

Program Endorsement Brief: 0934.00/Electronics and Electric Technology Orange County Sub-Regional Automation Fundamentals Certificate – Pathway to Multiple Disciplines

Orange County Center of Excellence, March 2020

Summary Analysis

The Orange County Center of Excellence for Labor Market Research (COE) prepared this report to provide Los Angeles/Orange County regional labor market supply and demand data related to automation fundamentals. The proposed Orange County Sub-Regional Automation Fundamentals Certificate is designed to allow all Orange County community colleges to train students in baseline automation skills, such as basic electronic circuitry and other related competencies. After completing this fundamental skills certificate, students should continue their education in one of the stackable specialization certificate programs offered at various community colleges throughout Orange County. These specialization certificates include heating, ventilation, and air conditioning (HVAC), industrial electronics, mechatronics, and robotics.

Because these fundamental skills can lead to future employment in a variety of occupations, this report includes a broad overview of traditional labor market demand and supply data for 11 related middle-skill occupations. However, not all positions within these occupations will have an automation focus, so demand is overstated when considering automation roles. To better understand the current need for comprehensive automation knowledge, skills, and abilities (KSAs), this report primarily focuses on an analysis of online job postings for job titles related to Building Automation and Industrial Automation.

Building Automation and related systems allow building functions, such as those related to heating, ventilation, and air-conditioning (HVAC), to run automatically.¹ According to the US Department of Energy, residential and commercial buildings account for approximately 75% of all electricity use. Additionally, “building automation can optimize energy use leading to decreased energy costs while maintaining occupant preferences.”² Analyzing job postings for building and industrial automation roles will provide a better understanding of the local need for qualified workers, the skills requested for these roles, and educational requirements and preferences.

This report is intended to help determine whether there is demand in the local labor market that is not being met by the supply from community college programs that align with the relevant occupations.

Based on the available data there appears to be a need for automation fundamentals skills in the region. However, because these skills can be applied to numerous occupations, this analysis is primarily based on data from online job postings. While online job postings are useful for understanding KSAs, education requirements, and other employer hiring preferences, the number of job postings does not provide an accurate count of job openings. For example, employers may list jobs that they do not end up filling or may use a single posting to hire several people. For

¹ Hübner Christof, et al. Building Automation: Communication Systems with EIB/KNX, LON and BACnet. Springer, 2018.

² <https://www.energy.gov/articles/doe-announces-47-million-flexible-building-technologies-heating-ventilation-and-air>

these reasons, the number of online job postings are not comparable to nor indicative of the number of annual openings for any given occupation. **Therefore, the COE cautiously endorses this proposed sub-regional certificate.** Reasons include:

Demand:

- Over the past 12 months, there were **5,524 online job postings related to Building and Industrial Automation throughout the region.** The highest number of job postings were for maintenance technician, manufacturing technician, and electronics technician.
 - However, the **number of online job postings do not equate to the number of annual openings.** Therefore, **demand is likely overstated for these automation roles.**
- Within those job postings, **62% (3,452) included a requested and/or minimum level of education, of which 62% (2,148) requested a high school diploma, vocational training, or an associate degree.**
- Advertised entry-level wages for these positions are between **\$18.44 and \$20.16 which is higher than the California Family Needs Calculator (living wage) hourly wage for one adult in the region (15.04 in Los Angeles County and \$17.36 in Orange County).**³

Supply:

- There are **3 educational institutions, all of which are community colleges, in the region that currently have programs specifically related to industrial automation or building automation.**
 - Two of these colleges conferred an average of **12 awards annually between 2016 and 2019**
- Over the past 12 months, there were **4 program recommendations requests from Orange County colleges related to automation.** These programs could fall under either automation fundamentals or one of the specialized certificate areas.

Demand

To provide a broad overview of traditional labor market demand for building and industrial automation, the following 11 middle-skill occupations, which include automation fundamentals, were identified: Electrical and Electronics Engineering Technicians (17-3023); Electro-Mechanical Technicians (17-3024); Environmental Engineering Technicians (17-3025); Industrial Engineering Technicians (17-3026); Mechanical Engineering Technicians (17-3027); Electrical and Electronics Repairers, Commercial and Industrial Equipment (49-2094); Heating, Air Conditioning, and Refrigeration Mechanics and Installers (49-9021); Industrial Machinery Mechanics (49-9041); Maintenance Workers, Machinery (49-9043); Maintenance and Repair Workers, General (49-9071); Water and Wastewater Treatment Plant and System Operators (51-8031). In Los Angeles/Orange County, the number of jobs related to these 11 occupations is projected to increase by 5% through 2023. There will be more than 9,500 job openings per year due to job growth and replacements. However, while unquantifiable, these occupations include positions that

³ Living wage data was pulled from California Family Needs Calculator on 2/17/20. For more information, visit the California Family Needs Calculator website: <https://insightcced.org/2018-family-needs-calculator/>.

do not have an automation focus, therefore demand is overstated for automation roles. Demand information for these occupations is listed in Appendix A.

While students may be able to obtain employment in some of the entry-level occupations, such as Maintenance and Repair Workers, General (SOC Code 49-9071), they would need to continue their training and learn specialized skills to enter occupations such as Heating, Air Conditioning, and Refrigeration Mechanics and Installers (SOC code 49-9021).⁴ Since this program focuses on fundamental automation skills that can be used in several occupations, this report primarily focuses on online job postings related to automation fundamentals and the KSAs requested in those online postings.

Job Postings

The job titles listed in Exhibit 2 were used as search parameters to identify online job postings most closely related to automation fundamentals. The titles are grouped into two main functional areas: Building Automation and Industrial Automation. Over the past 12 months, there were 5,524 online job postings related to automation fundamentals. Of those, 63% (3,495) were for Industrial Automation roles and the remaining 37% (2,029) were for Building Automation roles.

Exhibit 2: Automation job titles analyzed in online job postings

Automation Type	Job Titles
Building Automation	BAS Technician, Building Automation Controls Technician, Building Automation Controls Programmer, Building Automation Programmer, Building Automation Technician, Building Engineer, Building Systems Specialist, Control Systems Installation Technician, Controls Engineer, Direct Digital Control, Facilities Maintenance Technician, HVAC Service Technician
Industrial Automation	Automation Design Engineer, Automation Engineer, Control Systems Engineer, Control Systems Technician, DCS Automation, Digital Controls System, Electro-Mechanical Technician, Electronic Specialist, Electronic Technician, HMI Automation, Human Machine Interface Automation Engineer, Industrial Control Technician, Industrial Maintenance Technician, Maintenance Mechanic, Manufacturing Technician, PLC Programmer, Robotics Software Engineer, Robotics Technician, SCADA Programmer

Exhibit 3 shows the distribution of job postings across Los Angeles and Orange Counties. Of the 5,524 postings, 64% (3,557) were posted in Los Angeles County and 36% (1,967) were posted in Orange County.

Exhibit 3: Number of job postings by county

County	Building Automation	Industrial Automation	Total
Los Angeles	1,289	2,268	3,557
Orange	740	1,227	1,967
Total	2,029	3,495	5,524

⁴ <https://www.bls.gov/ooh/installation-maintenance-and-repair/general-maintenance-and-repair-workers.htm#tab-4>

Building Automation

There were 2,029 online job postings related to Building Automation listed in the past 12 months. The highest number of job postings were for building engineer, HVAC service technician, controls engineer, and facilities maintenance technician. The top three employers throughout the region, by number of job postings, were CBRE, Marriott International Incorporated, and Sears. Of the 2,029 online job postings, 68% listed a minimum education requirement.

Industrial Automation

There were 3,495 online job postings related to Industrial Automation listed in the past 12 months. The highest number of job postings were for maintenance mechanic, manufacturing technician, electronics technician, and systems engineer. The top three employers throughout the region, by number of job postings, were Northrop Grumman, Grifols, and Extron Electronics. Of the 3,495 online job postings, 59% listed a minimum education requirement.

Educational Requirements in Online Job Postings

Building Automation

Of the 68% of Building Automation job postings listing a minimum education requirement in Los Angeles/Orange County, 54.3% (752) requested a bachelor's degree, 39.3% (553) requested a high school diploma or vocational training, and 2.5% (34) requested an associate degree. Postings that requested a high school diploma, vocational training, or an associate degree were split between technician and engineering roles such as building engineer, HVAC service technician, facilities maintenance technician, and controls engineer. However, 90% of postings that requested a bachelor's degree were for engineering positions such as controls engineer, automation engineer, senior controls engineer, and systems engineer.

Industrial Automation

Of the 59% of Industrial Automation job postings listing a minimum education requirement in Los Angeles/Orange County, 67% (1,386) requested a high school diploma or vocational training, 24% (493) requested a bachelor's degree, and 8% (175) requested an associate degree. Postings that requested a high school diploma, vocational training, or an associate degree were primarily for mechanic and technician roles such as maintenance mechanic, manufacturing technician, and electronics technician. Like Building Automation, over 85% of Industrial Automation postings that requested a bachelor's degree were for engineering roles such as systems engineer, automation engineer, and electrical engineer.

Skills

Automation Skills Requested in Online Job Postings

Of the top 20 most requested skills in automation job postings, there are several skills that employers request across both types of automation roles reviewed in this report. Some skills, such as plumbing, electrical systems, and Human Machine Interface (HMI) are requested at roughly similar rates for both types of automation postings. Exhibit 4, on the following page, shows the top 20 requested skills in online job postings across both types of automation.

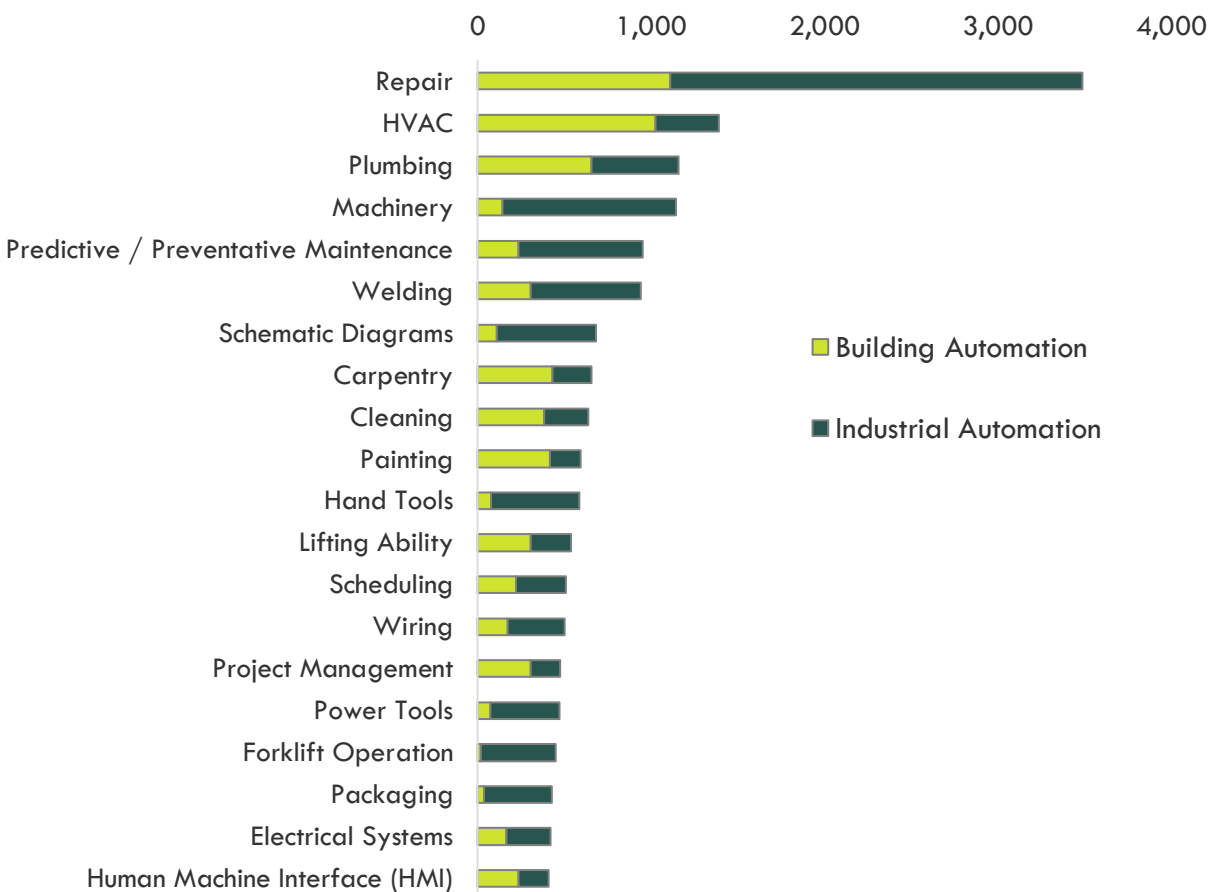
Building Automation

The top five requested skills for Building Automation positions were repair, HVAC, plumbing, carpentry, and painting. The top skills for Building Automation positions are primarily related to maintenance, repair, and installation.

Industrial Automation

The top five requested skills for Industrial Automation were repair, machinery, predictive/preventative maintenance, welding, and schematic diagrams. The top skills for Industrial Automation positions primarily fall into two categories: broadly grouped into maintenance, repair, and installation and manufacturing and production.

Exhibit 4: Top skills listed in online job postings



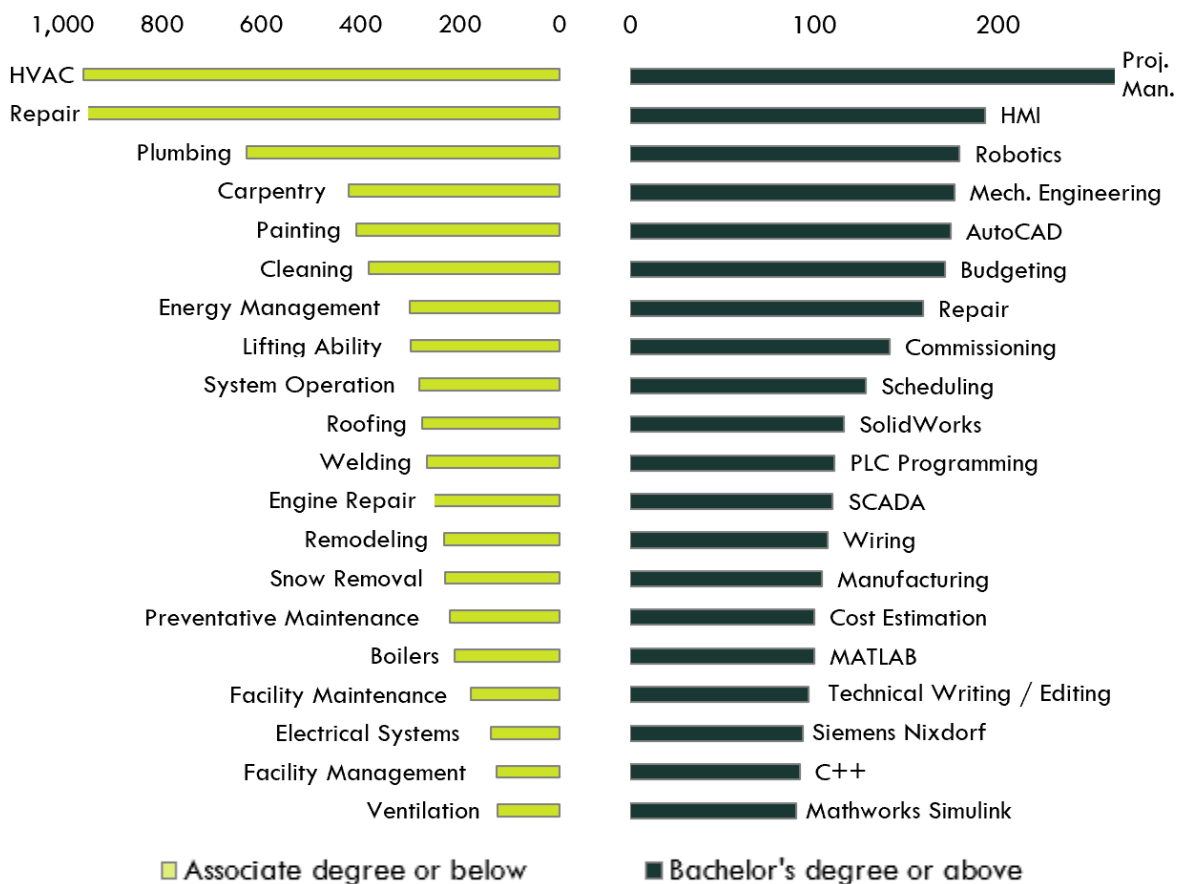
Skills by Education Level in Online Job Postings

Because this program provides students with training in base-level automation skills, it is important to consider the skills requested in online job postings by education level to better understand the skills employers request for entry-level positions versus those they request for mid-level positions. In order to have a sufficient number of job postings to analyze, education level was separated into two groups: associate degree or less and bachelor's degree or above.

Building Automation Skills by Education Level

Comparing skills for Building Automation by education level shows that postings that request an associate degree or less are related to repair and maintenance, while postings that request a bachelor's degree or above are related to more specialized areas of automation, programming, and project management. The top five requested skills in online job postings that request an associate degree or less are HVAC, repair, plumbing, carpentry, and painting. The top five requested skills in postings that request a bachelor's degree or above are project management, Human Machine Interface, robotics, mechanical engineering, and AutoCAD. Exhibit 5 shows the top 20 requested Building Automation skills by education level.

Exhibit 5: Top 20 building automation skills listed in online job postings by education level

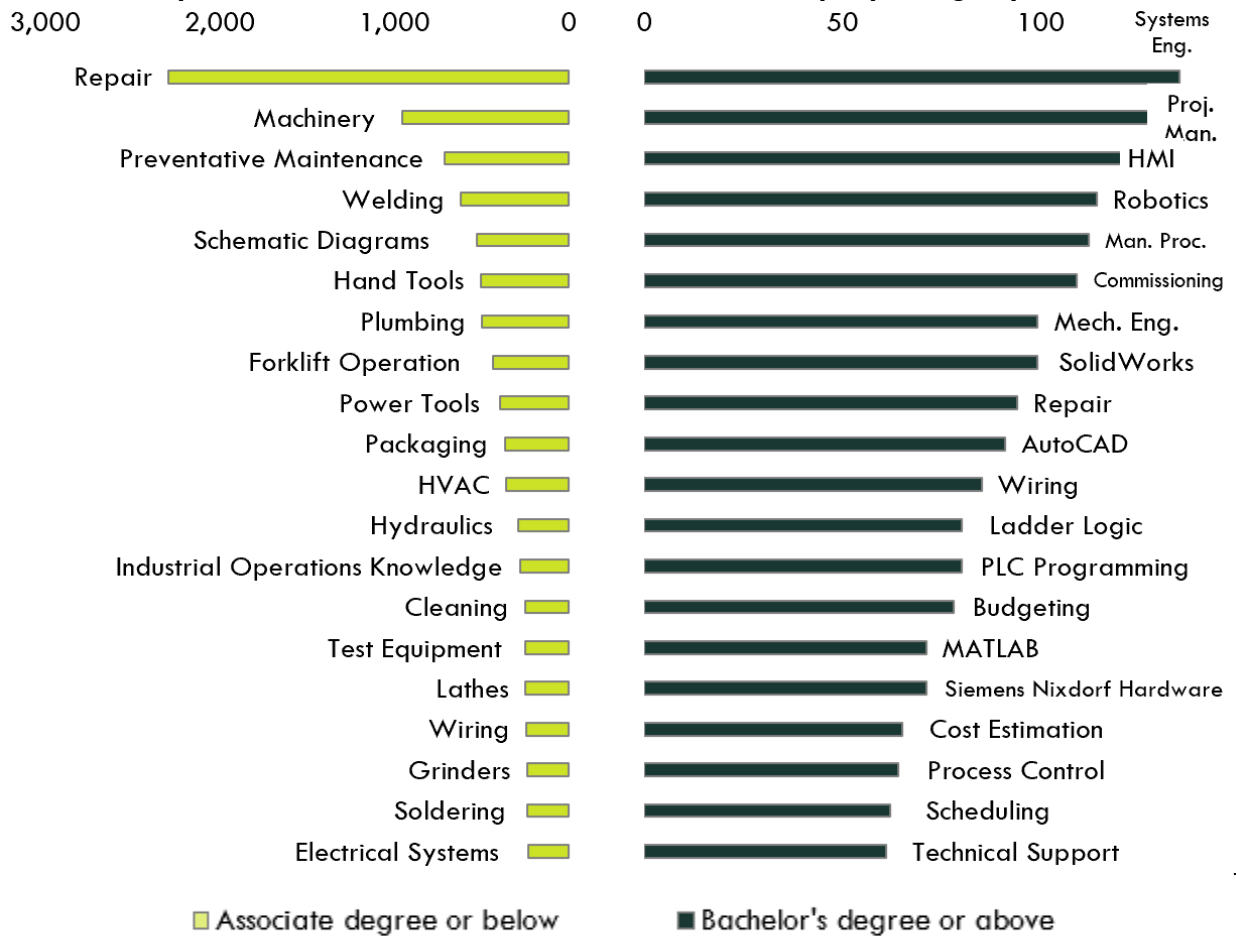


Industrial Automation Skills by Education Level

Similar to Building Automation, comparing skills for Industrial Automation by education level shows that postings which request an associate degree or less are related to maintenance and repair, while postings that request a bachelor's degree or above are related to more specialized areas of automation, programming, and project management. A notable difference from Building Automations is that online job postings for Industrial Automation tend to request skills that are more closely related to manufacturing such as packaging, forklift operation, and manufacturing processes. The top five requested skills in online job postings that request an associate degree or

less are repair, machinery, preventative maintenance, welding, and schematic diagrams. The top five requested skills in postings that request a bachelor's degree or above are systems engineering, project management, Human Machine Interface, robotics, and manufacturing processes. Exhibit 6 shows the top 20 requested Industrial Automation skills by education level.

Exhibit 6: Top 20 industrial automation skills listed in online job postings by education level



This analysis suggests that training in repair and maintenance skills could lead to a variety of entry-level job opportunities that are not exclusive to one type of automation. Training in specialized skills such as project management, Human Machine Interface, and robotics could help students advance to higher level positions. However, it is important to note that those skills are more prevalent in job postings that request at least a bachelor's degree. Students that receive community college training in the skills requested in bachelor's degree or above postings may not be able to obtain these positions due to employers' education preferences. However, employers do not always hire at the education level they request, especially if a candidate has a combination of a strong skill set and/or experience. Additionally, these skills could be valuable to incumbent workers that are looking to advance from their current positions.

Wages in Online Job Postings

Exhibit 7 shows the estimated salary from online job postings for both types of automation positions. These figures were calculated using Burning Glass's Market Salary tool, which provides

an estimate of the average salary for online job postings based on a variety of factors including location, education, skills, and experience. Burning Glass’s full definition and methodology is listed in Appendix B.

These “market salary” estimates suggest that entry-level hourly wages range from \$18.44 to \$20.16, both of which are above the living wage in both counties (\$15.04 in Los Angeles County and \$17.36 in Orange County). However, it is important to note that these figures are based on a machine learning model developed by Burning Glass and actual compensation will vary based on individual employer salary practices, education, and experience.

Exhibit 7: Advertised wages in online job postings

Job Title	Requested Education Level	Advertised Entry-Level Hourly Wages (25 th Percentile)	Advertised Median Hourly Wages	Advertised Experienced Hourly Wages (75 th Percentile)
Building Automation	Associate degree or less	\$20.16	\$24.24	\$28.18
	Bachelor’s degree or above	\$38.75	\$44.40	\$49.98
Industrial Automation	Associate degree or less	\$18.44	\$21.12	\$23.81
	Bachelor’s degree or above	\$33.62	\$42.53	\$48.14

Supply

Supply, the number of awards by educational institutions, is severely overstated because only a small number of programs have a specific emphasis on automation. Between 2016 and 2019, community colleges throughout the region conferred an average of 2,034 awards annually in programs related to the 11 automation-related middle-skill occupations identified in this report. Between 2013 and 2016, non-community college institutions conferred an average of 164 awards annually. The full list of related community college and non-community college awards are listed in Appendix A.

In order to provide a more accurate picture of supply for automation fundamentals, the following section includes supply data only for those programs that have a specific emphasis on automation.

Community College Supply—There are three colleges in Los Angeles and Orange counties with programs related to automation. Long Beach City, Mt. San Antonio, and Orange Coast offer nine automation programs across five different TOP codes. However, according to the Chancellor’s Office Curriculum Inventory (COCI), an additional five automation programs at Long Beach City were approved in 2019. Because these programs did not exist during the three years which comprise the 3-year award average, they are not included in the supply figures in this section.

Depending on their area of emphasis, automation programs may be placed under a variety of TOP codes within community colleges. Orange Coast’s automation programs are listed under the 0934.00 (Electronics and Electric Technology) TOP code, while Mt. San Antonio’s programs are listed under the 0946.10 (Energy Systems Technology) TOP code. It is important to note that

Orange Coast has non-automation programs listed under the 0934.00 TOP code. Because awards data is collected and organized by TOP code and colleges can list multiple programs under the same TOP code, awards conferred under this TOP code may not be specifically related to automation. For this reason, the three-year average of seven awards conferred by Orange Coast may be overstated for automation programs. All awards conferred under the 0946.10 (Energy Systems Technology) program at Mt. San Antonio are related to automation because Mt. San Antonio does not offer other programs under this TOP code.

Over the past 12 months, there was one other program recommendation request under the 0934.00 TOP code. Additionally, there were three other program recommendation requests related to automation. All four of these requests were from three Orange County colleges: Cypress, Fullerton, and Saddleback. These requests could fall under either automation fundamentals or one of the specialized certificate areas. Exhibit 8 shows the three-year average of awards conferred in these programs.

Exhibit 8: Regional community college awards (certificates and degrees), 2016-2019

TOP Code	Program	College	2016-2017 Awards	2017-2018 Awards	2018-2019 Awards	3-Year Award Average
0934.00	Electronics and Electric Technology	Orange Coast	7	11	4	7
		OC Subtotal	7	11	4	7
		Subtotal/Average	7	11	4	7
0946.10	Energy Systems Technology	Mt. San Antonio	2	7	4	4
		LA Subtotal	2	7	4	4
		Subtotal/Average	2	7	4	4
Supply Total/Average			9	18	8	12

Appendix A: Sources

Exhibit 9 shows traditional labor market data, including occupational demand, wages, and supply for 11 middle-skill occupations related to automation.

Note of caution when reading the traditional labor market data: While the Automation Fundamentals Certificate will teach skills that can lead to a variety of occupations, not all positions within these occupations will have an automation focus, so demand is greatly overstated for automation roles. Similarly, supply figures include programs that do not have a specific emphasis on automation, so supply for automation positions is greatly overstated.

Exhibit 9: Occupational demand, wage, and supply data in Los Angeles and Orange counties

Occupation (SOC)	Annual Openings	Entry-Level Hourly Earnings (25th. Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75th. Percentile)	TOP/CIP Code	TOP/CIP Title	Average Annual Awards (2016-2019)*	Supply
Electrical and Electronics Engineering Technicians (17-3023)	566	\$21.42	\$28.74	\$37.74	0924.00	Engineering Technology, General	184	966
					0934.00	Electronics and Electric Technology	334	
					0934.10	Computer Electronics	87	
					0934.30	Telecommunications Technology	34	
					0934.40	Electrical Systems and Power Transmission	57	
					0952.20	Electrical	171	
					15.0000	Engineering Technology, General.	32	
					15.0303	Electrical, Electronic and Communications Engineering Technology/Technician.	42	
					15.1201	Computer Engineering Technology/Technician.	9	

Occupation (SOC)	Annual Openings	Entry-Level Hourly Earnings (25th. Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75th. Percentile)	TOP/CIP Code	TOP/CIP Title	Average Annual Awards (2016-2019)*	Supply
					15.0305	Telecommunications Technology/Technician.	-	
					46.0301	Electrical and Power Transmission Installation/Installer, General.	16	
					46.0302	Electrician.	-	
Electro-Mechanical Technicians (17-3024)	94	\$24.96	\$29.10	\$34.57	0935.00	Electro-Mechanical Technology	2	2
					0943.00	Instrumentation Technology	-	
					15.0499	Electromechanical and Instrumentation and Maintenance Technologies/Technicians, Other.	-	
					15.0404	Instrumentation Technology/Technician.	-	
Environmental Engineering Technicians (17-3025)	116	\$18.28	\$22.91	\$29.41	0303.00	Environmental Technology	35	35
					15.0507	Environmental Engineering Technology/Environmental Technology.	-	
Industrial Engineering Technicians (17-3026)	167	\$24.15	\$34.72	\$44.56	0924.00	Engineering Technology, General	Already accounted for	105
					0934.20	Industrial Electronics	0	
					0956.00	Manufacturing and Industrial Technology	67	

Occupation (SOC)	Annual Openings	Entry-Level Hourly Earnings (25th. Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75th. Percentile)	TOP/CIP Code	TOP/CIP Title	Average Annual Awards (2016-2019)*	Supply
					15.0000	Engineering Technology, General.	Already accounted for	
					15.0612	Industrial Technology/Technician.	34	
					15.0613	Manufacturing Engineering Technology/Technician.	4	
Mechanical Engineering Technicians (17-3027)	159	\$22.81	\$30.11	\$37.37	0924.00	Engineering Technology, General	Already accounted for	127
					0945.00	Industrial Systems Technology and Maintenance	127	
					15.0000	Engineering Technology, General.	Already accounted for	
					15.0805	Mechanical Engineering/Mechanical Technology/Technician.	-	
Electrical and Electronics Repairers, Commercial and Industrial Equipment (49-2094)	190	\$20.30	\$27.59	\$37.10	0934.00	Electronics and Electric Technology	Already accounted for	27
					0934.10	Computer Electronics	Already accounted for	
					0934.20	Industrial Electronics	Already accounted for	
					47.0101	Electrical/Electronics Equipment Installation and Repair, General.	-	
					47.0104	Computer Installation and Repair Technology/Technician.	27	
					47.0105	Industrial Electronics Technology/Technician.	-	

Occupation (SOC)	Annual Openings	Entry-Level Hourly Earnings (25th. Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75th. Percentile)	TOP/CIP Code	TOP/CIP Title	Average Annual Awards (2016-2019)*	Supply
Heating, Air Conditioning, and Refrigeration Mechanics and Installers (49-9021)	1,294	\$18.87	\$26.95	\$36.46	0946.00	Environmental Control Technology	453	505
					0946.10	Energy Systems Technology	52	
					15.0501	Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technology/Technician.	-	
					15.0503	Energy Management and Systems Technology/Technician.	-	
Industrial Machinery Mechanics (49-9041)	838	\$19.47	\$25.31	\$32.50	No match	N/A	-	0
					No match	N/A	-	
Maintenance Workers, Machinery (49-9043)	196	\$19.23	\$25.30	\$31.20	No match	N/A	-	0
					No match	N/A	-	
Maintenance and Repair Workers, General (49-9071)	5,700	\$14.85	\$19.45	\$26.25	No match	N/A	No match	-

Occupation (SOC)	Annual Openings	Entry-Level Hourly Earnings (25th. Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75th. Percentile)	TOP/CIP Code	TOP/CIP Title	Average Annual Awards (2016-2019)*	Supply
Water and Wastewater Treatment Plant and System Operators (51-8031)	243	\$28.81	\$36.65	\$45.81	0958.00	Water and Wastewater Technology	418	418
					15.0506	Water Quality and Wastewater Treatment Management and Recycling Technology/Technician.		
Total	9,564							2,198

*Due to different data collection periods, the most recent three-year period of available data for CIP programs is from 2013 to 2016.

Appendix B: Burning Glass Market Salary Explanation

Burning Glass's definition and methodology for Market Salary calculations are included below. This definition was pulled from Burning Glass's data dictionary on February 27, 2020:

What is this? This is Burning Glass's estimate of the average salary for job postings in this occupation and geography. Actual compensation may vary based on individual employer salary practices and experience.

How is it calculated? Market Salary is calculated using a machine learning model built off of millions of job postings every year; and accounting for adjustments based on 1) locations 2) industry 3) skills and experience and 4) education requirements (among other variables). To develop the Market Salary model, we first built a training set of 5 million postings from the last two years which have advertised salaries from employers. Then we use those data to train a neural network machine learning model which can predict the salaries for the remaining job postings. The model uses the following inputs to predict a salary: job title; occupation; location; employer; industry; education level; skills and experience. To evaluate the performance of the model we tested it against a set of job postings which have advertised salaries but were not part of the training set. The average error or difference between the advertised salary of a job and the predicted base salary for each posting was \$3.8K per year. This model meets or exceeds the performance of similar models published by other job data providers including LinkedIn; Payscale; and Adzuna.

How is it helpful? Market Salary provides insight into the likely salary workers within a specific occupation; as well as further detail on the impact on salary of additional skills.

Appendix C: Sources

- O*NET Online
- Labor Insight/Jobs (Burning Glass)
- Economic Modeling Specialists, International (Emsi)
- Bureau of Labor Statistics (BLS)
- Employment Development Department, Labor Market Information Division, OES
- Employment Development Department, Unemployment Insurance Dataset
- Living Insight Center for Community Economic Development
- California Community Colleges Chancellor's Office Management Information Systems (MIS)
- California Family Needs Calculator, Insight Center for Community Economic Development
- Chancellor's Office Curriculum Inventory (COCI 2.0)

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