



OC Strong: Economic and Occupation Projections for Orange County, 2021-2025

Los Angeles/Orange County Regional Consortium,
Orange County Region

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Kleinhenz Economics
Cities+Regions

OC Strong: Economic and Occupation Projections for Orange County, 2021-2025

Prepared for LAOCRC

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Introduction and Purpose of Study

The LA/OC Regional Consortium consists of 28 community colleges and a standalone noncredit continuing education center located across Los Angeles and Orange Counties. It serves as a regional framework to communicate, coordinate, collaborate, promote, and plan career and technical education, workforce development, and economic development in the Los Angeles/Orange County Region.

The LAOCRC's programs and initiatives must account for the current economic situation that is overshadowed by the COVID-19 pandemic, while also anticipating broader economic and workforce developments through at least the first half of the new decade. This includes changes in the county's industries, changes to its workforce/occupational needs, and more fundamental changes to the economy, including demographics, advances in technology (for example, automation and artificial intelligence), and economic cycles.

The OC Strong study was undertaken on behalf of the Orange County office of the Consortium, henceforth referred to as the LAOCRC. The purpose of this study is to comprehensively analyze the recent state of the Orange County economy, to develop forecasts of the county's industries, and to identify opportunities for its current and future workforce. The study also provides essential background on the current state of the U.S., California, and Orange County economies, including the impact of the COVID-19 pandemic.

OC Strong complements the LAOCRC's four-year Strong Workforce Program Regional Plan for the Orange County community colleges. It also equips the LAOCRC to coordinate more effectively with other regional workforce planning initiatives, particularly those developed by the three Workforce Development Boards in Orange County. Most importantly, it informs community college efforts to successfully plan and implement career education programs to provide the county economy with a capable workforce that is trained for the 21st Century.

Key Findings

The analyses and forecasts contained in OC Strong may be used to identify trends in the county's industries and occupations as well as the underlying forces that are driving those trends. The report will enable the LAOCRC to make informed, data-driven decisions on behalf of the students and communities their constituent members serve as they determine the array of academic and training alternatives that will best equip the workforce of the future. Key findings include:

Current Conditions and Outlook

- The 2020 pandemic caused sharp job losses and record high unemployment. Leisure and hospitality, retail trade, administrative support services, and personal services among the hardest hit industries. Self-employed and small businesses were among those affected in part because of their large presence in these four industries.
- The Orange County economy is currently recovering from the COVID-19 pandemic. Some industries are recovering faster than others, including such priority sectors as construction, logistics, retail trade, and financial services. While activity will likely accelerate in 2021 as the COVID-10 vaccine is administered, it may take up to five years to regain all jobs lost during the first part of 2020.
- As recovery turns to expansion, the county's historically tight labor market will force employers to tap into the broader regional labor market to fill positions, as workers tend to be more mobile with respect to where they work than where they live.

Priority Sectors and Occupations

- The eight priority sectors, as identified by the LAOCRC, account for more than 7 out of every 10 jobs in the county. Within the sectors, occupations that require community college education or training account for about eight percent of all jobs in all industries across the county (120,000 out of 1.56 million).
- As these industries recover from the pandemic, they will create job opportunities over the four year planning horizon from 2021 through 2025, mainly in health care, leisure and hospitality, construction, and retail trade, creating employment opportunities in Orange County and the surrounding region for students who complete their community college career education.
- The largest number of openings among occupations that require community college education or training will be in medical and dental occupations, hair styling, cosmetology, and other personal service occupations, office occupations in bookkeeping and accounting and legal services, and automotive repair and maintenance occupations.
- Smaller increases are expected in other so-called traded industries that contribute to overall economic growth (expanding the economic pie) even if they have smaller employment head counts. These include ICT and Digital Media, financial activities, and manufacturing.

- Self-employed have a substantial presence in the county economy. This includes several industries within the priority sectors: construction, transportation and logistics, real estate, health care, and food services.
- A detailed cross-tabulation of the county's current working population shows that while certain occupations are logically found in large numbers in their associated industry (for example, health care providers working at health care establishments) there can be unexpected matches as well, such as hair stylists working in ICT and Digital Media establishments. This makes it necessary to track trends in both the demand for occupations and industry job trends.
- There is considerable variation in the socio-economic characteristics of the priority sector workforce. Analysis of the county's current workforce by industry shows that one-third to two-thirds of the workers in the priority sectors have academic backgrounds consistent with community college career education. The distribution of workers by racial and ethnic background also varies widely, with Whites accounting for over half of the workforce in Business and Entrepreneurship and ICT and Digital Media, and Hispanic workers accounting for 4 out of 10 positions in Advanced Transportation and Logistics, and Retail, Hospitality, and Tourism.

Community College Challenges and Opportunities

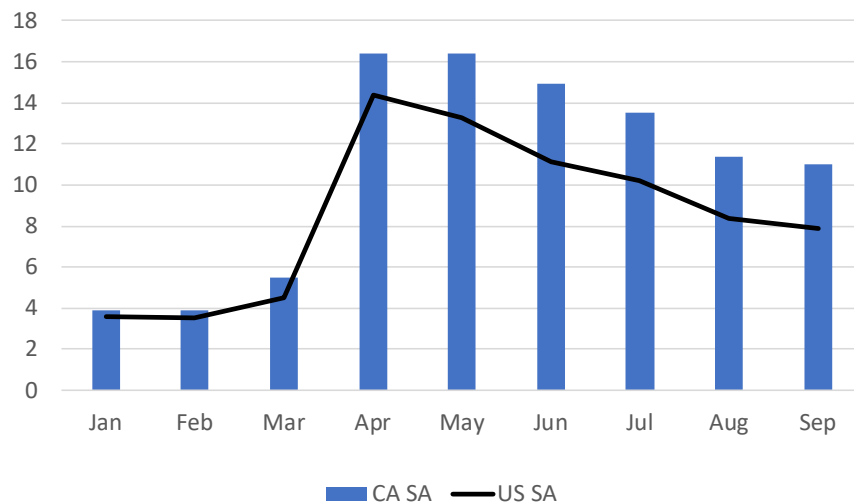
- While the prospects for community college students to find employment upon completion of their studies are good, the community colleges themselves may be challenged to fill classrooms and courses in some fields. Demographic projections suggest that the college age/young adult-age population in Orange County will decline by approximately four percent from 2021 through 2025. Los Angeles County will also experience a decline in student age numbers, but the Inland Empire will see an increase of approximately three percent.
- In an economy that is increasingly digital and information-driven, the role of community colleges in workforce preparation will become ever more important. Automation and artificial intelligence may not displace jobs per se, but they may eliminate certain routine tasks, potentially disrupting the work environment in the process. This will occur across increasing numbers of occupations and educational backgrounds. Future workers must engage in life-long education and training to maintain or enhance their skills in order to keep up with advances in technology. Community college programs must inculcate students with the ability to be flexible and nimble, so they can adapt in the face of technological change.
- Given the presence of self-employed and small businesses in the priority sectors, many students who pursue career education and training at community colleges will benefit from training in business management and operations, and entrepreneurship skills, in addition to studies within their field of interest.

- Connecting the education and workforce pipelines will be all-important to the future growth of the Orange County economy and the vitality of its workforce. As academic institutions make that connection through engagement with the business community and others in the county, they will be able to improve upon existing in-house education and training programs. In partnership with local employers, they can identify opportunities to enhance existing or establish new joint training programs to meet the needs of a rapidly changing workplace environment. Finally, nonprofits can play an important role in serving as a bridge between academic institutions and local employers across many areas of workforce training and development.

Recent Trends in U.S. and California Economies

The longest economic expansion in U.S. history was abruptly ended by the onset of the COVID-19 pandemic in 2020. In just two months, record low unemployment rates gave way to record highs, as the U.S. unemployment rate jumped from 3.5% in February 2020 to 14.7% by April (Figure 1). While activity in commercial aviation, hospitality, and goods movement ground to a halt early in the year, the nationwide shutdown in mid-March suddenly caused economic activity to reverse course across the board. By the end of the second quarter, GDP had contracted by \$2 trillion, an unprecedented 10% decline in just two quarters from its peak of \$19.3 trillion in the fourth quarter 2019. While no sector was spared, the hardest-hit industries were those that rely on personal interaction, including arts and entertainment, hospitality, retail trade, personal services, and health care. The widespread shutdown also induced a sharp decline in industries related to building and employment services.

Figure 1: California and U.S. Unemployment Rates Decreasing Slowly



Source: CA EDD, U.S. BLS, Analysis by KE

While the vast majority of industries in the economy had shut down or moved to remote work, much attention was devoted to households and small businesses. Many households live paycheck to paycheck and have scant financial reserves to draw from when their work is interrupted. A survey conducted by the Federal Reserve Bank in 2019¹ revealed that 40% of households do not have the financial wherewithal to pay for a \$400 emergency. Similarly, small businesses lack the financial reserves and credit alternatives that are available to large firms, and thus are less able to weather financial disruption. The situation led Congress to pass the CARES Act (Coronavirus Aid,

¹ Report on the Well-being of U.S. Households in 2018, Board of Governors of the Federal Reserve System (2019)

Table 1: California Recovering Slowly from Pandemic-Related Job Losses

Industry Employment	Feb-20	February to April	% Change	April to September	% of Losses Recovered	Sep as % of Feb
Total Nonfarm	17,604,500	-2,615,800	-14.9%	993,600	38%	91%
Leisure & Hospitality	2,055,300	-982,400	-47.8%	381,400	39%	71%
Health Care & Social Assistance	2,460,900	-285,700	-11.6%	164,300	58%	95%
Retail Trade	1,654,900	-279,400	-16.9%	160,400	57%	93%
Other Services	581,300	-172,700	-29.7%	54,800	32%	80%
Administrative & Support & Waste Services	1,138,400	-161,800	-14.2%	63,400	39%	91%
Construction	896,900	-150,000	-16.7%	95,100	63%	94%
Manufacturing	1,315,700	-133,800	-10.2%	39,100	29%	93%
Professional, Scientific & Technical Services	1,351,700	-84,400	-6.2%	40,100	48%	97%
Government	2,631,800	-80,300	-3.1%	-75,200	-94%	94%
Information	588,200	-78,700	-13.4%	6,200	8%	88%
Wholesale Trade	690,800	-66,200	-9.6%	28,900	44%	95%
Transportation, Warehousing & Utilities	718,200	-58,900	-8.2%	26,900	46%	96%
Educational Services	392,900	-42,200	-10.7%	-4,900	-12%	88%
Real Estate & Rental & Leasing	306,400	-23,400	-7.6%	5,100	22%	94%
Management of Companies & Enterprises	253,100	-13,400	-5.3%	2,000	15%	95%
Finance & Insurance	545,300	-1,500	-0.3%	6,400	427%	101%
Mining and Logging	22,700	-1,000	-4.4%	-400	-40%	94%

Source: California EDD, Analysis by KE

Relief, and Economic Security Act) authorizing more than \$3.3 trillion in assistance across the economy, with households and small businesses receiving approximately \$800 billion.

By June 2020, parts of the U.S. had reopened, leading to a surge in wage and salary employment. In subsequent months, job gains moderated as parts of the country went through various stages of opening and closing, employers hired with hesitancy, and consumers spent cautiously. California was hit harder by the pandemic shutdown than the nation as a whole. The unemployment rate rose from 3.9% in February 2020 to 16.4% by April, coming down more slowly than the U.S. in subsequent months. As of September, the state unemployment rate was in the low double digits at 11.0%. While the state's mix of industries may account in part for its elevated unemployment rate, it has also pursued a more cautious response to the pandemic than other states, resulting in more deliberate progress during the re-opening stage of the recovery.

Compared to peak employment of 17.6 million in February 2020, the state lost 2.6 million nonfarm positions between February and April (Table 1). Every industry lost jobs, with leisure and hospitality accounting for nearly 990,000 job losses, followed by health care and social assistance (286,000), and retail trade (279,000). While recovery ensued in most sectors by the middle of the year, most industries advanced slowly and a few continued to shed jobs, notably government, which lost nearly the same number of positions since the shutdown (75,000) as during the shutdown (80,000).

A surge of hiring in June was followed by more subdued increases in subsequent months. As of September, California had recovered just 38% of the jobs lost during the shutdown while the U.S.

had recovered 54%. Indeed, it will take years, not months or quarters for the U.S. and California to fully recover. GDP is expected to return to its pre-pandemic level by late 2021, but the labor market will advance more slowly as firm hiring tends to lag other indicators of economic activity. California is apt to follow the U.S path in the coming quarters, with its labor market taking somewhat longer to fully recover the state equivalent of full employment. Keeping in mind that the nation and state were at record low unemployment rates prior to the pandemic, the full employment "target" for the U.S. is not the February rate of 3.5% but closer to 4.4%.

Orange County and the COVID-19 Pandemic

The pandemic hit Orange County just as the county's hospitality and tourism sector had begun to ramp up to peak season employment. The county unemployment rate stood at 2.8% in February 2020. It had been at or below three percent for a year and was consistently below the rates of its neighbor counties, the state, and even the U.S. as a whole.

The March pandemic shutdown abruptly ended the county's growth trajectory as the county lost 42,000 jobs in March followed by a much larger loss of 226,000 in April for a total decline of 267,600 positions over a two-month period (Table 2). Virtually every industry shed jobs, but leisure and hospitality alone accounted for nearly forty percent of the county's job losses (102,800), followed distantly by health care and social assistance (28,000), retail trade (23,100), other services (17,800), and construction (15,500).

Table 2 - Orange County Hit Hard by Pandemic-related Job Losses

Industry	Feb-20	February to April	% Change	April to September	% of Losses Recovered	Current Shortfall	Now % of Feb
Total Nonfarm	1,677,800	-267,600	-15.9%	101,000	38%	166,600	90%
Leisure & Hospitality	227,500	-102,800	-45.2%	37,000	36%	65,800	71%
Health Care & Social Assistance	200,600	-28,000	-14.0%	19,400	69%	8,600	96%
Administrative & Support & Waste Services	151,000	-26,700	-17.7%	20,800	78%	5,900	96%
Retail Trade	150,300	-23,100	-15.4%	11,700	51%	11,400	92%
Other Services	50,800	-17,800	-35.0%	7,500	42%	10,300	80%
Manufacturing	158,700	-15,500	-9.8%	200	1%	15,300	90%
Professional, Scientific & Technical Services	136,200	-9,500	-7.0%	900	9%	8,600	94%
Wholesale Trade	78,300	-8,700	-11.1%	1,500	17%	7,200	91%
Construction	105,400	-8,600	-8.2%	8,700	101%	-100	100%
Government	168,700	-6,700	-4.0%	-9,100	-136%	15,800	91%
Finance & Insurance	81,000	-5,600	-6.9%	1,900	34%	3,700	95%
Information	25,800	-4,000	-15.5%	0	0%	4,000	84%
Educational Services	34,500	-3,400	-9.9%	-3,800	-112%	7,200	79%
Real Estate & Rental & Leasing	39,800	-3,100	-7.8%	800	26%	2,300	94%
Transportation & Warehousing	26,700	-2,400	-9.0%	2,900	121%	-500	102%
Management of Companies & Enterprises	39,100	-1,700	-4.3%	500	29%	1,200	97%
Mining and Logging	400	0	0.0%	0		0	100%
Utilities	3,000	0	0.0%	100		-100	103%

Source: EDD, Analysis by KE

The county has recovered 101,000 positions as of September, equivalent to 38% of the losses, but total industry employment was still 166,600 jobs below its February figure. Both the transportation and warehousing and construction sectors have more than made up for job losses during the shutdown. Most other industry sectors are recovering to varying degrees with two exceptions: education services and government continue to experience losses.

As expected, weekly unemployment insurance claims for Orange County shot up during the shutdown, with weekly claims exceeding 86,000 in late March and early April. The number of initial claims has since receded to less than 20,000 per week, a level that is still considerably higher than the pre-pandemic period when claims averaged 2,200 per week.

Unfortunately, few official indicators outside of employment and unemployment are available at the county level with the frequency required to track the economy's performance during these turbulent times. However, as of November 1, the website TrackTheRecovery.org reports that consumer spending in Orange County is 11.7% below January 2020 levels, although this represents a considerable improvement from the shutdown period in March and April when consumer spending was 38% below January levels.²

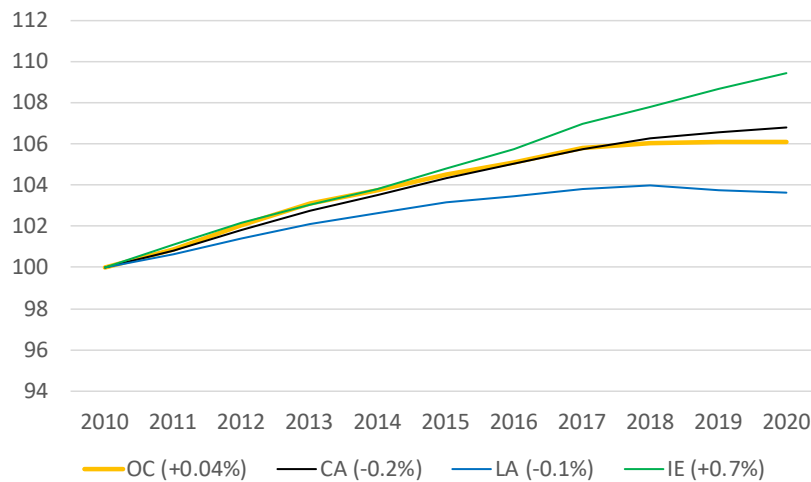
To be sure, the Orange County economy has embarked on a recovery path, not unlike the nation and the state. However, given the somewhat large concentration of jobs in leisure and hospitality, the county is expected to improve somewhat more slowly than the state as a whole. The county unemployment rate decreased to 9.0% in September 2020 from a peak of 14.7% in May, although part of that improvement is attributable to a decline in the labor force, which fell by nearly 58,000 workers year-to-year in September. It will take years for the county to recover all of the jobs that were lost during the shutdown, with full recovery expected toward the middle of the decade.

² Opportunity Insights Economic Tracker (TrackTheRecovery.org) is a publicly available database that tracks activity at a detailed level using anonymized data from private companies.

Trends in Orange County Industries and Occupations

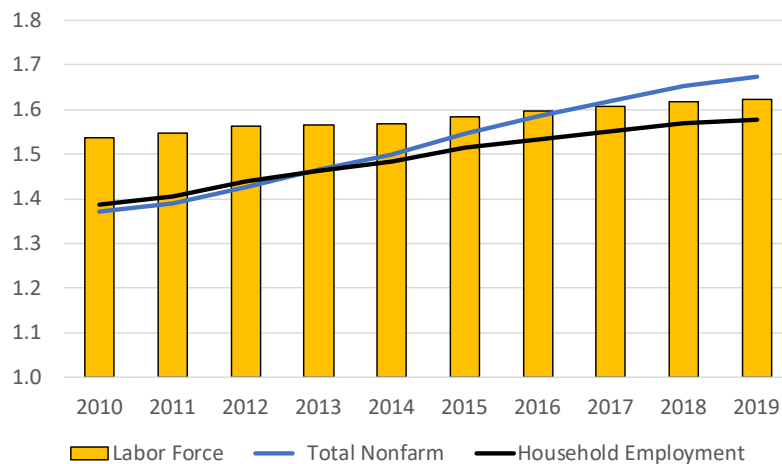
While the pandemic has caused unprecedented upheaval, the Orange County economy will regain momentum in the coming quarters and return to a sustainable growth trajectory that will lead once again to substantial job growth and a low unemployment rate. That said, Orange County’s recent and future economic progress depends on a combination of internal and external forces. Internally, population growth in Orange County has essentially been flat at 0.04% annual (Figure 2). While this was marginally faster than the state and Los Angeles County, it was well behind the growth rate of the Inland Empire (IE).

Figure 2: Negligible OC Population Growth in Recent Years (2010=100)



Source: CA EDD, U.S. BLS, Analysis by KE

Figure 3: Slow County Labor Force Growth, Must Hire Non-County Workers (millions)



Source: CA EDD, U.S. BLS, Analysis by KE

Slow growth in county population has contributed to slow growth in the labor force (Figure 3). Indeed, as the number of homegrown workers has fallen short of wage and salary positions, workers from other parts of Southern California have filled the void. The Inland Empire region has become a major source of workers for Orange County, with over 100,000 commuting from the IE to Orange County, and just 30,000 commuting in the opposition direction (Table 3). To be sure, the county also draws over 180,000 workers from Los Angeles County, but a roughly equal number of Orange County residents travel to Los Angeles County for work.

Table 3: Commuting Flows for Orange County (2011-2015)

3-a: Place of Work is Orange County		3-b: Place of Residence is Orange County	
County of Residence (Origin)	Workers in Commuting Flow	County of Work (Destination)	Workers in Commuting Flow
Orange County	1,242,588	Orange County	1,242,588
Los Angeles County	185,878	Los Angeles County	185,058
Riverside County	73,342	Riverside County	14,166
San Bernardino County	35,745	San Bernardino County	13,538
San Diego County	13,290	San Diego County	10,828
Ventura County	1,184	Ventura County	712
Total	1,552,027	Total	1,466,890

Source: Census Bureau, EDD, Analysis by KE

Orange County Industries

The diversity of the Orange County economy is reflected in its leading industries that include tourism and hospitality, health care, financial and professional services, and even manufacturing. In preparing for the future workforce and training needs of Orange County, it is imperative to understand the structure of the county economy as well as its recent trends. While employment is commonly used to describe a region's structure and to track its performance over time, additional metrics may also be used to better understand the composition of the county economy and its long-term performance. These include industry shares of total employment, location quotients, the distribution of establishments across industries, and the presence of self-employed.

Leading up to the pandemic shutdown, total nonfarm employment in Orange County advanced steadily. The county came out of the Great Recession between 2010 and 2014, adding more than 125,000 jobs for a 9.2% gain (Table 4).

Table 4: Orange County Employment (2010-2019)

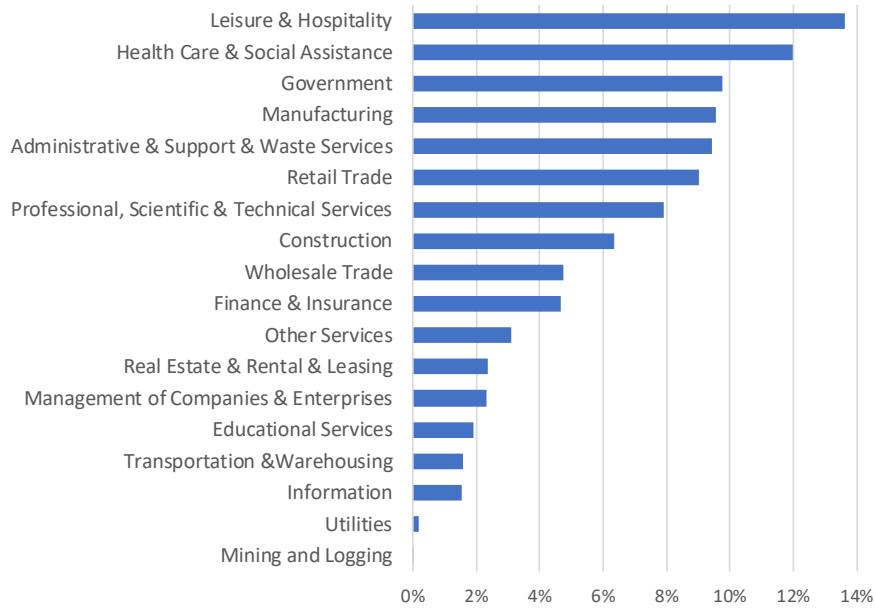
Industry	2010	2014	2019	% Change 2010-14	% Change 2015-19
Total Nonfarm	1,372,400	1,498,000	1,672,500	9.2%	11.6%
Mining and Logging	400	500	500	25.0%	0.0%
Construction	68,900	83,100	106,400	20.6%	28.0%
Manufacturing	151,100	158,200	159,800	4.7%	1.0%
Wholesale Trade	75,900	79,100	79,400	4.2%	0.4%
Retail Trade	141,300	148,600	150,500	5.2%	1.3%
Transportation & Warehousing	22,800	23,200	26,600	1.8%	14.7%
Utilities	4,000	3,300	2,900	-17.5%	-12.1%
Information	21,700	23,400	26,100	7.8%	11.5%
Finance & Insurance	69,500	76,400	77,800	9.9%	1.8%
Real Estate & Rental & Leasing	34,200	37,600	39,600	9.9%	5.3%
Professional, Scientific & Technical Services	107,300	123,100	132,000	14.7%	7.2%
Management of Companies & Enterprises	27,300	30,200	38,700	10.6%	28.1%
Administrative & Support & Waste Services	115,700	126,400	157,500	9.2%	24.6%
Educational Services	23,600	25,300	31,700	7.2%	25.3%
Health Care & Social Assistance	145,500	165,600	200,100	13.8%	20.8%
Leisure & Hospitality	168,700	194,500	228,000	15.3%	17.2%
Other Services	42,200	47,300	52,000	12.1%	9.9%
Government	152,300	152,200	162,900	-0.1%	7.0%

Source: California EDD, Analysis by KE

Job growth accelerated during the second half of the decade as the county added nearly 175,000 jobs between 2015 and 2019, an increase of 11.6%. Every industry except utilities added jobs between 2010 and 2019, led by leisure and hospitality (59,300), health care (54,600), administrative support services (41,800), and construction (37,500). These four industries accounted for nearly two-thirds of all the job gains in the county during that period. In percentage terms, construction, leisure and hospitality, health care, and other services led the way throughout the last decade. Of these, the last three were hit especially hard during the pandemic shutdown.

That leisure and hospitality and health care led the county in absolute job gains should be no surprise as these two industries accounted for the largest share of jobs at 13.6% and 12.0% respectively (Figure 4). Among the private sector industries, manufacturing, and retail trade, and professional and technical services also had sizable shares of total employment. Large parts of these industries are so-called traded industries, meaning a significant share of their business involves selling or "trading" outside the county.

Figure 4: Industry as % of Total Employment

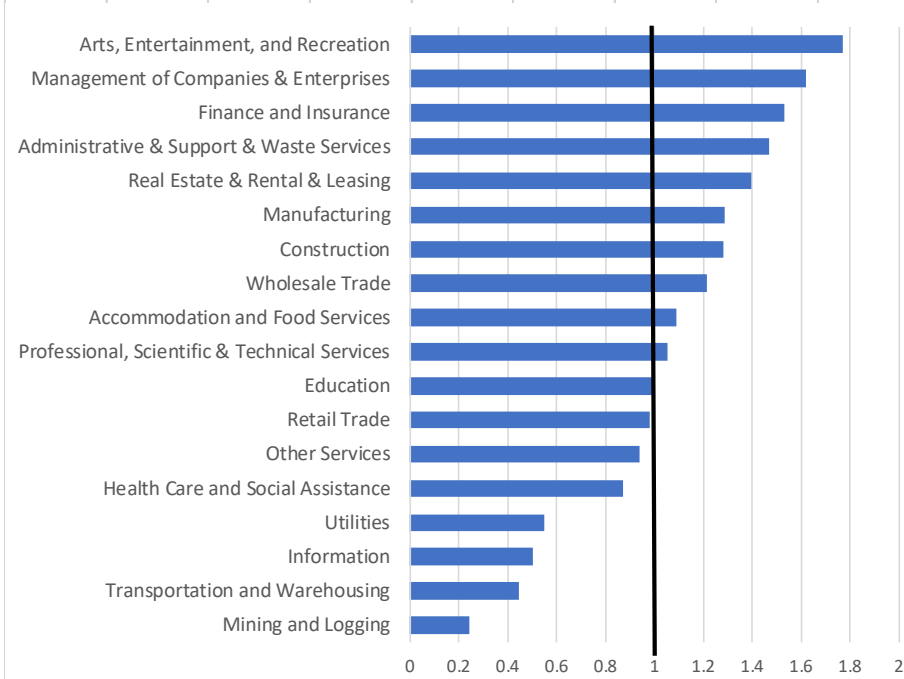


Source: California EDD, Analysis by KE

Manufacturing is clearly such an industry, as are many individual industries within professional and technical services. Leisure and hospitality and its component industries, arts, entertainment, and recreation along with accommodation and food services, are a mix, serving tourists and visitors as well as the local population. Retail trade rides on this sector's coattails despite typically being considered a local population-serving industry. These industries play a large role in expanding the size of the county's "economic pie", because much of the spending in these industries recirculates throughout the rest of the economy when residents patronize firms in local population-serving industries.

Location quotients (LQs) measure the relative importance of an industry in Orange County compared to the state as a whole. If an industry LQ is greater than one, the county's share of employment in that industry is greater than the statewide share. If the LQ is less than one, the county's share is less than the statewide share, and if the LQ equals one, the county's share equals the state's share.

Figure 5: Industry Location Quotient, OC to CA



Source: California EDD, Analysis by KE

Looking simultaneously at employment shares and the LQs for the county's industries, a number of the county's largest industries are also industries where the county has relatively more jobs than the state as a whole (Figure 5). In a sense, the county has a relative advantage in these industries compared to the state. For example, the arts, entertainment, and recreation industry is a component of the major industry group leisure and hospitality, along with accommodation and food services. Leisure and hospitality accounts for the largest share of employment in the count, but its two component industries also have LQs that exceed 1.0. Arts, entertainment, and recreation has the largest LQ at 1.8, meaning that the arts, entertainment, and recreation industry as a share of Orange County's total employment is 80% higher than that sector's share of total employment statewide. Accommodation and food services has an LQ of 1.1, meaning that its share of total employment is 10% higher than at the state level.

As another example, manufacturing has the fourth largest share of all positions countywide at 9.6% and it has an LQ of 1.3, meaning that the relative share of manufacturing jobs is 30% higher compared to the state as whole. On the other hand, and somewhat surprisingly, health care accounts for the second largest share of jobs at 12%, yet has an LQ of just 0.9, meaning that the concentration of health care employment is 10% lower in the county compared to the state.

The ranking of industries by LQ also identifies certain industries that may not have large numbers of jobs but are important contributors to county economic growth as traded industries.

Management of companies and enterprises is relatively small with a job count of 38,700 in 2019, representing just two percent of total employment. Yet, it is important as a traded sector because the establishments in this industry often play a "headquarters function" meaning they own a controlling interest in companies or play an oversight role over firms in which they have a controlling or managerial interest. With an LQ of 1.6, the concentration of this industry in the county is 60% higher than in the state as a whole. Similarly, finance and insurance jobs represent just 4.6% of all jobs in Orange County, but with an LQ of 1.5, employment in this industry is 50% higher than for the state. Like management of companies and enterprises, parts of finance and insurance are also traded industries. In fact, the financial services industry is the fourth largest traded industry in the county, based on data from the U.S. Economic Development Association.

In the same vein, traded industries rarely have the same job counts as local population-serving industries, but wages and salaries are often, although not always, above average. For example, the average annual wage in finance and insurance was over \$120,000 in 2019, somewhat ahead of management of companies and enterprises where the average wage exceeded \$112,000 (Table 5).

Table 5: Orange County Average Wage by Industry (2019)

Industry	Average Weekly Wage	Average Annual Wage
Utilities	\$2,475	\$128,692
Finance and Insurance	\$2,317	\$120,491
Information	\$2,220	\$115,440
Management of Companies & Enterprises	\$2,155	\$112,060
Professional, Scientific, and Technical Services	\$1,922	\$99,955
Wholesale Trade	\$1,697	\$88,218
Mining	\$1,681	\$87,402
Real Estate and Rental	\$1,610	\$83,733
Manufacturing	\$1,609	\$83,689
Construction	\$1,486	\$77,289
All Private Industries	\$1,234	\$64,176
Transportation and Warehousing	\$1,061	\$55,147
Health Care	\$1,027	\$53,412
Administrative Support	\$827	\$43,021
Education Services	\$799	\$41,544
Other Services	\$766	\$39,851
Retail Trade	\$753	\$39,142
Arts, Entertainment, and Recreation	\$690	\$35,872
Accommodation and Food Services	\$494	\$25,688

Source: BLS, Analysis by KE

Similarly, the average wage in manufacturing is considerably higher than the county average (\$83,700 compared to \$64,200). Not all traded industries pay above the mean wage, but this is due to a combination of factors which include an above average concentration of low-skill jobs and worker schedules that are less than full-time. For example, despite the importance of tourism

to the county economy, pay is well below average in each of the industries that are either directly or indirectly related to tourism: arts, entertainment and recreation, accommodation and food services, and retail trade.

Table 6: Payroll Establishments-Number and Size of Payroll

Industry	Number of Establishments	% of Total	Payroll (\$ millions)	Average Payroll per Establishment
Total Private	124,261	100.0%	\$96,108.1	\$773,400
Mining	36	0.03%	\$39.9	\$1,108,300
Utilities	84	0.1%	\$371.8	\$4,426,500
Construction	7,666	6.2%	\$8,226.8	\$1,073,100
Manufacturing	5,256	4.2%	\$13,352.7	\$2,540,500
Wholesale Trade	7,280	5.9%	\$6,936.7	\$952,800
Retail Trade	9,527	7.7%	\$5,887.9	\$618,000
Transportation and Warehousing	1,508	1.2%	\$1,451.1	\$962,300
Information	1,566	1.3%	\$2,974.5	\$1,899,400
Finance and Insurance	6,516	5.2%	\$9,321.8	\$1,430,600
Real Estate and Rental	6,422	5.2%	\$3,318.4	\$516,700
Professional, Scientific, and Technical Services	17,550	14.1%	\$13,044.2	\$743,300
Management of Companies & Enterprises	600	0.5%	\$4,326.4	\$7,210,600
Administrative Support	5,336	4.3%	\$6,724.1	\$1,260,100
Education Services	1,653	1.3%	\$1,289.6	\$780,100
Health Care	36,024	29.0%	\$10,512.4	\$291,800
Arts, Entertainment, and Recreation	1,487	1.2%	\$1,959.1	\$1,317,500
Accommodation and Food Services	8,192	6.6%	\$4,452.5	\$543,500
Other Services	7,558	6.1%	\$1,918.2	\$253,800

Source: BLS, Analysis by KE

The composition of industry in terms of establishments lends further insights into the structure of the economy, and in turn, sheds light on the landscape prospective workers face as they complete their studies and training at community colleges and venture out to find work. Overall, there were 124,300 payroll establishments in Orange County in 2019 (Table 6).

Some industries, notably mining, utilities, and management of companies and enterprises all have fewer than 1,000 establishments, and as discussed above, have relatively few workers. At the other extreme, health care has over 36,000 establishments and the second largest job count at just over 200,000. Despite the presence of large medical facilities in the county, the sector has numerous firms that are relatively modest in size. Similarly, with 107,000 workers and more than 17,000 establishments, the professional, scientific, and technical services industry has numerous relatively small firms.

Establishment payroll also varies in its distribution across industries. For example, comparing health care with professional, scientific, and technical services, health care has more than double the number of establishments, but total payroll is \$2.5 billion lower. Moreover, highly visible industries such as accommodation and food services have a relatively low average payroll

(\$543,500), while less well-known industries such as management of companies and enterprises has an exceptionally high average payroll exceeding \$7 million.

Table 6 shows data for establishments with payroll employees but a separate data source reports non-employer establishments, better known as self-employed workers, who are also referred to as sole proprietors or independent contractors. In 2018, the number of self-employed in the county stood at 323,600, almost three times the number of payroll establishments (Table 7).

Table 7: Self-Employed Establishments, Number and Total Receipts

Industry	Number of Establishments	Total Receipts (\$Millions)	Establishments-% of Total
All Industries	323,593	\$19,313	100.0%
Mining	479	\$20	0.1%
Utilities	92	\$8	0.03%
Construction	18,752	\$1,302	5.8%
Manufacturing	4,548	\$340	1.4%
Wholesale Trade	7,633	\$910	2.4%
Retail Trade	25,422	\$1,522	7.9%
Transportation and Warehousing	26,351	\$857	8.1%
Information	4,949	\$235	1.5%
Finance and Insurance	11,697	\$1,128	3.6%
Real Estate and Rental	39,454	\$5,129	12.2%
Professional, Scientific, and Technical Services	63,792	\$3,601	19.7%
Administrative Support	25,059	\$828	7.7%
Education Services	9,276	\$186	2.9%
Health Care	23,098	\$1,045	7.1%
Arts, Entertainment, and Recreation	15,520	\$484	4.8%
Accommodation and Food Services	4,390	\$219	1.4%
Other Services	42,662	\$1,477	13.2%

Source: Census Bureau, Analysis by KE

Not surprisingly, industries such as health care and professional, scientific, and technical services, and real estate and rental services have large numbers of both payroll establishments and self-employed. Transportation and warehousing has a relatively small number of payroll establishments (1,508), but the number of self-employed (26,351) is nearly as large as the number of wage and salary workers (26,600). The number of self-employed in other services (42,662) also approaches the number of wage and salary workers in that industry (52,000). Finally, self-employment accounts for a significant share of overall employment in construction, retail trade, and administrative support.³

Taken together, observations about the structure of Orange County's industries reflect certain fundamental characteristics. For example, the relative ease of entry into segments of the construction sector along with transportation and warehousing partly explains the large numbers

³ More information on the employment status of students with California community college career education or training may be found in the CTE (Career Technical Education) Employment Outcomes Survey which is produced by Santa Rosa City College (<https://cteos.santarosa.edu/employment-status>).

of self-employed in each. More capital-intensive sectors of the economy like mining and logging, utilities, and to a lesser extent, manufacturing, tend to have fewer but larger establishments. Finally, services such as health care and professional, scientific, and technical services, and other services do not lend themselves to scale outside of large medical facilities (which are the most capital intensive in the industry), and thus have large numbers of small establishments.

Orange County Workforce

Just as the industries of Orange County are organized into a classification system, the composition of the county's occupations may also be organized into a classification system with over 640 individual occupations aggregated into a set of 22 major occupation groups (Figure 6).

Figure 6: Count of Workers by Major Occupation Category, Orange County



Source: BLS, Analysis by KE

Data for Orange County from the Occupational Employment Survey (OES) show that 1.67 million workers in 2019 who worked at establishments in the county (occupation by place of work rather than place of residence) were distributed across occupations ranging from management to administrative support to farming. Just over 220,000 worked in office and administrative support positions, followed by sales and related occupations with 166,000 workers. On the low end, there were 12,000 workers in legal positions that ranged from legal support workers to attorneys.

Between 2015 and 2019, positions were added in occupations related to the county's leading industries, including food preparation workers, transportation related workers, financial and professional services, construction and other real estate related occupations, and health care (Table 8). Most occupations added to their ranks over this period, but office and administrative support occupations and personal services declined in number.

Table 8: Recent Trends in Major Occupations, Orange County

Major Occupation Categories	2015	2019	Change	% Change
All Occupations	1,523,810	1,666,820	143,010	9.4%
Transportation and Material Moving	79,400	120,050	40,650	51.2%
Healthcare Support	33,320	73,800	40,480	121.5%
Food Preparation and Serving Related	144,990	164,270	19,280	13.3%
Business and Financial Operations	102,520	118,640	16,120	15.7%
Construction and Extraction	65,410	80,680	15,270	23.3%
Educational Instruction and Library	75,910	90,570	14,660	19.3%
Management	97,790	108,280	10,490	10.7%
Community and Social Service	16,520	25,750	9,230	55.9%
Computer and Mathematical	50,380	56,240	5,860	11.6%
Installation, Maintenance, and Repair	42,380	48,200	5,820	13.7%
Healthcare Practitioners and Technical	68,470	72,250	3,780	5.5%
Protective Service	25,410	28,360	2,950	11.6%
Architecture and Engineering	37,880	39,860	1,980	5.2%
Arts, Design, Entertainment, Sports, and Media	23,010	24,680	1,670	7.3%
Legal	12,200	12,670	470	3.9%
Building and Grounds Cleaning and Maintenance	53,970	54,010	40	0.1%
Farming, Fishing, and Forestry	1,710	1,320	-390	-22.8%
Sales and Related	167,150	166,230	-920	-0.6%
Production	108,800	107,790	-1,010	-0.9%
Life, Physical, and Social Science	13,750	12,700	-1,050	-7.6%
Personal Care and Service	43,960	37,170	-6,790	-15.4%
Office and Administrative Support	258,880	223,300	-35,580	-13.7%

Source: BLS, Analysis by KE

A separate data source allows for analysis of workers who reside in the county but may or may not work within the county. It also includes self-employed workers, not just those employed at payroll establishments. Using data from the Census Bureau's American Community Survey (ACS) and also the ACS Public-Use Micro-Sample (PUMS), it is possible to see how Orange County's resident workers are distributed across both their occupations and the industries in which they work (Table 9).

Table 9: Distribution of Resident Workers by Major Industries and Major Occupations, Orange County

	Total	Management, business, science, and arts occupations	Service occupations	Sales and office occupations	Natural resources, construction, and maintenance occupations	Production, transportation, and material moving occupations
Civilian employed population 16 years and over	1,621,719	44.0%	17.1%	21.5%	7.1%	10.2%
Natural resources and mining	12,146	18.8%	5.4%	7.5%	61.3%	6.9%
Construction	107,117	26.4%	0.5%	7.8%	61.9%	3.5%
Manufacturing	181,466	44.6%	0.7%	13.9%	3.2%	37.6%
Wholesale trade	55,319	30.7%	1.3%	54.1%	2.0%	11.8%
Retail trade	165,647	15.9%	3.9%	59.2%	4.8%	16.1%
Transportation and warehousing, and utilities	62,146	18.8%	0.9%	24.3%	5.4%	50.6%
Information	30,043	70.8%	3.0%	17.4%	7.6%	1.2%
Financial activities	137,726	56.2%	1.7%	38.2%	2.3%	1.6%
Professional and business services	229,527	62.5%	16.3%	14.8%	1.9%	4.5%
Education and health care	333,441	68.6%	17.9%	11.7%	0.4%	1.3%
Leisure and hospitality	172,773	20.9%	61.7%	14.1%	1.1%	2.3%
Other services, except public administration	85,641	24.8%	45.9%	10.8%	10.3%	8.1%
Public administration	48,727	39.3%	41.4%	14.6%	3.6%	1.1%

Source: Census American Community Survey, Analysis by KE

Overall, 44% of the occupations in the county fall into the broad category that includes management, business, science, and arts, with smaller shares of workers in service occupations (17.1%), sales and office occupations (21.5%), natural resources, construction, and maintenance occupations (7.1%), and production and material movement occupations (10.2%).

Management, business, science, and arts occupations tend to be well represented across all industries, but there are particularly high concentrations in information (70.8%), education and health services (68.6%), professional and business services (62.5%), and finance and insurance (56.2%). Service occupations are heavily concentrated in leisure and hospitality (arts, entertainment, and recreation along with accommodation and food services) and other (personal) services (45.9%).

Not surprisingly, certain occupations align strongly with certain industries. For example, sales and office occupations account for more than half of all workers in wholesale trade and retail trade, natural resources and construction occupations are heavily concentrated in construction and natural resources, while production and material moving occupations are largely in manufacturing and transportation and warehousing.

The relatively high concentration of occupations in the county that require significant education reflect the county's educational attainment profile. Forty-two percent of the county workforce has at least a bachelor's degree, 27% have some college or an associate's degree, 18% have a high school diploma or better, with just 13% having less than a high school diploma (Table 10).

Table 10: Educational Attainment, Orange County Workers

Education Level	% of Total
Less than high school graduate	13%
High school graduate (includes equivalency)	18%
Some college or associate's degree	27%
Bachelor's degree or higher	42%

Source: Census American Community Survey, Analysis by KE

By comparison, educational attainment for the state as a whole is as follows: 35.0% with a bachelor's degree or higher, 28.5% with some college or an associate's degree, 20.6% completing high school, and 16.0% with less than a high school diploma.

Even as Orange County battles against the coronavirus, it must cultivate its current and future workforce. As illustrated above, the county's industries are diverse and multi-faceted. They generate work opportunities for workers with a wide array of training and education. This includes middle wage jobs, many of which require career education that is best delivered through community colleges. Education is particularly important during periods of disruption such as the present pandemic. Education can enable greater adaptability and agility in workers so they can better weather changes at the workplace and in the overall economy.

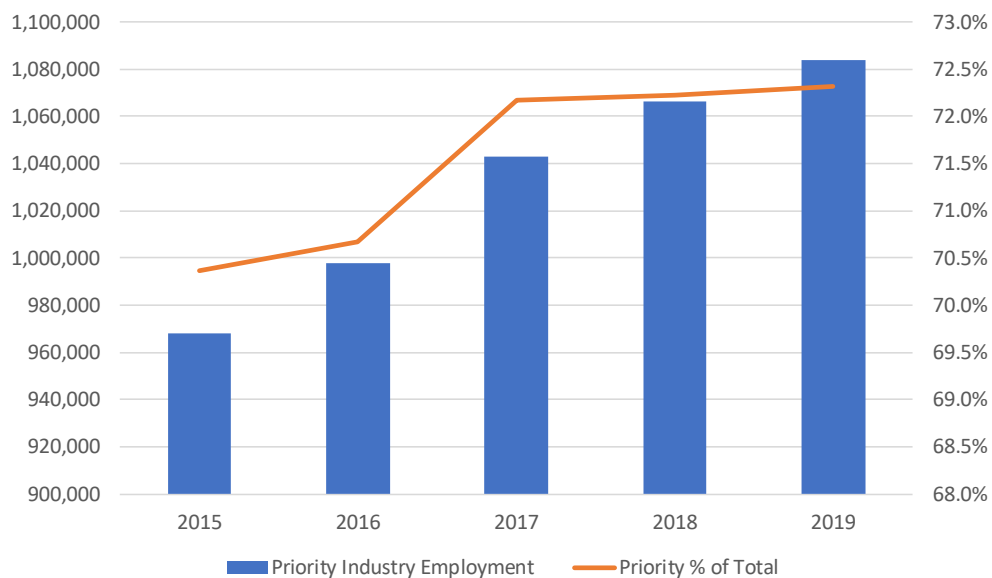
As described by the projections presented later in the report, it may take time for the county's industries to recover the jobs that have been lost during the pandemic. However, the mix of industries coupled with the capabilities of the county's workforce will eventually lead to recovery of lost jobs, job growth in the county's industries, and a return to the low unemployment rates that have characterized the economy in recent decades.

Profile of Orange County's Priority Sectors

Orange County has a well-balanced employment base comprised of high-value industries, both established and growing, that offer diverse occupation opportunities. One priority of the Strong Workforce Program (SWP) Regional Plan is to promote better job quality for the future workforce by targeting middle-skilled positions associated with education, training, or certifications provided by the community college system.

Eight priority sectors have been identified by the Orange County community colleges as important to both middle-skilled and overall employment in Orange County. These priority sectors represent 72.3% of all private nonfarm employment (Figure 7). The eight industries include Advanced Transportation and Logistics; Advanced Manufacturing; Health Care; Business and Entrepreneurship; Energy, Construction, and Utilities; Information and Communications Technology (ICT) and Digital Media; Life Sciences and Biotechnology; and Retail, Hospitality, and Tourism (RHT).⁴ Each of these industries provides dynamic positions with growing employment counts and above-average economic contributions.

Figure 7: Priority Industries Comprise Growing Share of Total Employment



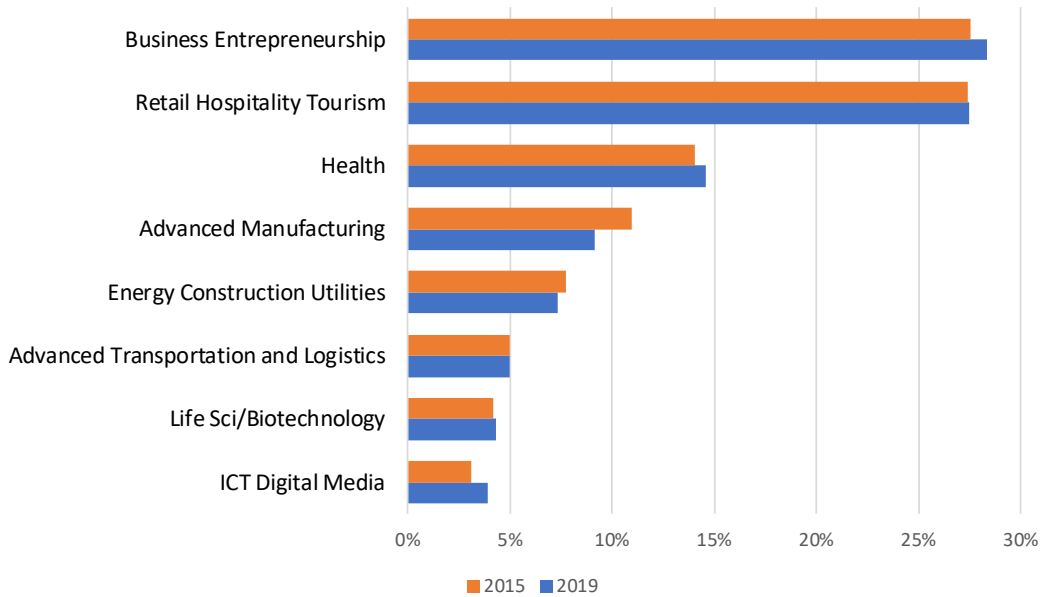
Source: BLS, Analysis by KE

Focusing on payroll employment (by place of work) in the county, the priority sectors increased their share of all employment by nearly two percentage points from 2015 to 2019 (Figure 8). Of

⁴ The priority sectors are industry “clusters” in the sense that they are generally comprised of several individual industries as identified by the industry classification system, North American Industry Code System or NAICS. The priority sectors are generally capitalized in this report while the NAICS-based industries are not.

the priority sectors, the three largest sectors in terms of private employment include Business and Entrepreneurship (28.3%), Retail, Hospitality, and Tourism (27.5%), and Health Care (14.6%). When combined, these three sectors account for 70.4% of the employment share across all priority sectors.

Figure 8: Distribution of Employment Across Priority Sectors, Orange County



Source: BLS, Analysis by KE

Employment may be the most commonly used indicator to gauge trends across industries, but additional insights may be gleaned from analyzing establishment counts and payroll. Between 2015 and 2019, Industries such as ICT Digital Media and Life Sciences led growth in the county's number of establishments (Table 11). The sectors that led to employment growth over the same period were Digital Media (42.2%), Health (16%), and Life Sciences (15.1%). Although most sectors experienced employment growth, Advanced Manufacturing fell by 7%.

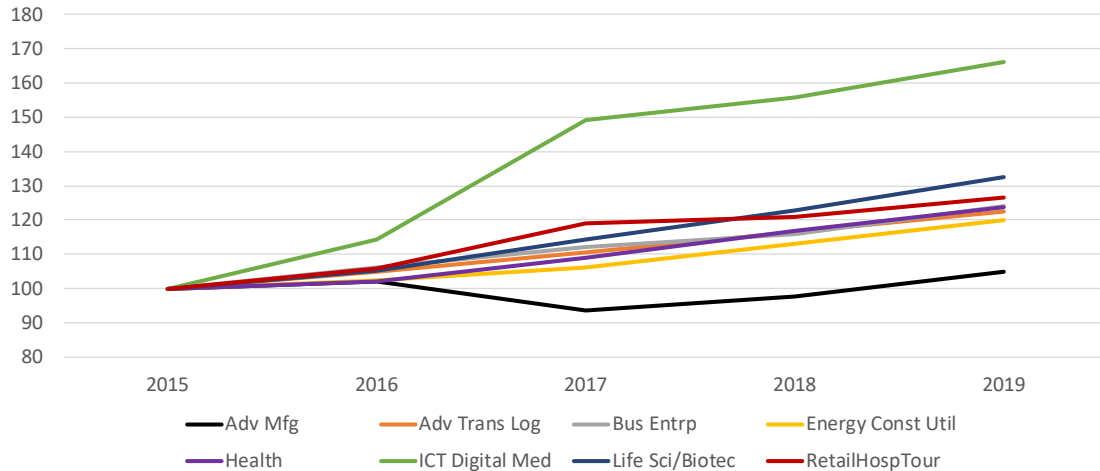
Table 11: Number of Establishments by Priority Sector

Industry	2015	2016	2017	2018	2019
Advanced Manufacturing	4,395	4,380	4,481	4,761	4,744
Advanced Transportation and Logistics	3,419	3,426	3,601	3,928	4,014
Business Entrepreneurship	20,441	20,679	21,785	24,071	25,022
Energy Construction Utilities	8,017	7,761	7,852	8,363	8,504
Health	9,871	10,127	10,458	10,990	11,285
ICT Digital Media	2,788	2,841	3,337	3,833	4,006
Life Sciences/Biotechnology	1,482	1,565	1,693	1,830	1,883
Retail Hospitality Tourism	14,615	14,994	16,033	17,050	17,569
Total-All Priority Industries	65,028	65,773	69,240	74,826	77,027

Source: BLS, Analysis by KE

Payroll growth in seven out of eight priority sectors outpaced countywide private employment totals. ICT Digital Media captured the most considerable increase in payroll at 66% (Figure 9). At the same time, Advanced Manufacturing experienced marginal growth in payroll under-pacing the county average.

Figure 9: Payroll Growth Leaders: Digital Media, Life Sciences, and Retail (Indexed payroll, 2010=100)



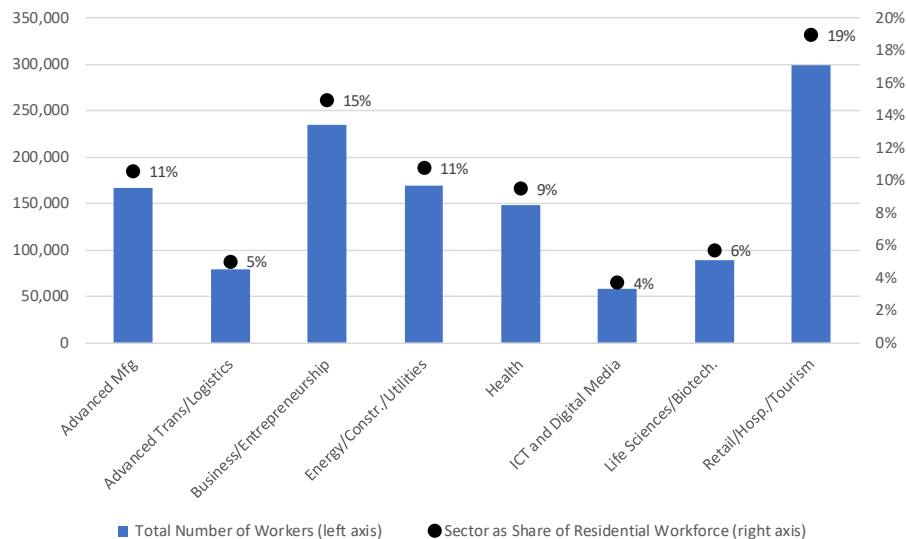
Source: BLS, Analysis by KE

Up to this point in the report, employment figures in this section of the report refer to workers at Orange County establishments. This is also known as employment by place of work and may include workers who reside within the county as well as those who live elsewhere but work at Orange County establishments.

A separate analysis was conducted on Orange County’s resident workforce – meaning workers who reside in the county but may or may not work in the county or employment by place of residence -- in the eight priority sectors. This analysis was based on the U.S. Census Bureau’s American Community Survey (ACS) public use micro-sample (PUMS). Across the eight priority sectors, there were 1.25 million resident workers, comprising 79% of the county’s resident workforce averaging 1.58 million in 2019. Total resident employment by sector and each sector’s share of total resident employment appear in Figure 10. Retail, Hospitality and Tourism is the largest sector with nearly 300,000 workers and 19% of the county’s workforce. Business and Entrepreneurship is next largest with 15% of the workforce, followed by Advanced Manufacturing and Energy, Construction, and Utilities (11%) and Health (9%).

Socio-economic characteristics of Orange County’s priority sector workforce are summarized in Table 12 on pages 33 and 34.

Figure 10: Priority Sector Residential Employment and Share of Residential Workforce



Source: Census Bureau, Analysis by KE

The following priority sector profiles summarize each industry in terms of

- the number of wage and salary jobs in each sector (occupation by place of work)
- the number of Orange County residents in each sector (occupation by place of residence)
- the average wage for resident workers in the sector
- socio-economic characteristics of the resident workforce in each industry

Advanced Manufacturing

The Advanced Manufacturing sector comprises production activities that depend on information, automation, computation, and software in specific industries such as medical, pharmaceutical, and aerospace. The sector supported 98,919 workplace employees in 2019, accounting for 9.1% of all private nonfarm employment in Orange County. Advanced Manufacturing has experienced a decline in workplace employment by nearly two percentage points since 2015, while the number of establishments in this industry has grown by 7.9% from 2015 to 2019 (please see Figure 8 and Table 11 on p. 27).

The Manufacturing sector saw declines in overall employment further resulting in subsequent smaller payroll gains than most industries. Manufacturing jobs have steadily fallen since the 1970s and the decline has become more apparent over the last two decades. Structural transformations have influenced the adoption of automation advancing production processes and the technologies used. Various routine tasks have become computerized so that automation has replaced many labor intensive, often low-skilled positions. While more capital-intensive techniques may increase

productivity and efficiency, they rely less on labor thus providing fewer employment opportunities. As a result, the share of workers in the goods-producing industries of the Orange County economy has fallen, while the share of service-sector jobs has increased.

While Advanced Manufacturing establishments in Orange County employed nearly 99,000 workers, the industry's residential workforce – workers who reside in the county but may or may not work in the county – is considerably larger. Based on data from the 2014-18 5-year Census ACS, the county's Advanced Manufacturing residential workforce was an estimated 166,464 workers. On average, the annual wage for a residential based worker is \$75,778, slightly above the industry average.

The socio-economic composition of the Advanced Manufacturing residential workforce is similar to the county (Table 12). On average more than 80% of the workforce hold at minimum a high school diploma, and 43.2% hold an associate degree or better, falling 7.5 and 4.5 percentage points below the county average, respectively (Table 12-A). The sector's age structure exhibits a slightly older distribution, with only 25.6% of the workforce below age 35, 9.2 percentage-points lower than the county average of 34.8% (Table 12-B). The industry is dominated by male workers, representing 70.3% of the residential workforce (Table 12-D). The racial and ethnic composition of this industry is similar to the overall county residential workforce.

Advanced Transportation & Logistics

The Advanced Transportation and Logistics industries incorporate transportation (trucking, railroads, airlines, barge), transportation support activities, and emerging technologies in renewable alternative fuel sources (clean energy). The sector represented 5% of all private nonfarm employment in 2019, supporting 53,725 workplace employees. The industry experienced payroll gains on track with industry averages, and employment levels have remained relatively stable from 2014 to 2018. The industry experienced growth in local establishment counts of 17.4% from 2015 to 2019 (Table 11).

Transportation activity follows a cyclical pattern, but the goods movement sector in Orange County and the rest of Southern California has demonstrated a long-term growth trend during the last two decades. Shipping activity at the twin San Pedro Bay ports (Long Beach and Los Angeles) continues to be the largest container port complex in the western hemisphere, but Southern California is also home to significant air cargo activity, including transportation and distribution of online retail trade activity. Growth in Orange County's Advanced Transportation and Logistics sector has been the beneficiary of these regional trends.

Between 2014 to 2018, the estimated Orange County residential workforce in Advanced Transportation was 78,737. The estimated average annual wage for a residential based worker in this sector was \$61,113, slightly above the industry average.

The Advanced Transportation and Logistics sector has socio-economics characteristics similar to the distribution of the county workforce (Table 12). The high school or equivalent educational attainment in the sector is three percentage points below the county (Table12-A). The gender distribution reveals this is a male-dominated sector, as 78.1% of the workforce identify as males (Table 12-D). The largest ethnic concentration of workers are Hispanics or Latinos, representing 40.2% of the residential workforce, over nine percentage points higher than the county (Table 12-C).

Business and Entrepreneurship

The Business and Entrepreneurship sector is a critical contributor to innovation and new job growth, with linkages across many of Orange County's industries. The sector represents 28.3% of all private nonfarm employment in Orange County, and has grown significantly since 2015, with the number of establishments increasing by 22.4%. As of 2019, Orange County is home to 25,022 Business and Entrepreneurship establishments that employ 307,053 workers.

Focusing on the residential-based workforce of Orange County from 2014 to 2018, there were an estimated 235,296 workers in Business and Entrepreneurship. On average, the annual wage for a residential based worker is \$85,381, slightly above the industry average.

The socio-economic characteristics in Business and Entrepreneurship are comparable to the county-wide residential workforce. The industry has a largely educated workforce with 96% of workers holding at minimum a high school diploma or equivalent, exceeding the county-wide share by nine percentage points (Table12-A). On average this industry has a slightly older workforce as 70% of the work is 35 years of age or older, compared to the county at 65.2% (Table 12-B). The racial and ethnic composition in this sector aligns closely with the county (Table 12).

Energy, Construction, and Utilities

The Energy, Construction, and Utility sector includes industries responsible for installing and managing technologies related to efficient energy creation, dispersal, and storage. The sector employs 7.3% of all workplace private nonfarm employment in Orange County. Between 2015 to 2019, the number of establishments in the region grew by 6.1% representing an increase of 487 establishments in Energy, Construction, and Utilities (Table 11). Overall, firms in this sector employed 79,418 workplace workers in Orange County.

Concentrating on the Orange County residential workforce from 2014 to 2018, there are a 169,634 residents employed in the Energy, Construction, and Utilities sector. The average annual wage for a residential based worker is slightly above the industry average, at \$90,382.

The socio-economic characteristics of the Energy, Construction, and Utilities sector follow a similar distributional pattern to the county's workforce. The high school education and college attainment in this sector are on track with the county with 85.1% holding at least a high school diploma or equivalent and 43.6% holding any college degree (Table 12-A). The number of workers age 35 years or older is 6 percentage points higher than the county average (Table 12-B). More than 77.9% of the workforce are males compared to 54.4% at the county level (Table 12-D). Overall, the racial distribution of occupations held by residents track the county (Table 12-C).

Health Care

The Health Care sector comprises companies that specialize in products and services related to health and medical care. Overall, the sector accounts for 14.6% of all workplace private nonfarm employment in Orange County. Between 2015 and 2019 the number of establishments in the region increased by 14.3% to 11,285. Additionally, this sector supports 157,858 workplace jobs.

Focusing on the residential-based workforce of Orange County between 2014 to 2018, there is an estimated 148,956 workers in Health Care. The typical annual wage for a residential based worker is \$64,755.

The socio-economic trends of the residential workforce in Health differ from the county's average workforce composition. Roughly 95.4% of residential workers in this sector have, at minimum, a high school diploma, outperforming the county by more than 7 percentage points. Further, about 64% in the industry hold an associate degree or better, more than 16 percentage points higher than the county average (Table 12-A). The age distribution is comparable to the overall county workforce (Table 12-B). Females have a larger representation in the industry at nearly 70% of the workforce (Table 12-D). Looking at the racial composition, Asians are highly represented in this industry cluster, accounting for 30.2% of the workforce, more than 10 percentage points higher than the county (Table 12-C).

Information and Communications Technology (ICT) and Digital Media

The Information and Communications Technology (ICT) and Digital Media sector encompasses several rapidly emerging and evolving technologies related to computers, software, networking, telecommunications, the Internet, programming, information systems, and digital media. The sector employs about 3.9% of all workplace private nonfarm employment in Orange County.

Between 2015 to 2019, the number of ICT and Digital Media establishments increased by 43.7% to 4,006. Overall, Orange County upholds 42,730 workplace employees in the sector.

Based on data for resident workers in Orange County from 2014 to 2018, there are an estimated 57,893 workers in ICT and Digital Media. On average, the annual wage for a residential based worker is \$129,766, performing above the industry average.

The socio-economic characteristics of the residential workforce in ICT and Digital Media are different from the county workforce distribution. Over 98% of the workforce in ICT and Digital media have at least a high school diploma, which is more than 10 percentage points higher than the county's average workforce (Table 12-A). The industry has a large male presence, representing 78.1% of its workers (Table 12-D). Further, there are unequal concentrations of racial and ethnic groups across the industry but track closely to the county workforce distribution (Table 12-C).

Life Sciences and Biotechnology

The Life Sciences and Biotechnology sector is a cluster of industries that includes research institutions and other related life sciences such as pharmaceuticals, biotechnology, biomedicine, neuroscience, cell biology, and more. This sector represented about 4.3% of all private nonfarm employment in Orange County in 2019. Between 2015 to 2019, the number of Life Sciences and Biotechnology establishments in the region has increased by 27.1% to 1,883. As of 2019, Orange County 46,574 workplace employees.

Orange County is in the middle of a life sciences and bio-pharmaceutical hotbed that stretches from Los Angeles County through San Diego County. The synergies associated with such a concentration of activity have fueled sustained growth in the county's Life Sciences and Biotechnology sector, which is expected to continue over the foreseeable future.

Between 2014 to 2018 the Orange County residential based workforce employed in Life Science and Biotechnology is estimated at 89,419 workers. On average, the annual wage for a residential based worker is \$88,856, slightly above the industry average.

The socio-economic composition of this industry aligns closely with the county's residential workforce (Table 12). The percentage of workers in the industry with at least a high school education is over 5 percentage points higher than the county (Table 12-A). The industry supports a workforce with 40% females, five percentage points below the county (Table 12-D). Further, the age and racial distribution among workers, follow a close pattern to the county overall (Table-12).

Retail, Hospitality, and Tourism

The Retail, Hospitality, and Tourism (RHT) sector has a robust presence in Orange County, employing 27.5% of total private nonfarm employment. The industry comprises a wide range of occupations, from sales to management. As of 2019, there were 17,569 RHT establishments in the region, a 20.2% increase from 2015. The sector employs a total of 297,632 workplace employees.

The RHT residential workforce of Orange County was estimated to employ 298,943 in 2019. On average, the annual wage for a residential based worker is \$30,133, below the industry average. The socio-economic characteristics of the RHT industry are comparable to the county workforce. The educational attainment of the workforce is on par with the county (Table 12). There is a slightly younger average age of workers in this industry as 53.6% of the workforce is under 35 years of age (Table 12-B). The gender breakdown is relatively even, with roughly 50% of the population represented by females and males (Table 12-D). The racial and ethnic composition have a similar structure to the county workforce, though Hispanics have a higher representation at 40.1%, nearly 7 percentage points higher than the county (Table 12-C).

Table 12: Socio-Economic Characteristics by Priority Sector**Table 12-A: Educational Attainment by Sector**

Priority Sector	Less than high school	H.S. diploma or equivalent plus some college	Associates degree	Bachelor's or higher
Advanced Manufacturing	19.1%	37.7%	6.1%	37.1%
Advanced Transportation and Logistics	15.5%	54.7%	8.3%	21.5%
Business and Entrepreneurship	3.5%	33.2%	7.6%	55.7%
Energy, Construction, and Utilities	15.0%	41.5%	6.7%	36.9%
Health	4.6%	31.4%	11.6%	52.4%
ICT and Digital Media	1.7%	27.4%	6.4%	64.5%
Life Sciences/Biotechnology	7.0%	30.0%	6.2%	56.7%
Retail, Hospitality, and Tourism	15.7%	55.0%	7.9%	21.4%
Total OC Residential Workforce	12.5%	39.8%	7.6%	40.1%

Table 12-B: Age Distribution by Sector

Priority Sector	Age 16 to 24	Age 25 to 34	Age 35 to 49	Age 50 to 64	Age 65 or older
Advanced Manufacturing	6.6%	19.0%	32.4%	37.0%	5.0%
Advanced Transportation and Logistics	9.2%	24.0%	31.2%	30.8%	4.8%
Business and Entrepreneurship	6.3%	23.1%	35.1%	28.0%	7.4%
Energy, Construction, and Utilities	6.1%	22.4%	35.6%	29.4%	6.5%
Health	7.6%	25.1%	33.3%	27.6%	6.5%
ICT and Digital Media	7.5%	28.1%	39.2%	22.5%	2.6%
Life Sciences/Biotechnology	7.2%	22.3%	33.5%	31.1%	5.8%
Retail, Hospitality, and Tourism	29.0%	24.6%	23.8%	18.9%	3.7%
Total OC Residential Workforce	11.9%	22.9%	32.2%	27.7%	5.3%

Table 12: Socio-Economic Characteristics by Priority Sector

Table 12-C: Racial and Ethnic Composition of Workforce

Priority Sector	White	Black or African American	Asian	American Indian, Alaskan, Hawaiian	Other race or multiple races	Hispanic
Advanced Manufacturing	36.9%	0.9%	24.0%	0.4%	1.8%	36.0%
Advanced Transportation and Logistics	38.1%	2.2%	16.5%	1.2%	1.8%	40.2%
Business and Entrepreneurship	53.7%	1.9%	19.2%	0.4%	2.6%	22.2%
Energy, Construction, and Utilities	47.9%	1.3%	12.8%	0.4%	1.5%	36.1%
Health	38.6%	2.2%	30.2%	0.5%	2.3%	26.2%
ICT and Digital Media	53.3%	2.3%	27.1%	0.3%	3.1%	13.8%
Life Sciences/Biotechnology	42.6%	1.1%	32.6%	0.6%	1.8%	21.3%
Retail, Hospitality, and Tourism	39.3%	1.5%	16.0%	0.4%	2.6%	40.1%
Total OC Residential Workforce	42.6%	1.7%	19.6%	0.5%	2.3%	33.3%

Table 12-D: Gender Breakdown by Sector

Priority Sector	Male	Female
Advanced Manufacturing	70.3%	29.7%
Advanced Transportation and Logistics	78.1%	21.9%
Business and Entrepreneurship	50.8%	49.2%
Energy, Construction, and Utilities	77.9%	22.1%
Health	30.6%	69.4%
ICT and Digital Media	73.1%	26.9%
Life Sciences/Biotechnology	60.0%	40.0%
Retail, Hospitality, and Tourism	50.3%	49.7%
Total OC Residential Workforce	54.4%	45.6%

Source: Census American Community Survey, Analysis by KE

Priority Sector Occupations Requiring Community College Career Education

The economic structure of Orange County comprises a broad array of occupations reflecting the mix of industries in the county. In 2020, the county supported over 1.5 million workplace jobs across all occupations and industries. Of these occupations, 7.5% of jobs are in the eight priority sectors as defined by the LAOCRC (114,100 out of 1.53 million). The identified occupations correspond to middle-wage jobs that align with community college career education. The positions spread across 65 different occupational categories.

It is essential to evaluate occupations separately from industries in developing strategies to target high-growth, high demand, and emerging occupations in the region. This may seem unintuitive, as both cover work fields; however, each looks at work from a different perspective. Industries describe the type of activity at place of work classified based on an establishment's significant products or services. In comparison, occupations define the tasks and responsibilities of individual workers. This is an important distinction as some occupations are found in one or two industries, while other occupations are found across many industries.

Some occupations generally align with a particular industry. For example, most of the county's nurses and other health care positions are employed in the health care industry, which supports 4,897 residential workers. The same pattern is seen elsewhere, such as the Advanced Transportation and Logistics Sector where specific occupations such as Automotive Service Technicians and Mechanics are commonly associated and further support 7,770 residential workers. Other occupations, such as bookkeeping or paralegals, are often associated with business operations that may be found in a broad array of industries. Surprisingly, occupations such as skincare specialists also appear in multiple sectors such as ICT and Digital Media, Life Science and Biology, or Advanced Manufacturing. Unlike business occupations, their connection across multiple industries may seem less intuitive, and regardless their services are employed at some capacity within these sectors.

Focusing on employment by occupation, Tables 13 through 23 summarize all 65 identified occupational categories organized into 11 major occupational groups, showing estimated 2020 employment for each occupation. Some occupational groups are consolidated into larger groups due to their association with industries. For instance, the three individual categories, Business, and Financial Operations Occupations, Office and Administrative Support Occupations, and Legal Service Occupations, have been aggregated into one group presented in Table 15. The same method has been used to combine the Health-related industries, including Healthcare Practitioners and Technical Occupations, and Healthcare Support Occupations, displayed in Table 18.

The top ten occupations by employment count represent 66,800 positions. Bookkeeping, Accounting, and Auditing Clerks have the largest share of employment across the 65 occupations, employing 14.6% of all occupations, and 24.9% of the top ten occupations (16,630 employees) (Table 15). Computer Network Support Specialists are the second largest category supporting 8,460 jobs in OC, representing 7.4% of all professions and 12.6% of the top ten occupations (Table 16). The Healthcare sector represented in four out of ten top employed occupations, represent 22,750 occupations, nearly 20% of all occupations, and 34% of the top ten occupations. Healthcare has been a robust sector growing steadily over the last ten years, noted by the representation in positions. Advanced Transportation and Logistics has a considerable influence in OC, represented by 4,830 employed in Automotive Service Technicians. One sector missing from the 65 occupations identified is Construction. According to information from the Economic Development Department (EDD), construction jobs do not have a community college level requirement.

Priority Sector Occupations with Community College Career Education Requirements, Estimated 2020 Employment

Source: Kleinhenz Economics

Table 13: Architecture and Engineering Occupations

Architecture and Engineering Occupations	Number of Workers
Aerospace Engineering and Operations Technicians	200
Architectural and Civil Drafters	1,430
Civil Engineering Technicians	1,090
Drafters, All Other	280
Electrical and Electronic Engineering Technologists and Technicians	2,540
Environmental Engineering Technicians	260
Industrial Engineering Technicians	500
Mechanical Drafters	650
Mechanical Engineering Technicians	400

Table 14: Arts, Design, Entertainment, Sports, and Media Occupations

Arts, Design, Entertainment, Sports, and Media Occupations	Number of Workers
Audio and Video Equipment Technicians	1,250
Broadcast Technicians	170
Sound Engineering Technicians	260

Table 15: Business and Financial Operations, Office and Administrative Support, and Legal Occupations

Business and Financial Operations, Office and Administrative Support, and Legal Occupations	Number of Workers
Bookkeeping, Accounting, and Auditing Clerks	16,630
Desktop Publishers	110
Human Resources Assistants, Except Payroll and Timekeeping	980
Insurance Appraisers, Auto Damage	320
Legal Support Workers, All Other	520
Paralegals and Legal Assistants	3,390

Table 16: Computer and Mathematical Occupations

Computer and Mathematical Occupations	Number of Workers
Computer Network Support Specialists	8,460
Computer User Support Specialists	1,580
Web Developers	1,720

Priority Sector Occupations with Community College Career Education Requirements, Estimated 2020 Employment (continued)

Table 17: Educational Instruction and Library Occupations

Educational Instruction and Library Occupations	Number of Workers
Library Technicians	730
Preschool Teachers, Except Special Education	3,560

Table 18: Healthcare Practitioners, Technical, and Healthcare Support

Healthcare Practitioners, Technical, and Healthcare Support Occupations	Number of Workers
Cardiovascular Technologists and Technicians	320
Dental Assistants	5,390
Dental Hygienists	2,130
Diagnostic Medical Sonographers	620
Dietetic Technicians	490
Emergency Medical Technicians and Paramedics	1,640
Licensed Practical and Licensed Vocational Nurses	5,280
Magnetic Resonance Imaging Technologists	410
Medical Assistants	7,220
Medical Transcriptionists	700
Nuclear Medicine Technologists	80
Nursing Assistants	4,860
Occupational Therapy Assistants	540
Ophthalmic Medical Technicians	330
Phlebotomists	1,050
Physical Therapist Assistants	580
Psychiatric Technicians	320
Radiologic Technologists and Technicians	1,330
Respiratory Therapists	1,480
Surgical Technologists	600
Veterinary Technologists and Technicians	840

Priority Sector Occupations with Community College Career Education Requirements, Estimated 2020 Employment (continued)

Table 19: Installation, Maintenance, and Repair Occupations

Installation, Maintenance, and Repair Occupations	Number of Workers
Aircraft Mechanics and Service Technicians	600
Automotive Service Technicians and Mechanics	4,830
Avionics Technicians	80
Computer, Automated Teller, and Office Machine Repairers	1,710
Electrical/ Electronics Repairers, Commercial/ Industrial Equipment	480
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	2,800
Medical Equipment Repairers	730
Telecommunications Equipment Installers and Repairers	2,790

Table 20: Life, Physical, and Social Science Occupations

Life, Physical, and Social Science Occupations	Number of Workers
Agricultural and Food Science Technicians	60
Chemical Technicians	530
Environmental Science and Protection Technicians, Including Health	470
Life, Physical, and Social Science Technicians, All Other	830

Table 21: Personal Care and Service Occupations

Personal Care and Service Occupations	Number of Workers
Hairdressers, Hairstylists, and Cosmetologists	2,720
Manicurists and Pedicurists	1,210
Morticians, Undertakers, and Funeral Arrangers	80
Skincare Specialists	470

Priority Sector Occupations with Community College Career Education Requirements, Estimated 2020 Employment (continued)

Table 22: Protective Service Occupations

Protective Service Occupations	Number of Workers
Firefighters	1,940

Table 23: Production, Transportation, and Material Moving Occupations

Production, Transportation, and Material Moving Occupations	Number of Workers
Captains, Mates, and Pilots of Water Vessels	170
Heavy and Tractor-Trailer Truck Drivers	7,180
Prepress Technicians and Workers	620
Tool and Die Makers	530

Major Industry and Occupation Projections

The upheaval caused by the pandemic has made it difficult to develop forecasts of occupations associated with the priority sectors of Orange County. The California Employment Development Department (EDD) produced projections of occupations specific to Orange County for the period from 2016 through 2026, but these projections were developed long before the pandemic.

Forecasts for Major Industries and Major Occupational Groups

As of this writing, 2019 was the latest available year for which annual data on industry employment are available. Following ten consecutive years of job gains, annual nonfarm employment in Orange County peaked in 2019 at 1.67 million jobs. However, employment fell by nearly nine percent to an estimated 1.53 million jobs in 2020, with losses concentrated in the first part of the year during the spring shutdown. Total nonfarm jobs in the county are forecast to increase by two percent to 1.56 million in 2021, the initial year of the LAOCRC planning horizon.

Because data and forecasting methodology for producing industry forecasts are more readily available for industries than for occupations, a set of industry forecasts was developed and used to produce an aggregate forecast of total nonfarm jobs for the planning horizon from 2021 through 2025. The nonfarm job projections then formed the basis for occupational forecasts.

Over the planning horizon from 2021 through 2025, nonfarm jobs are projected to grow by 7.9% or nearly two percent per year to 1.68 million positions, finally surpassing pre-pandemic levels by 2025 (Table 24).⁵

More than 123,000 positions will be added across the county's industries, led by health care and social assistance (25,200), leisure and hospitality (21,600), and professional, scientific, and technical services (18,100), which together are expected to account for over half of all job gains. Construction and retail trade will also make sizable contributions to the recovery, as will the government sector. Management of companies and enterprises alone is expected to lose jobs over the planning horizon with a relatively small loss of 500 positions or a decline of 1.9%.

⁵ The growth trajectory implied by the forecasts that were prepared for this study falls roughly in between those of Moody's Analytics (a global economic analysis and forecasting firm) and Cal State Fullerton's Wood Center for Economic Forecasting. Moody's projects that full recovery of jobs in the county will occur in 2029. Cal State Fullerton anticipates a faster growth trajectory, but its forecast horizon goes through 2022.

Table 24: Total Nonfarm and Major Industry Employment Forecasts for Orange County

	Employment		Change	% Change
	2021	2025	2021-2025	2021-2025
Total Nonfarm	1,555,600	1,679,000	123,400	7.9%
Health Care & Social Assistance	196,000	221,200	25,200	12.9%
Leisure & Hospitality	175,200	196,800	21,600	12.3%
Professional, Scientific & Technical Services	132,900	151,000	18,100	13.6%
Construction	105,300	117,600	12,300	11.7%
Retail Trade	141,900	149,900	8,000	5.6%
Administrative & Support & Waste Services	142,700	150,400	7,700	5.4%
Manufacturing	148,900	156,200	7,300	4.9%
Government	157,500	162,700	5,200	3.3%
Wholesale Trade	73,800	78,900	5,100	6.9%
Other Services	43,000	46,600	3,600	8.4%
Finance & Insurance	78,800	82,200	3,400	4.3%
Real Estate & Rental & Leasing	38,600	42,000	3,400	8.8%
Educational Services	29,900	31,100	1,200	4.0%
Information	23,000	24,100	1,100	4.8%
Transportation & Warehousing	26,700	27,400	700	2.6%
Utilities	3,000	3,100	100	3.3%
Mining and Logging	400	400	0	0.0%
Management of Companies & Enterprises	38,000	37,400	-600	-1.6%

In producing occupational forecasts, occupational and industry jobs data were first evaluated for comparability. Despite coming from different sources, nonfarm job and the total occupation time series track fairly closely with each other. For example, the total occupation count and the nonfarm job count in 2019 were nearly the same at 1,666,800 and 1,672,500, respectively. As such, projected rates of change for nonfarm jobs were applied to the total number of occupations in Orange County from 2019 through 2025 and then distributed across major occupation groups based on a modified version of the actual distribution of jobs in 2019.

Overall, total occupations are expected to increase by 7.9% or 123,000 from 2021 to 2025, following a 4.1% decrease during the previous four-year period, which was entirely concentrated in the year 2020. (Table 25).

Table 25: Projections by Major Occupation Group for Orange County

Occupational Title	Occupations		Change	% Change
	2021	2025	2021-2025	2021-2025
Total all occupations	1,550,300	1,673,300	123,000	7.9%
Food Preparation and Serving Related Occupations	152,790	171,942	19,152	12.5%
Construction and Extraction Occupations	75,040	88,797	13,757	18.3%
Business and Financial Operations Occupations	110,340	120,340	10,000	9.1%
Transportation and Material Moving Occupations	111,660	121,444	9,784	8.8%
Healthcare Support Occupations	68,650	78,043	9,393	13.7%
Healthcare Practitioners and Technical Occupations	67,200	76,588	9,388	14.0%
Management Occupations	100,710	109,840	9,130	9.1%
Personal Care and Service Occupations	34,570	42,273	7,703	22.3%
Educational Instruction and Library Occupations	84,240	91,334	7,094	8.4%
Computer and Mathematical Occupations	52,310	58,899	6,589	12.6%
Building and Grounds Cleaning and Maintenance Occupations	50,240	54,748	4,508	9.0%
Sales and Related Occupations	154,610	158,403	3,793	2.5%
Installation, Maintenance, and Repair Occupations	44,830	48,163	3,333	7.4%
Architecture and Engineering Occupations	37,080	39,825	2,745	7.4%
Arts, Design, Entertainment, Sports, and Media Occupations	22,950	25,444	2,494	10.9%
Community and Social Service Occupations	23,950	26,176	2,226	9.3%
Protective Service Occupations	26,380	27,893	1,513	5.7%
Legal Occupations	11,780	13,222	1,442	12.2%
Life, Physical, and Social Science Occupations	11,810	12,666	856	7.2%
Office and Administrative Support Occupations	207,690	207,554	-136	-0.1%
Farming, Fishing, and Forestry Occupations	1,220	1,014	-206	-16.9%
Production Occupations	100,260	98,876	-1,384	-1.4%

Source: Kleinhenz Economics

Occupations experiencing the largest numeric gains from 2021 to 2025 include food preparation and serving occupations (19,152), and construction and extraction occupations (13,757). Five industries are individually expected to add between 9,000 and 10,000 positions over the planning horizon, including: management occupations, business and financial operation occupations, health care practitioners and technical occupations, health care support occupations, and transportation and material moving occupations. Production occupations, office and administrative support occupations, and farming/fishing occupations are expected to decrease over the period from 2021 to 2025.

Projections of Priority Sector Occupations Requiring Community College Career Education

Forecasts were developed for all 65 occupations that called for community college level education or training that were found in one or more of the eight priority sectors. Projections for top occupations appear in Table 26. Virtually all of the occupations shown fall into one or more service-based industries. Health care occupations are most heavily represented, led by medical assistants, which is expected to add over 580 positions between 2021 and 2025. Dental assistants, licensed practical and licensed vocational nurses, and nursing assistants also are among the top ten in terms of the number of new positions created over the planning horizon (Table 26-A). Cyclical recovery combined with long term demographic trends (growing and aging of the population) are together fueling growth in health care occupations.

The mix of consumer and household expenditures has increasingly tilted toward services in recent decades. When coupled with long term demographic trends, growing demand for personal services will give rise to growth in a number of personal care occupations, including manicurists and pedicurists along with skincare specialists.

Finally, households and businesses alike have increasingly relied on professionals for a number of specialized services in accounting and related fields, information technology, and legal services. Occupations in these fields round out the top ten list of occupations in terms of absolute growth over the period 2021 through 2025.

Among the fastest growing occupations, civil engineering technicians top the list with a growth rate of 9.0% over the period 2021 through 2025 (Table 26-B). A number of health and personal care occupations are also among the fastest growing occupations in the county (Table 26-B). Technical occupations such as computer, automated teller, and office machine repairers, web developers, environmental science technicians also expect to see above average growth.

Table 26: Forecast of Top Occupations in Priority Sectors of Orange County**Table 26-A Top 10 Occupations by Absolute Job Growth**

Occupational Title	Employment		Change	% Change	Mean Wages (\$) - Entry Level	
	2021	2025	2021-2025	2021-2025	Hourly	Annual
Bookkeeping, Accounting, and Auditing Clerks	16,970	18,310	1,340	7.9%	16.39	34,096
Computer Network Support Specialists	8,630	9,320	690	8.0%	19.69	40,965
Heavy and Tractor-Trailer Truck Drivers	7,320	7,900	580	7.9%	17.49	36,389
Medical Assistants	7,370	7,950	580	7.9%	16.22	33,747
Dental Assistants	5,500	5,940	440	8.0%	15.52	32,295
Licensed Practical and Licensed Vocational Nurses	5,390	5,810	420	7.8%	21.24	44,174
Automotive Service Technicians and Mechanics	4,930	5,320	390	7.9%	15.16	31,534
Nursing Assistants	4,960	5,350	390	7.9%	14.71	30,592
Preschool Teachers, Except Special Education	3,630	3,920	290	8.0%	13.87	28,861
Paralegals and Legal Assistants	3,460	3,740	280	8.1%	18.46	38,402

Table 26-B Top 10 Fastest Growing Occupations (Occupations with more than 500 positions)

Occupational Title	Employment		Change	% Change	Mean Wages (\$) - Entry Level	
	2021	2025	2021-2025	2021-2025	Hourly	Annual
Civil Engineering Technicians	1,110	1,210	100	9.0%	22.48	46,769
Manicurists and Pedicurists	1,230	1,340	110	8.9%	13.40	27,885
Computer, Automated Teller, Ofc. Machine Repairers	1,740	1,890	150	8.6%	15.68	32,611
Web Developers	1,750	1,900	150	8.6%	23.49	48,858
Physical Therapist Assistants	590	640	50	8.5%	32.55	67,701
Medical Transcriptionists	710	770	60	8.5%	15.42	32,067
Emergency Medical Technicians and Paramedics	1,670	1,810	140	8.4%	17.19	35,763
Environmental Sci./Protection Technicians, Including Health	480	520	40	8.3%	14.35	29,849
Skincare Specialists	480	520	40	8.3%	13.46	27,999
Dental Hygienists	2,170	2,350	180	8.3%	27.49	57,165

Table 26-C Top 10 Occupations by Average Hourly Wage

Occupational Title	Employment		Change	% Change	Mean Wages (\$) - Entry Level	
	2021	2025	2021-2025	2021-2025	Hourly	Annual
Nuclear Medicine Technologists	80	90	10	12.5%	42.46	88,326
Magnetic Resonance Imaging Technologists	420	450	30	7.1%	40.62	84,488
Diagnostic Medical Sonographers	630	680	50	7.9%	38.20	79,470
Physical Therapist Assistants	590	640	50	8.5%	32.55	67,701
Radiologic Technologists and Technicians	1,360	1,470	110	8.1%	31.09	64,677
Occupational Therapy Assistants	550	590	40	7.3%	30.64	63,740
Firefighters	1,980	2,140	160	8.1%	28.66	59,605
Dental Hygienists	2,170	2,350	180	8.3%	27.49	57,165
Respiratory Therapists	1,510	1,630	120	7.9%	26.24	54,581
Avionics Technicians	80	90	10	12.5%	24.61	51,172

Finally, nuclear medicine technologists rank highest among the top ten occupations in terms of hourly wages, with an hourly rate of \$42.46 (Table 26-C). This equates to an annual wage of nearly \$90,000. Occupations in medicine and health care occupy eight positions on the top ten list, with hourly wages exceeding \$25.00. The top ten list also includes firefighters and avionics technicians.

A complete list of projections and entry-level wages for occupations that require entry -level community college career education appears in Table 27, with occupations organized by major occupational group.

Table 27: Forecasts of Occupations in Priority Sectors of Orange County

Occupational Title	Employment		Change		Entry-Level Wage, \$	
	2021	2025	2021-2025	% Change 2021-2025	Hourly	Annual
Architecture and Engineering Occupations						
Aerospace Engineering and Operations Technicians	200	220	20	10.0%	22.03	45,831
Architectural and Civil Drafters	1,460	1,580	120	8.2%	22.66	47,124
Civil Engineering Technicians	1,110	1,210	100	9.0%	22.48	46,769
Drafters, All Other	290	310	20	6.9%	17.42	36,232
Electrical and Electronic Engineering Technologists and Technicians	2,590	2,800	210	8.1%	20.53	42,715
Environmental Engineering Technicians	270	290	20	7.4%	20.98	43,649
Industrial Engineering Technicians	510	550	40	7.8%	22.12	46,020
Mechanical Drafters	660	710	50	7.6%	22.83	47,493
Mechanical Engineering Technicians	410	440	30	7.3%	22.99	47,827
Arts, Design, Entertainment, Sports, and Media Occupations						
Audio and Video Equipment Technicians	1,280	1,380	100	7.8%	15.96	33,195
Broadcast Technicians	170	190	20	11.8%	14.08	29,278
Sound Engineering Technicians	260	270	10	3.8%	23.88	49,669
Office and Administrative Support Occupations						
Bookkeeping, Accounting, and Auditing Clerks	16,970	18,310	1,340	7.9%	16.39	34,096
Desktop Publishers	110	120	10	9.1%	24.56	51,093
Human Resources Assistants, Except Payroll and Timekeeping	1,000	1,070	70	7.0%	15.39	32,017
Insurance Appraisers, Auto Damage	330	350	20	6.1%	22.71	47,240
Legal Support Workers, All Other	530	570	40	7.5%	21.01	43,713
Paralegals and Legal Assistants	3,460	3,740	280	8.1%	18.46	38,402
Computer and Mathematical Occupations						
Computer Network Support Specialists	8,630	9,320	690	8.0%	19.69	40,965
Computer User Support Specialists	1,610	1,740	130	8.1%	20.46	42,563
Web Developers	1,750	1,900	150	8.6%	23.49	48,858
Educational Instruction and Library Occupations						
Library Technicians	740	800	60	8.1%	19.99	41,585
Preschool Teachers, Except Special Education	3,630	3,920	290	8.0%	13.87	28,861
Healthcare Practitioners and Technical Occupations						
Cardiovascular Technologists and Technicians	330	350	20	6.1%	23.90	49,715
Dental Hygienists	2,170	2,350	180	8.3%	27.49	57,165
Diagnostic Medical Sonographers	630	680	50	7.9%	38.20	79,470
Dietetic Technicians	500	540	40	8.0%	14.37	29,896
Emergency Medical Technicians and Paramedics	1,670	1,810	140	8.4%	17.19	35,763
Licensed Practical and Licensed Vocational Nurses	5,390	5,810	420	7.8%	21.24	44,174
Magnetic Resonance Imaging Technologists	420	450	30	7.1%	40.62	84,488
Nuclear Medicine Technologists	80	90	10	12.5%	42.46	88,326
Ophthalmic Medical Technicians	340	360	20	5.9%	16.71	34,763
Psychiatric Technicians	330	350	20	6.1%	15.99	33,247
Radiologic Technologists and Technicians	1,360	1,470	110	8.1%	31.09	64,677
Respiratory Therapists	1,510	1,630	120	7.9%	26.24	54,581
Surgical Technologists	610	660	50	8.2%	21.13	43,967
Veterinary Technologists and Technicians	860	920	60	7.0%	17.93	37,294
Healthcare Support Occupations						
Dental Assistants	5,500	5,940	440	8.0%	15.52	32,295
Medical Assistants	7,370	7,950	580	7.9%	16.22	33,747
Medical Transcriptionists	710	770	60	8.5%	15.42	32,067
Nursing Assistants	4,960	5,350	390	7.9%	14.71	30,592
Occupational Therapy Assistants	550	590	40	7.3%	30.64	63,740
Phlebotomists	1,070	1,150	80	7.5%	17.43	36,241
Physical Therapist Assistants	590	640	50	8.5%	32.55	67,701

Table 27: Forecasts of Occupations in Priority Sectors of Orange County, continued

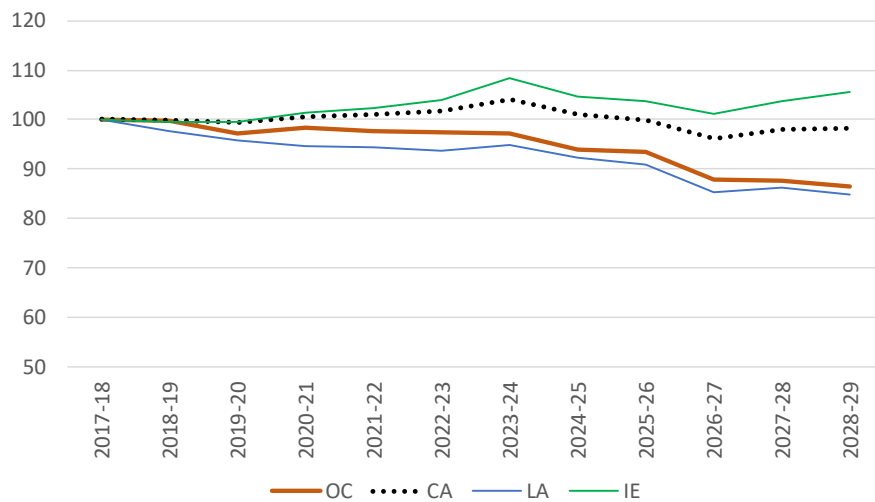
Occupational Title	Employment		Change	% Change	Entry-Level Wage, \$	
	2021	2025	2021-2025	2021-2025	Hourly	Annual
Installation, Maintenance, and Repair Occupations						
Aircraft Mechanics and Service Technicians	610	660	50	8.2%	21.40	44,510
Automotive Service Technicians and Mechanics	4,930	5,320	390	7.9%	15.16	31,534
Avionics Technicians	80	90	10	12.5%	24.61	51,172
Computer, Automated Teller, and Office Machine Repairers	1,740	1,890	150	8.6%	15.68	32,611
Electrical and Electronics Repairers, Commercial and Industrial Equipment	490	530	40	8.2%	18.98	39,487
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	2,860	3,080	220	7.7%	19.43	40,415
Medical Equipment Repairers	740	800	60	8.1%	17.06	35,486
Telecommunications Equipment Installers and Repairers, Except Line Installers	2,850	3,070	220	7.7%	19.59	40,747
Life, Physical, and Social Science Occupations						
Agricultural and Food Science Technicians	60	70	10	16.7%	16.85	35,063
Chemical Technicians	540	580	40	7.4%	15.85	32,978
Environmental Science and Protection Technicians, Including Health	480	520	40	8.3%	14.35	29,849
Life, Physical, and Social Science Technicians, All Other	850	910	60	7.1%	15.22	31,666
Personal Care and Service Occupations						
Hairdressers, Hairstylists, and Cosmetologists	2,770	2,990	220	7.9%	13.40	27,885
Manicurists and Pedicurists	1,230	1,340	110	8.9%	13.40	27,885
Morticians, Undertakers, and Funeral Arrangers	80	90	10	12.5%	18.70	38,882
Skincare Specialists	480	520	40	8.3%	13.46	27,999
Production Occupations						
Prepress Technicians and Workers	630	680	50	7.9%	15.36	31,943
Tool and Die Makers	540	580	40	7.4%	19.66	40,885
Protective Service Occupations						
Firefighters	1,980	2,140	160	8.1%	28.66	59,605
Transportation and Material Moving Occupations						
Captains, Mates, and Pilots of Water Vessels	170	190	20	11.8%	17.67	36,757
Heavy and Tractor-Trailer Truck Drivers	7,320	7,900	580	7.9%	17.49	36,389

Source: Kleinhenz Economics

Peering into the Workforce Pipeline

During the five-year planning horizon of the OC Strong project from 2021 through 2025, there is a mixed outlook for the future community college student body in Orange County. The number of high school graduates is expected to decline by approximately four percent from just under 38,000 in Academic Year (AY) 2020-2021 to 36,000 in AY 2024-2025 based on projections from the California Department of Finance's Demographic Research Unit (Figure 11). Declines will continue through the end of the decade. While California as a whole will see a negligible decrease over that period, the Inland Empire will experience an increase in the number of high school grads by approximately three percent.

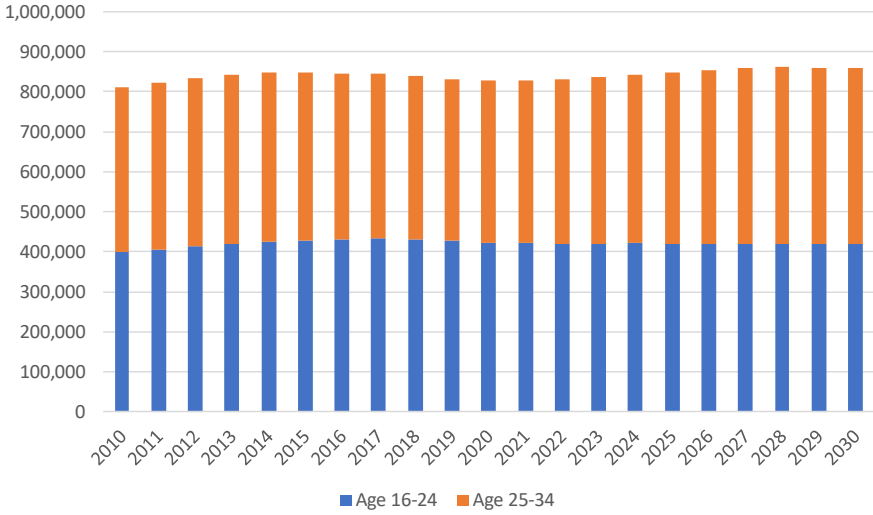
Figure 11: Number of High School Graduates (Indexed 2017-18=100)



Source: California Department of Finance, Analysis by KE

The number of Orange County residents in the 16 to 24 age range is projected to decline marginally over the period from 2021 through 2025 from 421,100 to 420,000 persons. (Figure 12). However, the number of individuals in the 25 to 34 age range – younger members of the Millennial cohort – is projected to increase from 406,600 to 429,600 over the same period. Therefore, the prospective sources for additional students in Orange County community colleges may be the 24 to 34 age group and recent high school graduates from the Inland Empire.

Figure 12: Projected OC College-Age and Young Adult Population



Source: California Department of Finance, Analysis by KE

Emerging Technologies: Disruptions and Opportunities

By now we have all heard warnings that in the not-too-distant future more than half of all current workplace tasks will be performed by machines. The Organization of Economic Cooperation and Development (OECD) reports that globally, 66 million people are at risk of losing their jobs to automation. That equates to 14 percent of jobs in industrialized countries. Although many jobs as we know them may cease to exist, the impact of automation is not as simple as technology replacing human workers. The implications, good and bad, are far more complex. While worker anxiety over automation is high, technology also has the potential to improve the lives and well-being of workers, freeing them from repetitive and dangerous work. Innovation and technological advances also typically spawn new jobs, but the challenges of meeting the demand for skilled workers to fill these jobs will be enormous. How do educational institutions develop programs to meet the needs of businesses? What should the roles of government, private industry and educational institutions be in supporting this process? Will the process be inclusive and diverse, and will older workers who are displaced have the ability to reinvent themselves?

This section of the report provides an overview of the work being done to answer these questions. We begin with a review of current research on the impact of automation and artificial intelligence on workers. We then discuss the opportunities and challenges automation poses for the future workforce and conclude by presenting a review of innovative workforce development programs from across the country and identify potential areas for Orange County community colleges to invest future resources.

Review of the Future of Work Literature

Following is a review of the existing literature on the implications of rising automation and artificial intelligence on the labor markets. Numerous of institutes and think tanks have devoted considerable resources to parsing out the direct and indirect effects of technology on workers. This is necessarily only a summary of common themes that have emerged from current research related to the effects of automation and artificial intelligence on workforce development. Links to useful papers and research programs may be found in a list of resources and references that appears in Appendix I.

1. *The occupations at greatest risk are those that involve routine tasks*

In 2003, Autor, Levey and Murnane at MIT pioneered the use of a task-based approach to determine which occupations and jobs are most likely to be disrupted by automation. Their contribution to this body of research was to distinguish tasks from skills. Tasks identified as

"routine" are at greatest risk of automation since these activities "follow a well-defined linear structure or procedural structure" and can more easily be executed by machines. From this, we can make the important distinction that it is not jobs that are automated, but tasks.

In the 1990s, researchers began documenting the rise in wage inequality in advanced economies and a decline in the proportion of the population in these nations (including the U.S.) working in middle-wage jobs. A Brookings Institution paper by Jaimovich and Sui (2019) reviews the literature on job polarization, that is, employment growth at the upper and lower ends of the wage distribution. Initially, work in this area focused on the rising skill premium paid to college-educated workers relative to those with lower educational credentials. This phenomenon was widely observed in the aftermath of the Great Recession and was often referred to as the "hollowing out" of middle-class jobs. While globalization was widely blamed at the time (and still is), the literature demonstrates that the loss of job opportunities in certain occupations that were comprised mainly of routine tasks was the result of advances in automation technologies.

In the Future of Work in America (2019) The McKinsey Global Institutes estimates that close to 50 percent of current work activities (tasks) have the potential to be automated based on current technology. In their estimation, less than 5 percent of occupations can be fully automated, but for 60 percent of occupations, at least 30 percent of the tasks performed by workers today will be automated at some point.

2. The least well off will suffer the automation's greatest impacts on the labor market

The debate between experts on how automation will affect the future of work has scholars on one side forecasting major disruptions while on the other, there are those who minimize the potential impacts. One commonality they share however, is that the least well off will suffer automation's greatest shocks to the labor market. Analysis based on forecasts of occupation-level automation exposure from the McKinsey Global Institute showed that higher-wage, better-educated workers will largely remain employable as automation spreads. Similar findings have accumulated in numerous reports, ranging from those by teams at Oxford University, the OECD, and the African American Mayors Association.

3. Artificial Intelligence is another matter...

Often used interchangeably, artificial intelligence (AI) is different than automation. Analyzing the labor market impacts of AI is challenging because there is no single definition of the technology that fully captures its operations and capabilities. Broadly, "AI involves programming computers to do things that could be said to require intelligence, such as planning, learning, reasoning,

problem solving, perception and prediction." A narrow definition focuses on machine learning, a branch of statistics on which most AI currently depends. Machine learning can be defined as computers' "use of algorithms to find statistical patterns in massive amounts of data which can then be used to make predictions."

A paper by Michael Webb, *The Impact of Artificial Intelligence on the Labor Market* (2019) quantifies the overlap between the text of job descriptions and the text of patents to identify the kinds of tasks and occupations likely to be affected by AI. Occupations were then assigned an "exposure score". Muro, Witon and Maxim (2019) of the Brookings Institution further analyzed these exposure scores to identify the specific occupations likely to be affected by AI. Their modeling suggested that just as the impacts of robotics and software tend to be sizable and negative on exposed middle- and low-skill occupations, so AI's inroads are projected to negatively impact higher-skill occupations. Well-paid, white-collar jobs in Orange County such as those held by radiologists, legal professionals, optometrists, and many more are no more likely to get a "free pass" in the coming years than production line workers replaced by robots.

4. *Automation has the potential to worsen gender and occupational segregation*

In their paper "Gender, occupational segregation and automation," Cortes and Pan (2019) explore occupational differences by gender, a persistent feature of labor markets around the world, and ask how automation will differentially affect the labor market prospects of men and women. In the 1980s, women faced a larger risk of being displaced by technological change; over the past four decades, however, more women relative to men shifted out of occupations characterized by high levels of routine task intensity. Research shows that women adapted differently to declining job opportunities in middle-skill and routine-intensive occupations by disproportionately entering high-skill occupations while men shifted to low-skill occupations. Women achieved this by raising their educational profiles and improving their occupational stature within education groups.

Women's educational attainment has increasingly outpaced that of men, suggesting that women are more likely to possess the skills that complement technological change and give them an advantage – namely interpersonal and social skills. Studies reveal these "soft" skills are increasingly rewarded in the U.S. labor market as evidenced by the rapid growth of social skill intensive occupations in terms of both employment share and wages.

5. *Technological innovation often excludes minority groups*

Studies from McKinsey and Brookings show that technological development often excludes minority groups. Given educational disparities, African-Americans and Hispanics are at greater risk

for job displacement. Individuals with a high school degree or less are four times more likely to work in occupations that are highly automatable relative to those with bachelor's degrees. McKinsey estimates that as many as 12 million incumbent Black and Hispanic workers could lose their jobs to automation and many more may be excluded from meaningful work if they do not acquire the necessary skills.

The tech industry has widely publicized issues related to workforce diversity but sometimes, it is the technology itself that is exclusionary. While discussions about diversity and inclusion are relatively new to the national dialog, schools at all levels should be teaching these concepts alongside technical skills. Even though conversations about diversity and inclusion are difficult, they are "necessary to improve students' current education, their future work environments and their ability to complement the technology that they will use in their careers." Although equity and diversity skills are not usually considered part of a technical toolkit, a lack of competence in this area can lead to technological discrimination. One such example is the case of an Oakland, CA pilot program that used software to identify areas predicted to have a high crime rate but instead, the algorithm highlighted areas that had a high population of minorities regardless of the crime rate.

6. *Automation has potential to exacerbate geographic inequality*

There is also a geographic and spatial component to how severely businesses and workers will be impacted by automation. McKinsey points out that cities and counties across the U.S. entered this period of technological and labor market change from different starting points. Their model of adoption of automation technologies in the American workplace shows some local economies experiencing more disruption than others. The majority of counties facing the greatest disruption are rural areas. In contrast, urban areas with more diversified economies and workers with high levels of education may experience less severe effects from automation. But what about regions that are neither rural nor intensely urban?

Rust-belt manufacturing job losses due to automation have been widely reported on in the media but a study (2017) by the Institute for Spatial Economic Analysis (ISEA) at the University of Redlands predicts that the hardest hit areas in the coming decades will be those with high concentrations of jobs in food preparation, office or administrative support, and sales. Places like Las Vegas or Riverside-San Bernardino may be the most vulnerable with up to 65 percent and 63 percent of jobs, respectively, being automatable by 2025. The authors also estimated that most large American metropolitan areas may lose more than 55 percent of their current jobs to automation in the next two decades. The key points are that 1) automation is going to be much more widespread than earlier researchers anticipated and 2) while previously automation hurt middle-class jobs such as those in manufacturing, it is now coming for lower-income jobs.

Orange County is different than Riverside-San Bernardino counties both demographically and in terms of their respective mix of industries. Orange County residents have higher levels of education on average, and the county has a more diverse economic base so it may be better positioned to weather the disruptive effects of automation. However, Orange County is also part of an integrated economic region with trade and workers moving back and forth across county lines. This implies that Orange County will not be fully immune to the low- and middle-income job losses predicted by the ISEA.

What Lies Ahead

Labor markets are not on the edge of an imminent takeover by robots. Instead, we are looking at a decades-long change in the mix of jobs in the economy and how work is organized. Many occupations will shrink through attrition and reduced hiring. Some jobs will decline and disappear as others are created; the advancement of technology itself will give rise to new occupations. All workers will have to adapt – no one will be exempt from the impact of automation and artificial intelligence. Machines will take over routine and some physical tasks (including those that are dangerous) while demand for socio-emotional, creative, technological, and higher cognitive skills will grow.

All industrial revolutions are disruptive, but this time the wheels of change are spinning much faster. Already, there are concerns that the skilled labor force is not growing fast enough to keep up with demand. In a 2016 survey, 46 percent of American employers reported difficulty filling positions due to a lack of qualified applicants. A Business Roundtable survey found that 94 percent of CEOs reported skill gaps that extended from entry level to advanced, highly technical positions. This implies a mismatch between the skills employers desire and skills possessed by potential workers. Part of the problem may be the decentralized post-secondary education system in the U.S. and insufficient support for workers seeking to get retrained.

Some large employers have moved to invest in training and upskilling programs for employees, but most firms lack the resources, infrastructure, or desire to make these investments themselves. The needs of young people just entering the workforce and older, incumbent workers are very different. Reinventing oneself at 20 is generally not a problem, that is what young people do. At 40 and 50, however, transitioning into another industry or occupation is a far more daunting prospect without targeted support.

The severity and persistence of the COVID-19 pandemic is accelerating the adoption of new technologies. Advances in AI paired with automating technologies are expanding the set of potential tasks that can be done by technology. Already we see businesses adapting to the

pandemic by putting in place processes that minimize human contact between consumers and workers and within the businesses themselves. In addition to more employees working remotely, the pandemic has pushed fast adoption and increased innovation in areas such as contactless customer services and delivery, robotic warehouse management and order fulfillment, and automated food service.

This suggests that while the economy will eventually recover, the structure and job composition of U.S. labor markets may be conspicuously different. There may be new job opportunities made possible by emerging technologies, but many will require new skills and in the near-term making a return to normal impossible for a significant number of workers.

A key component to resolving the skills mismatch between workers and firms is active public policy engagement. This includes committing to investments in community college-based training and fostering public-private partnerships that provide pathways to jobs and apprenticeships. Community colleges can play a pivotal role in mitigating skilled worker shortages and fostering middle-class mobility. For incumbent workers facing potential displacement, subsidies that provide support (stipends, childcare) during retraining, and incentives for private sector firms to retrain their workers, may be the key to saving jobs and increasing worker productivity and wages. Examples of supportive programs will be explored in more detail below.

Innovative Approaches to Community College Workforce Development Programs

The present situation is not wholly unique. Since the end of WWII there have been periods of interest in the role of training policy for addressing perceived national challenges. During the Lyndon Johnson's War on Poverty, youth unemployment and juvenile delinquency inspired the creation of the Job Corps and summer youth employment programs. During the Clinton administration concerns about declining American competitiveness relative to Germany and Japan led to efforts to encourage firms to increase investment in training their workforce. More recently, trade shocks and disruption caused by robots and artificial intelligence have resulted in a renewed interest in public employment and training policy.

The importance of training and education is undisputed but there are major concerns about the nation's present capacity to do it in a cost effective way and about the end result, which is to successfully train individuals to who can readily enter the workforce and upskill as needed. Fortunately, California Community Colleges are already making great strides in meeting this need on the front end of the talent pipeline through the K12 Strong Workforce Program.

In 2018, the California legislature introduced the K12 Strong Workforce Program (K12 SWP). The SWP is designed to support K-12 local educational agencies in "creating, improving and expanding career technical education sources, course sequences, programs of study and pathways for students transitioning from secondary education to post-secondary education to living-wage employment." The California Community College Office of the Chancellor states that the primary objectives of K12 SWP are to:

- Support essential collaboration access education systems between the K-12 sector and community colleges or intersegmental partnerships with involvement from industry businesses and organizations in strengthening career technical education (CTE) programs and pathways aligned with regional workforce needs.
- Enable a seamless and successful transition from secondary to postsecondary education within the same or related career paths; lead to completion of industry-valued certificates, degrees or transfers to four-year university or college.

The LAOCRC administers funds under the K12 SWP, which it awards through a competitive grant process. OC Pathways (Orange County Department of Education) receives support from the Chancellor's Office K12 SWP program through the LAOCRC. In addition to the LAOCRC, OC Pathways partners include middle schools, high schools, as well as the county's individual

community colleges and four-year universities. By connecting educators and industry leaders, OC Pathways brings cohesion to a decentralized educational system by working together with their partners to develop programs across 15 career pathways to prepare students to transition from secondary education to postsecondary education to living-wage employment.

One such example of an industry partnership is the Orange County Business Council's Community College Working Group (CCWG). The CCWG is a regional coalition of stakeholders including industry and education representatives serving the Orange County community college districts, regional occupation programs, non-profits, workforce development boards, university, and K-12 institutions. CCWG works with career technical education to align education programs with the workforce needs of business and industry.

Another workforce development initiative of the Orange County Business Council is their Workforce Development Committee. This is a coalition between education and training professionals, and business leaders and other community partners who work to ensure Orange County's workforce needs are met by focusing on the development of policy and legislative issues such as advocating on behalf of stakeholder partnerships; identifying in-demand skills; and strengthening education and business partnerships to promote the economic success of Orange County workers and businesses.

Following are additional examples of partnerships between government, industry, nonprofits, and educational institutions that are seeking innovative workforce development solutions, including examples currently in place in Orange County.

- The financial institution Citi operates [Citi University Partnerships in Innovation and Discover \(CUPID\)](#) through its Ventures initiatives. The CUPID program provides students with opportunities to participate in innovation activities across Citi, enabling them to engage with the firm to address and solve complex, real-world challenges. Originally directed toward university students, the program is now being expanded to community colleges through the LAOCRC's Business and Entrepreneurship initiatives.
- [Santiago Canyon College's Apprenticeship Program](#) provides students with training and skills for careers in carpentry, with a number of specialties in the field. The apprenticeship programs enable students to earn journeyworker status in the State of California while also satisfying major requirements for an associate degree.
- The [Mechatronics Apprenticeship Partnership Program \(MAP²\)](#) was established to address the workforce skills gap in Advanced Manufacturing. Through hands-on training, the program

is designed to train individuals in advanced manufacturing skills and earn an associate's degree in the process.

- Long Beach City College's [Maritime Center of Excellence](#) is a partnership with the Port of Long Beach to provide opportunities to individuals seeking the employment skills they need to join the goods movement workforce. The training at the Maritime Center of Excellence focuses on in-demand occupations. Classes in the program are scheduled during evenings and weekends to accommodate work schedules.
- Maryland's Prince George's Community College (PGCC) and MGM Resorts. The PGCC trains students through its Hospitality Express Certification Program and Dealer School, both of which are funded by MGM. More than 50 percent of those students go on to fill positions in various departments throughout the neighboring MGM National Harbor resort. MGM also helped establish the Prince George's County Promise Scholarship Program, which helps meet the financial needs of 500 students annually.
- Central Piedmont Community College in Charlotte, NC meets with local employers and makes recommendations on how the college can assist them in finding skilled workers. For some businesses that might mean the creation of an apprenticeship program or a work-based learning program, which is a semester-based career exploration where students work with an employer in a position related to their field of study and receive academic credit.
- Lee College in Texas established a Hispanic-Serving Institution Initiatives Department that provides students with a centralized hub to take advantage of academic support. The college also developed its Weekend College Program to meet the needs of its many part-time students. Lee College boasts a three-year graduate rate of 70 percent compared with the Texas statewide average of 20 percent.

Finally, given the speed with which change is occurring in the career education environment. Community colleges must recognize and adapt to technological change and innovation through their curricula, but they must also adjust to the dynamics of the education sector wherein which institutions that are less bureaucratic and more innovative are able to move quickly. As such, community colleges must become more nimble in their approaches to career educations. While community colleges continue to offer traditional degree and career pathway programs, they are also moving toward the development of competency-based education programs. Such programs acknowledge the need for innovative education solutions beyond the current system of learning and awarding degrees which are more flexible and responsive to changes in the environment.

Workforce Development Nonprofits

[Opportunity@Work](#) is part of a movement of employers, training providers, entrepreneurs and other advocates working to bridge the opportunity gap for workers who are “Skilled Through Alternative Routes” (STARS). STARS are often invisible to employers because they lack a college degree. Even employers that value potential over pedigree often struggle to identify and connect with STARS. Opportunity@Work aims to rewire the labor market and connect the millions of STARS locked out of good jobs with employers that urgently need skilled talent. By promoting skills instead of credentials Opportunity@Work helps employers fill pressing workforce needs while providing opportunities for skilled workers to earn higher wages and get on a promising career path.

[ProjectQUEST](#) (San Antonio) is part of a collaborative effort between four City of San Antonio and Bexar County agencies offering workforce education and training programs for those impacted by COVID-19. QUEST provides wrap around services, career coaching, and job readiness. Stipends are offered to workers while they train.

[Aspen Institute Economic Opportunities Program](#) (EOP) advances strategies, policies, and ideas to help low- and moderate-income people thrive in a changing economy. The EOP is focused on expanding opportunities for individuals to connect to quality work, start businesses and build economic stability that provides the freedom to pursue opportunities. They accomplish this through collaboration with national and local leaders across the U.S. – nonprofit leaders, policymakers, labor leaders, business leaders, educators, and academics.

[National Fund for Workforce Solutions](#) invests in a dynamic national network of over 30 communities taking a demand-driven, evidence-based approach to workforce development. At the local level, partner organizations contribute resources, test ideas, collect data, and improve public policies and business practices that help all workers succeed and employers have the talent they need to compete.

Recommendations for Community Colleges in Orange County

Community colleges play a central role in training the American workforce. These institutions are affordable (relative to four-year institutions or for-profit colleges) and well positioned for people looking to get skills-training that prepares them for good paying jobs. Community colleges offer focused career technical education programs in addition to a broad liberal arts education that helps students acquire the soft skills they need to become successful employees. In addition to important technical skills, skills in communication and problem solving, critical thinking and teamwork are vital. Moreover, with a significant number of individuals working in a self-employed

capacity, training in entrepreneurship and business management is increasingly important. With these objectives in mind, following are areas where Orange County community colleges should consider investing their resources.

Form strategic partnerships with individual Orange County firms and/or industry coalitions. These might include Boeing, Hoag Hospital or firms in the leisure and hospitality sector. Orange County's community colleges are a natural recruitment pool for nearby businesses and can help companies achieve a skilled, diverse, and inclusive workforce. However, the inherent challenges between education and industry will need to be overcome in order to create strong pathways for students. Working together, the county's community colleges and industry can design programs, opportunities, and perhaps even internships that equip students with the skills desired by employers.

Similarly, the county's community colleges should continue to align existing and future marketing efforts to steer students to career education programs that align with the needs of the Orange County economy such as pursuing in-demand fields of study like health care or logistics. There is little research on how students attending community colleges choose which fields to study but one recent paper (Acton 2020) suggests that students embarking on a two-year program are more likely to consider short-term fluctuations in labor demand and pursue programs associated with specific in-demand occupations close to home. Therefore, community college programs should highlight the job opportunities within the areas they serve and ensure their offerings evolve in tandem with local labor markets.

Along with technical skills, community colleges should consider embedding soft skills specifically related to gaining employment upon program completion such as networking, utilization of technology and social media tools (i.e., LinkedIn). This would provide students with the ability to better promote themselves to secure jobs in their related field of study. An example of this would be the Fall 2020 *FutureBuilt Fridays* campaign that brought various speakers who provided specific tips and tricks for OC students to obtain job interviews with a higher rate of job attainment success.

Embed entrepreneurship skills throughout career education programs and add entrepreneurship courses to prepare students for self-employment and small businesses opportunities throughout the priority sectors. Students will benefit from training in business management and operations in addition to studies within their field of interest since they will be better prepared to work for themselves or start their own businesses in addition to being able to obtain a job from an employer.

Focus on strategies that increase program completion and graduation rates. Many students work full-time or may have multiple jobs to support themselves and their families. Lack of childcare may also be an issue. Each of these things interfere with students completing their education. Research should be conducted to identify the challenges for Orange County's community college students in order to develop specific solutions that would lead to greater completions and graduations.

Work with industry partners to shift employers' focus from pedigree to skills acquisition by creating programs that assess students' existing skills and provide skills-based transitions to opportunities to earn a higher wage. For example, many of the skills used by a retail sales clerk are the same as a customer service rep. Opportunity@Work provides some excellent examples of how this approach works.

Conclusion

Protesting the loss of their place in society, Luddites in early 19th century Britain smashed the mechanized looms that deprived them of their traditional way of life. Machines have long been considered an existential threat to the livelihoods of workers, but economies have continued to survive and flourish in step with industrialization and technological change. Work is about solving problems and it is highly unlikely the world will run out of problems anytime soon.

Yet the current pace of change is so rapid and extensive that the disruption is occurring on a scale scarcely imaginable only a few decades ago. Workers are increasingly anxious that they will be made redundant by machines and firms are concerned they will not be able to find the skilled workers they need. Workers, now and in the future, will have to continually adjust to technology as it reshapes the workplace. Education equips a person to be flexible, to learn and to adapt, but the process must start at an early age and continue through secondary school. To the extent that students are entering community college inadequately prepared, it may be incumbent upon community colleges to develop innovative ways to bring students up to speed, whether through "boot camps", or other intensive pre-community college efforts. Programs such as the National Fund for Workforce Solutions acknowledge that one-size-fits all approaches will fall short so community colleges will also need to find flexible, innovative, and tailored approaches ensure the greatest change of success for their students.

Government also has an important role to play in this process. Workers will need support and funding that can be shared by firms and the state to maintain full employment – the prolonged absence of which will inevitably fray social cohesion and stability. Community colleges can be at the center of this nexus, providing both the technical and human skills that will be needed to make both workers and businesses successful in the coming decades.

Finally, community colleges are ideally positioned to provide relief from equity of opportunity bottlenecks. In a world where “credential-ism” is valued over “talent-ism” providing access to skills acquisition to underserved populations is the best social insurance workers have against downward mobility. Community colleges could do a lot more to promote the value of the education they provide. Employers will find their workforce needs more easily met when a community college degree or certificate holds the same prestige as a four-year degree if it brings the right skills to the job.

With the proper policy prescriptions and strong partnerships between workforce development stakeholders, the optimistic view that automation and AI will take society from a work ethic based in the industrial revolution to one that is based on purposeful work and lives that are much more enjoyable, may yet prevail.

Appendix I: Resources and References

Academic Papers and Articles

[Community college program choices in the wake of local job losses](#); Acton, Riley (July 2020)

[State-level policies to incentivize workplace learning: Impacts of California's incumbent worker training program](#); Megoita, Marian and Goger, Annelies (July 2020)

[The Future of Work in America](#); McKinsey Global Institute (July 2019)

[The differing impact of automation on men and women's work](#); Brookings Institution (September 2019)

[How automation and other forms of IT affect the middle class](#); Jaimovich, Nir and Siu, Henry (November 2019)

[Gender, occupational segregation, and automation](#); Cortes, Patricia and Pan, Jessica (November 2019)

[What jobs are affected by AI](#); Muro, Mark et al (November 2019)

[Employment Training for Mature Adults](#); Osterman, Paul (November 2019)

[Robots or Workers? A Macro Analysis of Automation and Labor Markets](#); Federal Reserve Bank of San Francisco (November 2019)

[The Future of Work: How New Technologies are Transforming Tasks](#); Fleming, Martin et al (IBM) (October 2019)

[ACT's Policy Platform Workforce Development](#) (2018)

[A future that Works: Automation, Employment and Productivity](#); McKinsey Global Institute (January 2017)

[Artificial Intelligence, Automation, and the Economy](#); Executive office of the President (December 2016)

[Preparing for the Future of Artificial Intelligence](#); Executive Office of the President National Science and Technology Council Committee on Technology (October 2016)

Associations and Initiatives

[African American Mayor's Association Future of Work Initiative](#)

[Brookings Institution Automation and the Middle Class Initiative](#)

[Institute for Spatial Economic Analysis, University of Redlands](#)

[OECD: I Am the Future of Work](#)

[World Economic Forum: The Future of Work](#)

Appendix II: Data Sources

Several data sources were used to analyze trends in Orange County's industries and its workforce, and to develop forecasts of key variables that were used in the study.

- Data on employment, payroll, and establishments were obtained from the following sources:
 - California Employment Development Department: Current Employment Survey (CES) and Monthly Household Current Population Survey (CPS)
 - U.S. Bureau of Labor Statistics: Quarterly Census of Employment and Wages (QCEW)
- Data on the county's workforce, including occupations and industries of employment, socioeconomic patterns, and wages were obtained from:
 - California Employment Development Department/U.S. Bureau of Labor Statistics: Occupational Employment Survey (OES)
 - U.S. Bureau of the Census: American Community Survey (ACS)-Summary tables online and custom tabulations using the ACS public use micro sample (PUMS)
- Data on self-employed
 - U.S. Bureau of the Census: Non-employer Statistics
- Demographic trends and projections
 - California Department of Finance, Demographic Research Unit: Overall population trends and population trends by age group