geolocator to locate and classify accidents, then match them using NDOT’s linear referencing methods.
- **Caltrans GIS Applications System:** Being utilized regarding environment and environmental streamlining contexts to develop probability-based assessments from GIS layers of geographical features to estimate the likelihood of encountering underground archeological sites.



To contribute to the growing use of GIS efforts such as those mentioned above, there are already opportunities available for tribal populations to obtain training in related skills, something that is a broad concern for these communities (Painter, 2019). Remote or online training may help bridge this accessibility gap for those who may not be located within proximity of classroom programs.

More in-depth education options include working toward a certificate or college degree. The Southwestern Indian Polytechnical Institute in New Mexico offers a Geospatial Information Technology (GIT) program using GIS and GPS with the goal of developing technical skills using the latest equipment and software, as well as GIS applications in industries such as transportation. Students can pursue either an Associate of Applied Science degree in geospatial technology or a Certificate in GIT (SIPI, 2019).

Additional educational resources include accessing the National Tribal Geographic Information Support Center (NTGISC), or Tribal GIS, for shared information on GIS technology, tips, techniques, and networking with GIS organizations, educators, and students in the tribal community. Through content provided on the Tribal GIS website, newsletter, community forum, and conference, individuals can access information regarding GIS broadly, where to find specific training or occupations, and how to deliver GIS training (NTGISC, 2019). An example of such a resource is the “What is GIS?” Esri presentation which provides information on the various industries GIS can contribute to and emphasizes the role of education in promoting GIS, particularly in K-12 schools (Esri, 2012). Esri also provides resources for introducing GIS technology and its use to K-12 students, including interactive web maps (Esri, 2019).

These serve as sample initiatives from which the SWTWC GIS Tribal Training action plan can draw in terms of potential partners, resources, materials, targeted skills to develop, and variety of program/module formats and intended age-groups. Through greater SWTWC involvement and partnerships with GIS organizations and programs, the individuals developing these skills can become more oriented towards career options in transportation.

Research Priorities

The development and implementation of training modules through collaboration with various industry partners is expected to have a positive impact on organizations and the workforce. Promoting such initiatives would provide awareness of available data and GIS-oriented critical positions in the transportation industry, as well as equip individuals with the training to perform these tasks.

Investment in career development can increase future employee satisfaction and examining current skill gaps through the program development process can assist in reducing gaps in present employee performance. Such training can also allow individual employees to grow specific skills and advance in their career. Further, organizations will gain a better understanding of the analysis-based skills required for effective and improved job performance.

Effective job performance in this area is particularly important in tribal communities to develop the vision of long-term plans for tribal land, transportation safety, and protecting and preserving the environment. Articulating specific transportation plans is required to obtain federal funding and utilizing GIS data can inform decisions when developing these plans.

Clearly, there are multiple future research efforts that would assist in furthering the SWTWC GIS Tribal Training Initiative, including:

- **Conduct Wage Comparisons in GIS Positions:** By looking at the wages of various GIS positions at the state-level, within the private sector, and on Native American Reservation, it would be possible to gain a better understanding of these distinct employment areas and whether changes to compensation are necessary to bring tribal GIS jobs to a similar level as their counterparts in government for private industry.
- **Identify Effective Marketing Programs for GIS Occupations:** By analyzing existing effective marketing programs for GIS occupations it becomes possible to specify which campaign deployment is most effective at reach specific demographic targets, as an aide to developing strategies that can increase both awareness of GIS occupations and their corresponding training opportunities. This would also provide constructive feedback as to how various existing marketing programs could improve.





Looking Forward: Focus on 2021

The demand for GIS skills and related training programs in tribal communities across the U.S. is increasing. Educational programs in the Southwest region have begun to address the rising demand. A key development in these efforts has been the collection of salary data of GIS professionals by surveying tribal leaders and employers. Using salary data, the impacts of programs focused on tribal communities can be quantified and potential improvements can be implemented. More importantly, if the survey expands beyond the Southwest region, communities that stand to benefit the most will be identified.

In 2021 and the years to come, this expansion is going to be executed. With proper assessment, workforce training programs will likely be found to be most beneficial when allocated near native communities. For these communities, GIS will generate new opportunities for tribal members to enhance the welfare of their communities through work in nearby reservations and by working remotely. For GIS employers, a larger and more diverse talent pool will contribute to their local economies and the growth of their companies. Net social benefits will be seen from the combination of increased salaries for tribal GIS professionals, expanding GIS talent pools, and rising economic sophistication for state, local, and tribal economies.



IX. Research Priority 3: Improve Access to Trucking Careers

Labor market data consistently identifies heavy and tractor-trailer truck driver positions as the largest workforce gap across the country, but especially in the southwestern region with a percent increase of about three times the national average. This challenge is exacerbated by the rapidly retiring Baby Boomer generation that has been working in the industry for decades and might take their institutional knowledge with them as they approach retirement. (*Nambisan et al., 2010*). Along with the loss of retiring workers, it is difficult to attract individuals to trucking positions, as well as retain them once employed. The lack of awareness of general transportation occupations is a large contributing factor to this issue. Additionally, it is un-common to encounter individuals with the proper knowledge, training, and certifications to immediately begin work. Due to the critical safety concerns involved with trucking, it is particularly important to hire qualified individuals (*Costello, 2017*).

WORKFORCE MEGATREND

Widespread Vehicle-Sharing, Electrification, and AV

Autonomous vehicles are expected to impact the required skills and duties in the trucking occupation.

Case Study Example: Pima Center for Transportation Training

Pima Community College hosts a variety of services in their Center for Transportation Training (CTT), which maintains its own instructional staff, provides license training, and offers a certificate program. CTT conducts activities with youth groups (Boy Scouts, community groups, junior high schools) to describe the trucking occupation and its option as a relatively high paying job and draws upon Pima's experience in recruiting minority populations. CTT is also in collaboration with TuSimple to develop and launch the first autonomous driving certificate program for truck drivers and is partnering with two trucking employers looking at this program for preferential hiring.

Labor Market Research

The projected growth in the Heavy and Tractor-Trailer Truck Driver occupation in most southwestern states is noticeably higher than the national average, as illustrated in Exhibit 9 below (*BLS, 2019*). This supports the importance of increasing the number of prospective workers through improved awareness of the field and development of skills necessary for the job.

Of the top ten national metropolitan areas with the highest employment level in this position, four are from the Southwest region. These include:

- **Dallas - Fort Worth - Arlington, TX**
- **Los Angeles - Long Beach - Anaheim, CA**
- **Houston - The Woodlands - Sugar Land, TX**
- **Riverside – San Bernardino – Ontario, CA**

In 2018, only 6.6% of the national truck driving labor force was female (*BLS, 2019*). Over the previous two decades, that number has remained somewhat steady (*Costello, 2017*). This is an influential area to grow the trucking occupation that is not currently being accessed.

STATE	# EMPLOYEES 2016	# EMPLOYEES 2026	INCREASE 2016 – 2026	% CHANGE
California	147,500	165,000	17,500	11.9%
Nevada	11,560	13,830	2,270	19.6%
Arizona	25,770	29,190	3,420	13.3%
New Mexico	10,630	11,190	560	5.3%
Colorado	25,380	29,830	4,450	17.5%
Utah	24,180	32,510	8,330	34.4%
Texas	185,220	217,490	32,270	17.4%
Oklahoma	24,890	26,850	1,960	7.9%
Southwest Total	455,130	525,890	70,760	15.5%
National Total	1,871,700	1,980,100	108,400	5.8%



Further, 77% identified as Caucasian, suggesting the opportunity to recruit minorities such as the tribal community. Veterans are another population of interest. Of total employed veterans, 9.8% held transportation and material moving occupations (BLS, 2019). However, only 3.6% of female veterans were working in these occupations, which is less than the national average. Recent federal regulations allow military drivers with over two years of safe driving experience to waive the Commercial Driver's License test due to their prior training (DOT, 2015). This provides additional incentives to attract veterans to trucking occupations, indicating that promoting awareness of this opportunity to veterans is valuable.

Key Occupational Competencies

Technical Skills: In addition to the technical skills for heavy and tractor-trailer truck drivers, there are several other knowledge, skills, and abilities necessary in trucking occupations. Knowledge of transportation (e.g., *methods for moving goods by road*), public safety principles (e.g., *relevant policies and procedures to follow local, state, and national security regulations*) and mechanical information (e.g., *machines and tool design, use, repair, and maintenance*) are all important for success in heavy and tractor-trailer truck driver positions.

Critical Skills: Beyond the operation and control skills and operation monitoring skills (e.g., *watching dials and gauges*) required to maneuver the vehicle and obtain a Commercial Driver's License, other critical skills include time management, critical thinking, and monitoring own performance to effectively plan for trips and address challenges that arise on the road. More effective communication skills are also becoming more critical for all transportation workers, including truck drivers, due to the public desire for more transparency and communication of technical information (Fuchs & Shehadeh, 2017).

Physical Skills: There are a variety of physical abilities required to perform the duties of a truck driver. A sample of these include manual dexterity, clear vision (e.g., *night, peripheral, far*), depth perception, hearing sensitivity, and arm-hand steadiness. Additional skills consist of deductive reasoning, spatial orientation, selective attention, and information ordering (O*Net, 2019). Providing training should not only encompass the skills required to pass a Commercial Driver's License test, but also to make future drivers aware of the necessary abilities and knowledge for the job.

Case Study Example: Pima Community College

Working with automated technology will be a future skill-need for trucking. While some perceive autonomous vehicles (AV) as the dawn of the end of truck drivers, it is unlikely the shift will be so drastic. Even as AV technology begins its deployment, drivers are still needed to interact with, monitor, and regulate vehicle systems. Eventually, drivers will benefit from a general understanding of the technology underlying automation and the general supply chain process. Empowering truck drivers with the skills they will need in the future to address the maintenance and operational needs of AV will be beneficial. Pima Community College offers an Intro to AV course as part of its Center for Transportation Training, to develop skills in logistics of supply chain management and coding.

Key Occupational Competencies

Two states in the southwest region, Texas and California, have the highest numbers of employees in the heavy and tractor-trailer truck driver positions in the country (BLS, 2019c). Additionally, because employment in this occupation is projected to grow over the next several years, methods to increase attraction to the position and expand training in the necessary skills should be implemented. Both efforts require collaboration with schools, colleges, and trucking companies. These partnerships permit more effective promotion of the occupation, and the necessary skill development to obtain required certifications. To expand the applicant pool, this strategy is specifically aimed at recruiting underrepresented populations into the occupation, such as women, veterans, and tribal community members. Communicating the mutual benefits to the trucking industry writ large, as well as to specific schools or organizations, will enable program development and implementation.

Sample Initiatives

There are numerous programs aimed at promoting the trucking industry, as well as training programs at employment education institutions and local colleges. The American Trucking Association (ATA) hosts several programs that communicate the benefits of the industry to the community. SWTWC can collaborate with these or similar organizations as well as develop similar programs to promote the trucking occupation. Examples include:

- **Trucks Move America Forward** *“tells trucking’s story” by endorsing trucking values of safety, professionalism, sustainability and essentiality through media and education. This initiative is working to enhance a positive image of the trucking industry to obtain more community support and a sustainable employee pipeline.*
- **GetTrucking.com**, *developed by the ATA, is a website to provide information on the deficit in available truckers, the benefits of pursuing this career, and points individuals in the direction of the most appropriate school to develop the necessary skills.*
- **Hiring Our Heroes** *is a U.S. Chamber of Commerce Foundation program that has collaborated with the trucking industry, which is targeted to a specific population – U.S. military veterans. The ATA committed Hiring Our Heroes to hiring 100,000 veterans, thus advertising this industry to this population.*
- **Trucker Buddy** *is aimed at promoting trucking occupations to younger students and provides teachers resources to match a truck driver with a classroom. Through phone calls, postcards, email, and the occasional in-person visit with a tractor-trailer truck, the truck driver can educate students about the occupation and its connection to geography, math, and social sciences (ATA, 2019).*

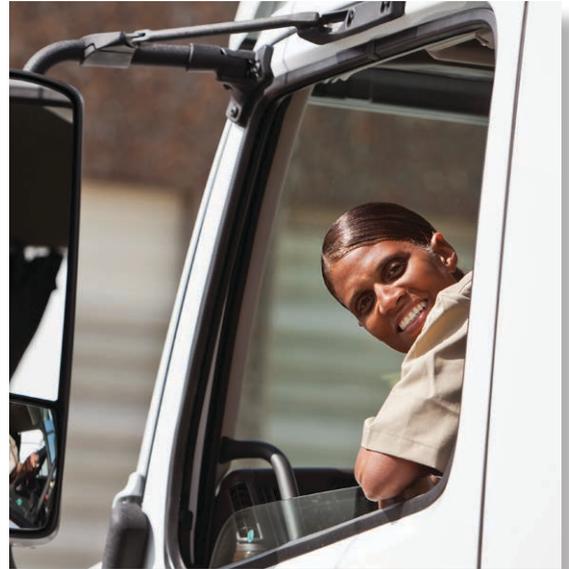
Other programs housed in technical trade schools and community colleges are aimed at training individuals to obtain their Commercial Driver’s License and be hired as a truck driver. One such program is the **Truck Driver Job Training Program** at the Center for Employment Training. This institution has locations throughout California and Texas to deliver hands-on training in the skills necessary to pass the Commercial Driver’s License Test as well as on-the-road safety.

The program lasts about six weeks and focuses on developments in safety, basic operation, advanced operating procedures, vehicle maintenance, non-vehicle activities, state license preparation, basic computers, customer service, and job preparation such as interview and resume skills. The Truck Driver Job Training Program also provides financial assistance to qualified applicants and job placement assistance after passing the license test. It costs about \$12,000, including the cost of supplies and tools (CET, 2019). This and other similar programs can be advertised by SWTWC to facilitate skill development and grow more qualified truck drivers.

Research Priorities

In addition to promoting awareness of the trucking industry and how to get involved to potential applicants, this visibility also demonstrates to the community the value the trucking industry contributes in transporting necessary materials to their destinations. Future research could focus on the following:

- **Identify Effective Marketing Techniques:** Through the identification of the most effective methods for marketing the trucking industry and its occupations, the trucking industry can then target and market to specific underrepresented populations (*e.g., women, tribal communities, veterans*).
- **Conduct Job Analysis to Identify Industry Changes:** Conducting an analysis that focuses on upcoming changes and new duties in trucking over the next decade will assist in the identification of what new driver skills will be necessary (*e.g., electric vehicles, autonomous vehicles, automation*). A job analysis will also help ensure education programs are evolving and aligned to match the changing landscape of the trucking industry.



Looking Forward: Focus for 2021

The trucking industry currently has one of the largest workforce gaps in the transportation sector, in part due to the required training and licensure. Anecdotal evidence also suggests trucking has a unique culture gap within the transportation sector. Groups that face abnormal unemployment rates potentially have much to gain from these gaps. To more effectively incentivize these groups to pursue a job in trucking, the barriers to entry must be lowered.

Licensing waivers have been an effective route for making trucking more accessible to veterans who have previously operated heavy-duty machinery. This allows veterans to integrate the skills they developed in their military careers into their civilian lives. The workforce gap in trucking and the veteran's employment gap will simultaneously line up with programs such as the "Military Skills Test Waiver Program" and the "Even Exchange State Implementation Program." Both programs are provided by the Federal Motor Carrier Safety Administration of the U.S. Department of Transportation and have been implemented and analyzed across the industry.

Another key community that would benefit from targeted training and recruitment are tribal communities. With tribal communities facing high unemployment and poor national infrastructure investments, this group has the potential to take advantage of the gains to the economy that will come from expanding the trucking supply chain to establish access for tribal communities. The efforts that have been effective for bringing veterans into the trucking sector must be studied and reapplied for the tribal workforce where similar gaps can be closed.

Underlying the future of the trucking industry is the controversial narrative of automation. Much of the dialogue on automation revolves around foreboding concerns of the labor force being outcompeted by automation. While this is an understandable concern, there is a low indication of such a shift within the short to medium term. The effective utilization of this time before an automated trucking industry comes into full effect, training new workers with the current skills of the profession and upskilling them to adapt to changing technologies is essential for a smooth transition. Workforce development investments into the already underutilized veteran and tribal communities can grow their economic status.

X. Research Priority 4: Workforce Diversity

In identifying the occupational priorities for surface transportation in the Southwest, it can be seen that at least three of these positions – Transportation, Storage, & Distribution Manager; Logistician; and Laborers, Freight, Stock, & Material Movers (*Hand*) – clearly overlap into the region’s massive Supply Chain & Logistics industry. For employers in the Southwest, establishing a stable pipeline of qualified candidates to fill the growing demand for these positions has become a critical workforce priority.

Despite the projected increase in these supply chain positions, Southwest stakeholders report challenges when it comes to attracting and retaining employees for these roles. Workers with similar skills are often employed in transportation construction jobs that the supply chain industry must compete with for candidates, particularly during construction season.

Certainly, more intentional outreach efforts could be used to promote transportation or supply chain jobs as viable options to candidates before they enter into other fields, and a primary target for such outreach should be an industry’s underrepresented populations. For the three cross-over occupations identified, reported employment demographics (*Exhibit 10*) demonstrate a familiar lack of proportional representation of women and minorities within this workforce.

Exhibit 10: Supply Chain Employment Demographics, Southwest (2018)

OCCUPATION	% WOMEN	% WHITE	% AFRICAN AMERICAN	% HISPANIC
Transportation, Storage, and Distribution Manager	16.0	84.9	7.2	13.7
Logistician	37.3	75.7	12.1	10.1
Laborers and Freight, Stock, and Material Movers, Hand	21.4	74.0	18.9	22.0

Attracting and training candidates from underrepresented populations to fulfill employment demands could therefore be one winning strategy. Returning veterans are similarly underrepresented in these fields, despite their offering a collection of transferable skills obtained through military experience and deployment that are directly applicable to these high-demand occupations (*Hochfelder, 2018*), both in the transportation and supply chain sectors.

Another challenge more specifically linked to supply chain employers is that of regional mobility. Supply chain jobs tend to cluster in certain regions, while the pool of potential employees does not. This distinction can be particularly problematic for those who rely on public transportation, as it can dramatically limit accessibility to many supply chain job locations (*Boarnet et al., 2019*). Known as a “modal mismatch,” this misalignment between access to public transportation and access to supply chain jobs is documented by an analysis of logistics jobs in Southern California. Here, researchers found that within 60 minutes, 55.9% of eligible workers could reach clusters of logistics jobs, but only 4.6% of those jobs were accessible by public transportation (*Boarnet et al., 2019*). Clearly, when considering how to attract and train underrepresented populations for high-demand jobs, successful strategies must account for basic barriers like accessibility and available modes of transportation.

Case Study Example: RTC of Southern Nevada Collaborates with Lyft

When supply chain employer Northgate Distribution Center (NDC) opened a warehouse in a region not serviced by public transportation, they looked to the Regional Transportation Commission (RTC) of Southern Nevada to help find solutions to meet the mobility needs of their employees. As a result, RTC entered into a partnership with rideshare organization Lyft to provide enhanced commuting options and greater job access to NDC, at a rider cost subsidized by RTC and the employer. Before this partnership, employees had to walk 1-2 miles from the closest bus stop to reach the warehouse, whereas now they can hail a Lyft driver to pick them up from any one of 11 transit stops. (*Mass Transit Mag, January 2019*)

Labor Market Research

An analysis of labor market data confirms the importance of these occupations in terms of job growth within the supply chain industry throughout the Southwest region. Projected through the year 2026 in Figure 14, most states reflect a double-digit increase in workforce demand (BLS, 2016). Targeting these occupations with outreach and recruitment strategies can make a significant impact on an employer’s ability to fill these high-demand jobs.

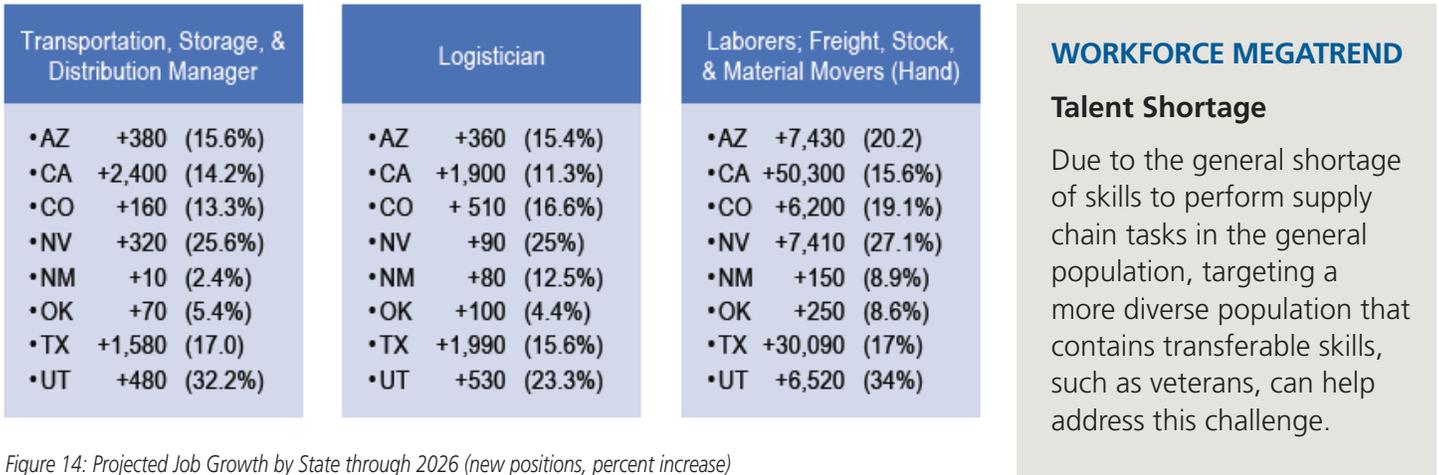


Figure 14: Projected Job Growth by State through 2026 (new positions, percent increase)

From this BLS projection, Southwestern states such as Nevada and Utah are expected to experience a relatively large increase in job growth, while states with less supply chain industry, such as Oklahoma, will likely not. More densely populated states like California and Texas, already hosts to a large number of supply chain positions, are still expecting to see a significant increase over the next 6 years.

Naturally, each of these occupations require a specific set of knowledge, skills, and abilities for workers to have success on the job, a sampling of which is shown in Figure 15 below (O*NET, 2019). This illustrates the collection of abilities that are key to job seekers as well as the necessary knowledge and skills to training upon.

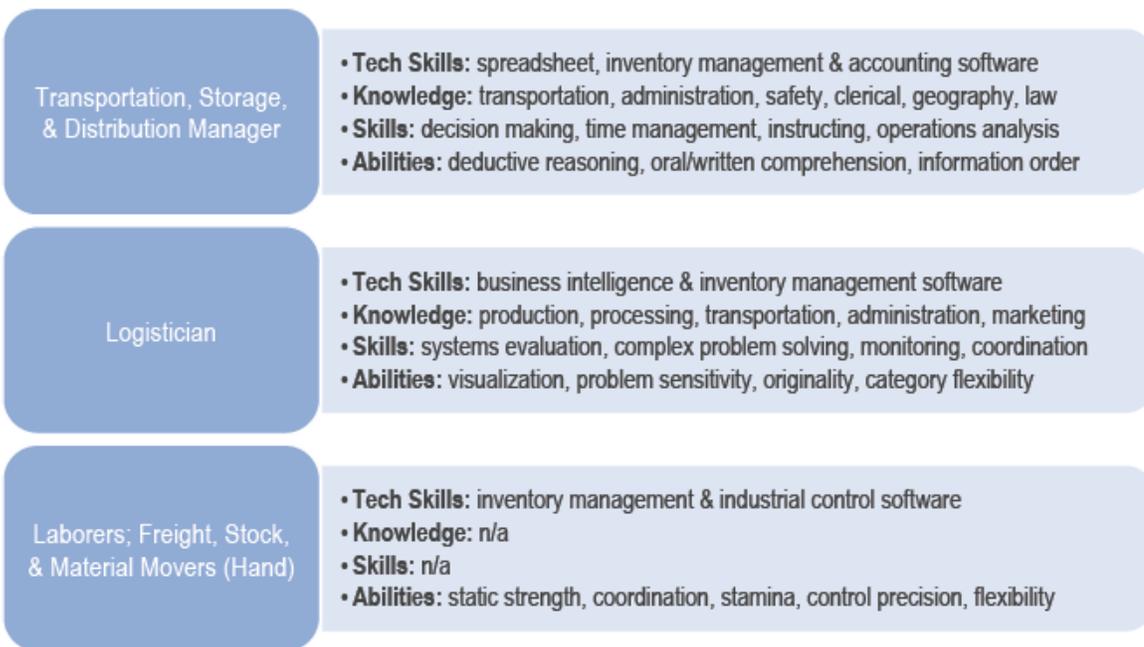


Figure 15: Relevant Supply Chain Job Skills

There are additional considerations for future supply chain skill needs, as many of the industry's occupations are currently or anticipated to be impacted by automation. The workforce skills required will likely need to be updated to adapt to the changing nature of the job, which might include such tasks as facilitating automated operations or addressing malfunctions, both associated with high technical skills and earning levels (Decas & Kailas, 2019). Similarly, a necessity for increased efficiency due to the growth of ecommerce and online shopping is impacting freight demands by requiring employers to deploy telecommunications and computing capabilities to remain competitive. To make the supply chain more efficient, industry must use data to predict where demand will be coming weeks in advance. Even if such computations occur virtually hidden from the supply chain labor force, workers will still be expected to interact with and react to a greater volume of data and information than ever before.

Practical Response Strategies

As indicated earlier, these priority occupations are forecast to experience double-digit growth within Southwest industries through the year 2026; a rate almost double that of the national average. It is a priority for the long-term success of the region's transportation and supply chain industries that strategies and action plans be developed to address this workforce gap, specifically by focusing on increasing the number of qualified candidates seeking access to these occupations.

The lack of diversity in these occupations suggests reaching out to underrepresented populations is a worthwhile avenue to increase the number of candidates.

One such strategy is to engage a wide range of educational programs and institutions around promoting these opportunities to underrepresented populations, such as women, veterans, rural or tribal, and non-native English speakers, where a lack of awareness as to career options and occupational opportunity can be addressed through targeted outreach efforts. Similarly, engaging transportation agencies and supply chain organizations to promote these positions and helping to establish training pathways to developing the necessary job skills can significantly contribute to filling demand for these roles.

Promotion through various educational programs ranging from K-12 to technical and college programs support better awareness of these supply chain opportunities. To sustain the flow of incoming workers in supply chain occupations, it is critical that schools take advantage of hosting career professionals to share their experiences and be seen as mentors to those entering the field. Additionally, college curriculum must remain relevant to real world experiences in the supply chain workforce, such as courses in trade logistics. Officials from within industry would be well-served to collaborate with academic institutions to develop desired skills in students and market job opportunities to them (Decas & Kailas, 2019).

Case Study Example: Volvo Research and Educational Foundations

Volvo's research and educational foundations develop and invest in projects and programs that facilitate collaboration and distribution of supply chain research among university researchers, outside organizations, and similar stakeholders. This allows educators to benefit from these research collaborations and for supply chain employers to promote open occupation to students. It also allows educators to identify and develop within their students the relevant skillsets needed for these occupations. (Empowering the New Mobility Workforce, Decas & Kailas, 2019)

The lack of diversity in these occupations suggests reaching out to underrepresented populations is a worthwhile avenue to increase the number of candidates. Dr. Genevieve Giuliano notes that the lack of equitable representation of women in this workforce is a concerning issue well worth studying, as the industry could only benefit by tapping into this pool of potential candidates (Boarnet et al., 2019).

But in order to both diversify its workforce and identify a large enough population to support a growing demand for transportation and supply chain workers, these industries need strategies that recruit and retrain female and minority workers in a more intentional way. Whether the challenges are an access to mobility or an institutional barrier to job entry or retention, forward-thinking and visionary leadership should take advantage of the current historic political moment as an opportunity to invite diversity into their workforce. The logistics industry alone could simultaneously choose to affirm the resurgent movement for women's rights, diversify the workforce, and build resilience and stability as the industry grows over the coming decades. (Boarnet et al., 2019).

Sample Initiatives

A variety of initiatives ranging from marketing career opportunities to apprenticeships in supply chain serve as illustrations in support of SWTWC's Supply Chain Diversity action plan. One such promotional example is the Women in Supply Chain Forum held at the 2019 Association for Supply Chain Management (ASCM) Conference in Nevada. This forum hosts prominent female speakers from the supply chain industry to network and discuss challenges and opportunities as part of ASCM's mission to attract, retain, and promote women in supply chain (ASCM, 2019). These types of opportunities can contribute to identifying barriers in implementing recruitment and training programs, as well as network with interested supply chain organizations.

Going beyond the apprenticeship model, many supply-chain programs within university business schools provide a foundation for students to enter supply chain and logistics positions.

In a cross between promotion and targeted training, the Council of Supply Chain Management Professionals (CSCMP) is conducting outreach and training to veterans. Though veterans often bring a complement of compatible skills from their military experience, the overlap with supply chain position competencies is sometimes difficult to detect. CSCMP works to promote high demand occupations to veterans as well as provide professional certification programs that help transfer their skills over to civilian supply chain positions. Through collaboration with colleges and military bases, CSCMP has developed Supply Chain Pro 1, 2, and 3 professional-level certification programs. What started with a grant from the Department of Education has been sustained through collaboration with institutions like Collins College in Texas. Similar certification processes for veterans are hosted by ISM, APICS, and SAP (Hochfelder, 2018).

Once supply chain positions become well-promoted to targeted populations, education systems and organizations can direct candidates into supply chain apprenticeships. Pilatus Aircraft, Ltd. offers a Logistics Coordinator Apprentice position in Colorado, where apprentices get to work in their Parts Warehouse. This two-year program combines classroom instruction with on-the-job training, focusing on workplace skills and duties that involve inventory control, managing domestic and international transportation options, supply chain decision making, and delivering production materials to the aircraft completion center. Upon program completion, participants earn a Certificate of Completion from the U.S. Department of Labor (Pilatus, n.d.).

Going beyond the apprenticeship model, many supply-chain programs within university business schools provide a foundation for students to enter supply chain and logistics positions (SCM, 2019). Promoting these programs early as career options and providing academic incentives like scholarships can help guide students towards an occupation in this industry.



Case Study Example: Increasing Rural Access at Northern Arizona State University

As a way to broaden the reach of their logistics program to a more diverse population, Northern Arizona University began offering the courses online. The success of this move became apparent as enrollment surged to 150% of normal, eventually contributing to a noticeable increase in the region's supply chain workforce pipeline. The goal was to specifically provide access to the region's more rural native American populations and has been effective at engaging both the Pascua Yaqui Tribe and Tohono O'odham Nation. (Empowering the New Mobility Workforce, Lambert & Roark, 2019)

The SWTWC response to this workforce priority is the Supply Chain Diversity action plan, presented in Phase 2 of its **"Job Needs and Priorities Report"** (SWTWC, 2016). In this plan, outreach and communication strategies, buy-in processes, resources, sample effective programs, possible collaborators, and details on deployment are provided.

Research Priorities

By promoting high-demand occupations through a variety of methods, by specifically targeting underrepresented populations, and by addressing potential barriers to mobility, worksite access, and competency attainment (*education and training*), an increased awareness and more positive perception of career within industries like surface transportation and supply chain can be developed. Training considerations and recruiting from talent pools that already have transferable skills (*e.g., veterans*) will result in an even greater pipeline of qualified candidates. Offering effective training solutions that ensure successful employment will serve to further encourage these new workforce prospects and better support employer recruitment efforts.

To fully develop a set of actionable strategies that more fully address diversifying the Southwest's transportation and supply chain workforce and providing a sufficient candidate pool to meet its growing demands, future research considerations should include:

- Updating the Southern California logistics analysis to identify where current clusters of supply chain occupations are located relative to the industry's current/potential workforce, examining accessibility using personal versus public transportation.
- Analyzing employer job specifications to identify how supply chain competencies may be changing over time due to factors like increased automation, ecommerce, etc.

Looking Forward: Focus for 2021

A major obstacle limiting the number of potential candidates who are eligible to fill high-demand jobs like those in the supply chain industry is modal mismatch; a misalignment between their access to public transportation and their access to supply chain jobs.

While strategies like promoting such occupations to underrepresented populations may address the anticipated need for more logistic professionals, it does tackle the ongoing issue of worker mobility and their access to public transportation. As indicated, the majority of logistic occupations tend to group around urban areas like Los Angeles and the Inland Empire (*both in California*), yet the natural dispersion of its current workforce has made personal transportation the common platform for worker commuting (*Boarnet et.al., 2019*). Looking to the future, when tapping into the pool of underrepresented populations to build a sustainable pipeline of new workers becomes critical to satisfying job growth, solving this issue of worker mobility by broadening access to various forms of public or subsidized transportation will be key.

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Appendix A: Labor Market Data for Relevant Occupations

Occupational Data and Projections for Relevant Occupations in the Southwest Region Engineering, Science, Construction, and Maintenance/Repair SOC Codes								
SOC Code	Occupation Title	# Employees in the SW May 2018	National Avg Hourly Wage	Typical Education Needed for Entry	# Employees 2016	Projected # Employees 2026	Change in # Employees	Percent Change
17-1021	Cartographers & photogrammetrists	3,870	\$32.86	Bachelor's degree	4,750	6,150	1,400	29.47%
17-1022	Surveyors	13,240	\$31.94	Bachelor's degree	12,970	15,230	2,260	17.42%
17-2011	Aerospace engineers	25,350	\$56.30	Bachelor's degree	25,870	29,170	3,300	12.76%
17-2051	Civil engineers	93,780	\$45.06	Bachelor's degree	90,050	104,880	14,830	16.47%
17-2071	Electrical engineers	54,810	\$48.85	Bachelor's degree	53,860	62,220	8,360	15.52%
17-2081	Environmental engineers	16,420	\$44.54	Bachelor's degree	14,730	16,780	2,050	13.92%
17-3021	Aerospace engineering & operations technicians	5,220	\$33.16	Associate's degree	4,900	5,480	580	11.84%
17-3022	Civil engineering technicians	23,740	\$26.29	Associate's degree	25,350	28,850	3,500	13.81%
17-3023	Electrical & electronics engineering technicians	45,950	\$31.27	Associate's degree	50,010	55,070	5,060	10.12%
17-3025	Environmental engineering technicians	5,980	\$26.34	Associate's degree	4,630	5,390	760	16.41%
17-3029	Engineering technicians, except drafters, all other	27,490	\$31.60	Associate's degree	24,820	27,800	2,980	12.01%
17-3031	Surveying & mapping technicians	16,930	\$22.93	High school diploma or equivalent	15,720	18,520	2,800	17.81%
19-1031	Conservation scientists	6,470	\$31.40	Bachelor's degree	6,000	6,730	730	12.17%
19-3051	Urban & regional planners	13,160	\$36.65	Master's degree	11,490	13,300	1,810	15.75%
47-2071	Paving, surfacing, & tamping equipment operators	13,310	\$21.32	High school diploma or equivalent	15,950	19,420	3,470	21.76%
47-2073	Operating engineers, construction equipment operators	107,930	\$25.50	High school diploma or equivalent	98,960	118,190	19,230	19.43%
47-2111	Electricians	183,140	\$28.46	High school diploma or equivalent	183,550	219,140	35,590	19.39%
47-4051	Highway maintenance workers	21,910	\$19.92	High school diploma or equivalent	21,630	24,420	2,790	12.90%
47-4061	Rail-track laying & maintenance equipment operators	1,820	\$27.46	High school diploma or equivalent	2,050	2,650	600	29.27%
49-2091	Avionics technicians	5,530	\$31.41	Associate's degree	5,760	6,310	550	9.55%
49-2093	Electrical/electronics installers/repairers, transportation	2,100	\$29.55	Postsecondary non-degree award	3,790	4,300	510	13.46%
49-3011	Aircraft mechanics & service technicians	41,490	\$31.36	Postsecondary non-degree award	46,510	51,990	5,480	11.78%
49-3031	Bus & truck mechanics & diesel engine specialists	67,850	\$23.63	High school diploma or equivalent	70,830	83,040	12,210	17.24%
49-3043	Rail car repairers	3,760	\$26.93	High school diploma or equivalent	3,880	4,440	560	14.43%
49-3051	Motorboat mechanics & service technicians	3,600	\$20.35	High school diploma or equivalent	3,540	3,940	400	11.30%
49-3052	Motorcycle mechanics	4,000	\$18.87	High school diploma or equivalent	4,610	5,210	600	13.02%
49-3092	Recreational vehicle service technicians	5,260	\$19.28	High school diploma or equivalent	4,060	4,430	370	9.11%
49-3093	Tire repairers & changers	36,060	\$14.20	High school diploma or equivalent	34,310	37,450	3,140	9.15%
49-9092	Commercial divers	540	\$28.59	Postsecondary non-degree award	330	390	60	18.18%
49-9097	Signal and track switch repairers	980	\$32.60	High school diploma or equivalent	1,250	1,400	150	12.00%
51-2011	Aircraft structure, surfaces, rigging, systems assemblers	9,510	\$26.70	High school diploma or equivalent	8,290	7,770	-520	-6.27%
51-9197	Tire builders	1,870	\$21.89	High school diploma or equivalent	210	220	10	4.76%

Occupational Data and Projections for Relevant Occupations in the Southwest Region Management, Service, and Support Occupations								
SOC Code	Occupation Title	# Employees in the SW May 2018	National Avg Hourly Wage	Typical Education Needed for Entry	# Employees 2016	Projected # Employees 2026	Change in # Employees	Percent Change
11-3021	Computer and information systems managers	112,410	\$73.49	Bachelor's degree	94,590	113,370	18,780	19.9%
11-3071	Transportation, storage, distribution managers	39,310	\$49.45	High school diploma or equivalent	34,300	39,700	5,400	15.7%
13-1081	Logisticians	47,700	\$37.85	Bachelor's degree	40,500	46,060	5,560	13.7%
13-2031	Budget analysts	15,370	\$38.38	Bachelor's degree	17,030	19,110	2,080	12.2%
13-2051	Financial analysts	80,090	\$48.55	Bachelor's degree	73,120	85,430	12,310	16.8%
33-3041	Parking enforcement workers	2,170	\$20.29	High school diploma or equivalent	2,390	1,600	-790	-33.1%
33-3052	Transit and railroad police	640	\$35.79	High school diploma or equivalent	610	710	100	16.7%
33-9093	Transportation security screeners	6,910	\$20.13	High school diploma or equivalent	6,680	7,170	490	7.3%
43-5011	Cargo and freight agents	25,550	\$22.15	High school diploma or equivalent	28,980	34,780	5,800	20.0%