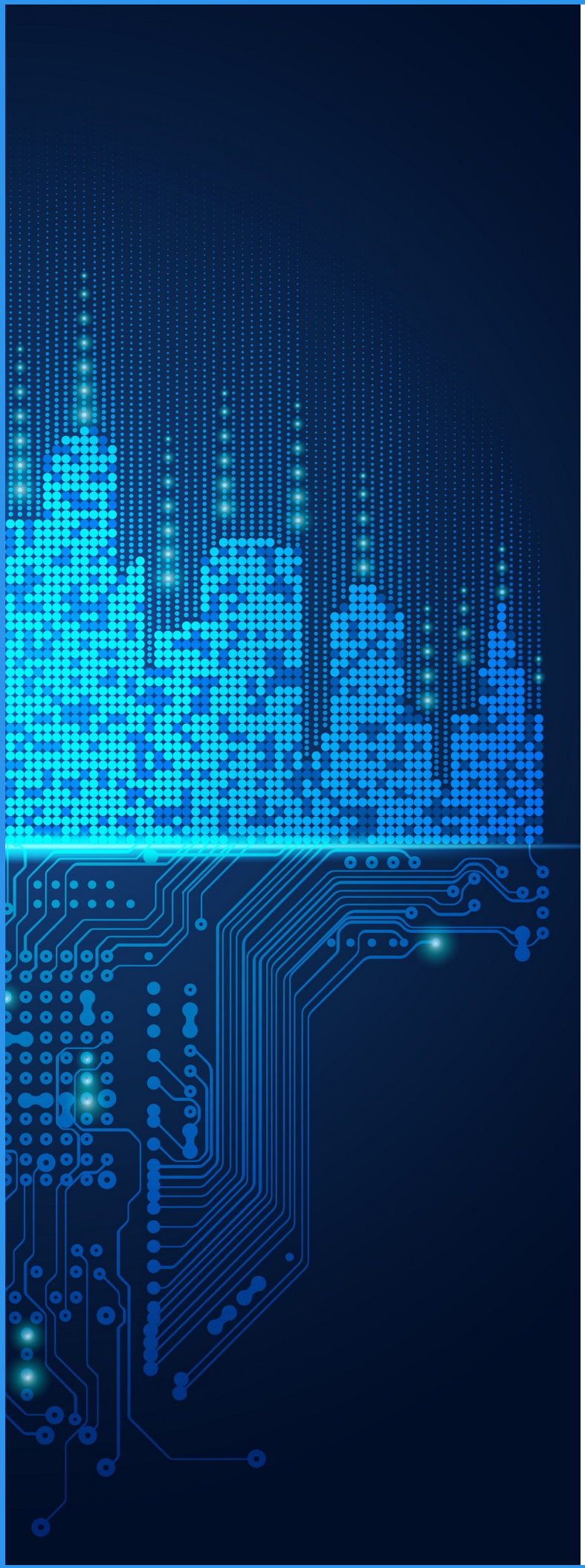

Assessment of Automation Employment Opportunities

Preparing 21st Century Automation Professionals

A Regional Perspective

Los Angeles County, CA
Orange County, CA

Research Report Summary

Prepared By

acp
Association Of Controls Professionals

Preface

Most studies and reports published by reputed organizations, governments, and think tanks present broad-based information on impacts of automation or AI on workforce needs of the 21st century. Lack of availability of data and lack of studies conducted on assessment of automation employment opportunities at the state or regional levels present challenges among key stakeholders (such as educational institutions, businesses, industries, economic development organizations, government, etc.) to prepare skilled professionals for 21st-century jobs.

This customized summary report is based on results and outcomes of a study conducted to characterize building automation systems and industrial automation controls (using programmable logic controllers as proxy) marketplace opportunities in Los Angeles and Orange counties, CA. The scope of this study serves an acute need for characterizing regional automation opportunities, often hidden behind confusing jargon resulting from marginally-defined career pathways into this emerging field.

Results of this study may provide some clarity on the part of job-seekers, program developers, and employers, as to how many opportunities exist, required skills of the positions, employment trends, and terminology used in job postings.

The research was led by Dr. Sudeep Vyapari, Executive Vice President and by Brian J. Lovell, President of the Association of Controls Professionals (ACP). This report contributes to ACP's mission to help building automation and controls stakeholders understand the factors transforming the global economy, identify strategic locations, and prepare skilled professionals for the 21st-century automation workforce.

This pilot study was funded by Energy, Construction & Utilities – California Community Colleges Economic Development. We are grateful for the support and guidance received from Mr. Jim Caldwell, Statewide Sector Navigator, ECU Sector (retired), Mr. Gregg D. Ander, FAIA Senior Fellow - Navigant Consulting, and Mr. Terry Schmidt, Adjunct Faculty & Consultant. We are grateful to Dr. Caitlin Faas, Assistant Professor - Mount St. Mary's University for her professional consultancy and services pertaining to the statistical and data analysis of the study.

We welcome your comments on this research at sudeep@acprofessionals.org.

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LOS ANGELES

Association of Controls Professionals

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Executive Summary

Automation and 21st-century Workforce

Application of automation or artificial intelligence (AI) for optimizing productivity began in the mid-20th century. Machine learning, a subset of AI, significantly contributed to rapid acceleration of the automation due to increased availability, storage, analysis and processing of big data.

Over the course of the past decade numerous reports and studies discussed the future of work in the automated workplace. Implications and impacts of automation on the 21st-century workforce, globally and in the United States, range from hopeful scenarios of enhanced employment opportunities to fear of losing occupations. Notwithstanding realities associated at both ends of the spectrum, better data and analysis is required to characterize workforce opportunities as automation impacts all sectors of the economies. Importantly, for a careful planning of automated workforce, this new human-digital ecosystem requires fundamental changes in and understanding of the skills and responsibilities to be acquired by everyone across the entire organizations and operations.

Bridging the Gaps: Significance of Regional Perspective

For creating better frameworks and to understand impacts of automation at the regional level, deeper quantitative and qualitative assessments are required. Specifically, tactical strategies and action plans are necessary to overcome some of the key challenges listed below.

1. Most of the studies and reports focus on global and/or national perspectives.
2. Lack of information and clarity on adverse impacts of automation at sector-specific occupational level.
3. Characterizing regional automation employment opportunities, often hidden behind confusing jargon resulting from marginally-defined career pathways into numerous evolving fields that share and value common set of portable skills.

The goals and the outcomes of this study, conducted in the Los Angeles County, CA and Orange County, CA, bridge some key gaps as listed above. A systematic and granular approach used, to study regional employment opportunities in building automation systems and industrial automation sectors (using programmable logic controllers as proxy), provides valuable data on existing marketplace opportunities, current hiring practices, preferred education, desired experience and skills, etc. Importantly, this summary report provides key data and recommendations of interest to a group of diverse stakeholders in academia, industry and workforce organizations.

Community College Career Pathways: Stronger by Design

Greater Los Angeles, among the 100 metro cities in the nation, is experiencing shifts in workforce needs that are impacting economic as well as human resources. Home to nearly 4 million people, this significant automation employment hub in the state of California is home to 34 community colleges within a 50-mile radius of Los Angeles.

While the rapid evolution of digital workforce is inevitable, many jobs continue to provide descent salaries or wages to employees that have a 2-year or lower education. Data analysis from this study, based on 420 job profiles, sheds light on automation employment opportunities at the county level as well as in the greater Los Angeles metro area. Qualitative data obtained, based on interviews held with industry professionals, provides insightful recommendations to academia as well as workforce organizations.

This report comprises of a summary distilled from a study that provides data on various other criteria assessed. The outcomes shared in this summary report are designed to provide valuable information and data that may help community colleges in leading an effort to design and build career pathways that share a common denominator – automation.

Content

CALIFORNIA ECONOMY

California, the 3rd largest state by area, is the most populous state in the US with a current population of 39.536 million residents (2017) according to the U.S. Census Bureau. California's population is projected to surpass 40 million residents by 2019, and surpass 50 million by 2050. Much of the CA population is centered in several large cities.

Los Angeles, CA is the second largest city (population 3.999 million, 2017), and the Los Angeles County is the largest county (population 10.16 million, 2017) in the US. As of May 2018 the Golden State (CA) was ranked as the fifth largest economy in the world by the U.S. Department of Commerce. California's $2.7 trillion economy is the largest in the United States, and represents 14% of the U.S. economy. California's outlook is bright with economic and job growth both expected to be strong over the next five years.

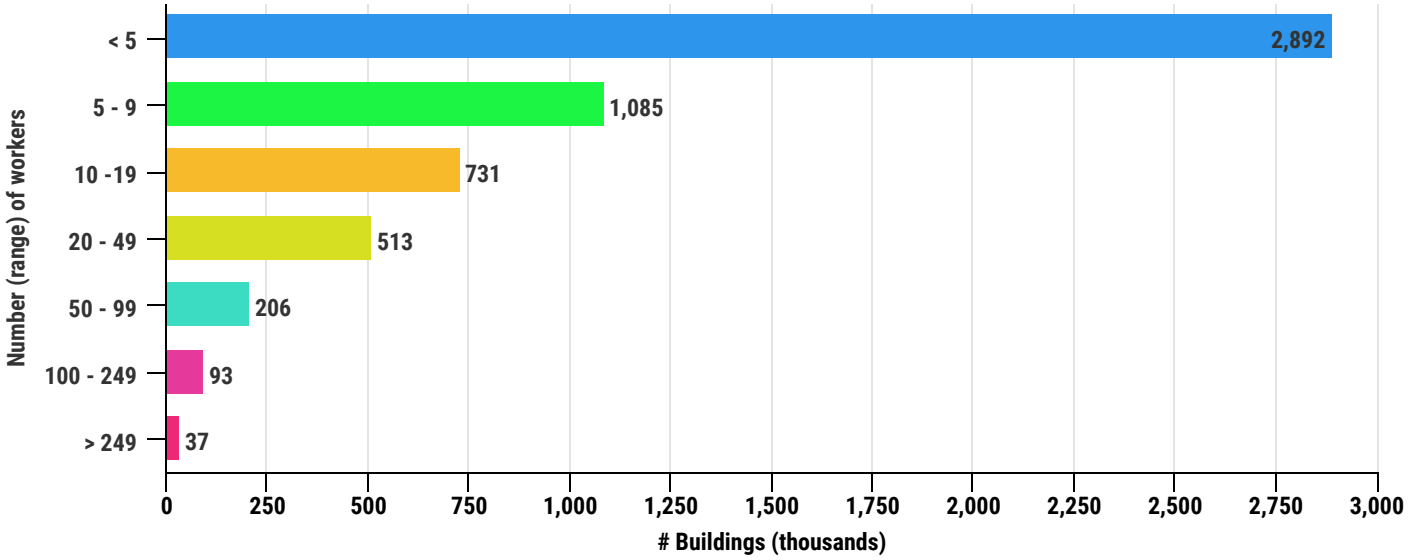
BUILDINGS BY NUMBERS

April 8, 2019
Data collection began for the 2018 CBECS survey

According to the United States Energy Information Administration Commercial Buildings Energy Consumption Survey (CBECS) report (2016) there were a total of 5.6 million commercial buildings in the United States as of 2012, covering a total of 87 billion square feet of floor space. Of the total # of buildings, 59% were heated and 43% were cooled. Further, the study also reports that the newer buildings tend to be larger than the older buildings and the average size of new commercial buildings continues to grow. Commercial buildings constructed between 2000 – 2012 on an average were 19,000 square feet whereas, those constructed between 1960 - 1999 on an average were 16,300 square feet (2015).

In terms of employment size, the following figure provides number of workers (range of employees) occupying a total of 5.6 million buildings, as of 2012. In 2018, CBECS began a survey to update the numbers from 2012.

Employment size category, number of buildings (2012 CBECS Survey)



COMMERCIAL BUILDINGS IN CALIFORNIA

In 2016, according to a report published by Calmatters, CA Energy Commission data on # of commercial buildings in CA included 600,000 commercial buildings, and a total of 65,800 local or state government, school, and college buildings. The United States General Service Administration (GSA) states that in the Pacific Rim (Region 9) of the federal buildings and facilities, which includes the state of California, there are 177 government-owned buildings and leased spaces in 908 commercial buildings totaling 36.5 million square feet.

Growth in building automation technologies and related industries sectors will impact many aspects of the business of building technologies, including human resources engaged in the profession. From retrofitting of old buildings, management of existing buildings to new construction, the building automation industries will require a workforce that is agile and prepared to efficiently use the technologies for optimal returns on energy and other investments. Educational institutions, particularly high schools and 2-year colleges, have a pivotal role in shaping career pathways that can prepare a 21st century-ready workforce for a thriving building automation sector economy.

IMPACT OF SHIFTS FROM HUMANS TO DIGITAL WORKFORCE

March, 2019

U.S. Government Accountability Office submits a 84-page report to collect better data for assessment of the impacts of AI on workforce to the U.S. House Committee on Ways and Means.

A recent study by Brookings Institution (2019) on *Automation and Artificial Intelligence: How machines are affecting people and places* provides an analysis of the impacts of automation in the past (1980 – 2016) and the coming trends (2016 – 2030). A thorough assessment, based on 800 occupations, details affects on people and communities across the United States. According to the study approximately 25% of U.S. employment (32 million jobs in 2016) will face high exposure to automation, with 70% of the current task content at a risk of substitution.

While automation risks vary from region to region and state by state, the 108 page report provides key data on average share of tasks susceptible to automation in a given metro area. Of the current total number of metro area jobs in the Los Angeles-Long Beach-Anaheim region (5,981,130), almost 46% share of tasks are susceptible to automation. Other metropolitan areas in California may experience share of risks ranging from a low of 40.4% (San Jose-Sunnyvale-Santa Clara) to a high of 48.3% each in Stockton-Lodi and Sacramento-Roseville-Arden-Arcade. Overall, among the top 100 U.S metro areas at risks, where in the Toledo, OH ranked #1 with highest risk (49% average automation potential), the Los Angeles-Long Beach-Anaheim region is ranked at #53 (45.6% average automation potential).

BUILDING AUTOMATION AND SMART CITIES

Automation, also referred to as intelligent automation (IA) and artificial intelligence (AI) are driving the agile workforce shaping process (traditionally known as strategic workforce planning), to help businesses transform themselves with a nimble and productive workforce for optimizing survival and growth in a rapidly advancing technological era. In a recent article in Forbes, James McPhail (CEO, Zen Ecosystems) writes that the smart city development spending is estimated to reach $41 trillion worldwide between 2016 and 2036.

The significance of smart city investments, as compared with the current global economy valued at $74 trillion, provides a clear context and the importance of an ecosystem within which building automation fits in, since the $41 trillion includes investments in existing infrastructure and implementation of internet of things (IoT) technologies to connect the urban ecosystem. Considering that cities are currently consuming more than 65% of world's energy, the new paradigms of thinking and applying knowledge depend upon operating more intelligently and efficiently to help mitigate total emissions. Innovative leaders are impacting the growth and progress of these investments and guiding our cities toward a smarter future.

EDUCATION, EXPERIENCE, KNOWLEDGE AND SKILLS IN THE AUTOMATION ERA: NEXUS OF RELEVANCY

Automation is heralding a renewed race between education and technology. A study published in 2016 by Goldman Sachs Global Markets Institute, Narrowing the Job Skills Gap: Overcoming Impediments to Investing in People recommends that workers must stay one step ahead of the machines by landing an "adaptive" career. Adaptive occupations, according to the study, frequently involve human interactions and social skills that offer better chances for job security. McKinsey Global Institute (2017) report on *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation*, states that while 30 percent of constituent work activities in 60 percent of occupations could be automated, IA will also create new occupations that do not exist today. Globally, up to 375 million people may need to shift their occupations, with the highest share in advanced economies. Investments in infrastructure and buildings may create up to 200 million new jobs, as investments in energy sector may create 20 million new positions.

Empathy

Critical skill in the automation era for effective management of human resources

Design and development of relevant career opportunities offered by post-secondary institutions are not keeping pace with the velocity at which automation is being integrated across numerous industries. The skills demanded by the labor market are evolving. Employers are demanding more flexible workers able to function at a high level. They are also demanding greater non-routine cognitive tasks, and there is also a growing demand for social skills.

In response to a survey conducted by the Pew Research Center and Elon University (2016), 70% of the 1,408 respondents stated affirmatively (yes) that by 2026 they will see the emergence of new educational and training programs that can successfully train large numbers of workers in the skills they will need to perform the jobs of the future alongside AI. The respondents suggest that workers of the future will require enhanced skills to cultivate and exploit creativity, collaborate, be systems thinkers, handle complex communication, and be able to thrive in diverse environments. The report by McKinsey (2017) also finds that in general the current educational requirements of the occupations that may grow are higher than those for the jobs displaced by automation. In advanced economies, occupations that currently require only a secondary education or less see a net decline from automation, while those occupations requiring college degrees and higher will grow. Increasing investments in education and workforce training will be a priority across developed and developing nations.

Workers of the future will spend more time on activities that machines are less capable of, such as managing people, applying expertise, and communicating with others. They will spend less time on predictable physical activities, and on collecting and processing data, where machines already exceed human performance.

AUTOMATION READINESS INDEX: ARE WE PREPARED?

A report by the Intelligence Unit of The Economist (2018) provided Automation Readiness Index measure of countries' preparedness for the coming wave of intelligent automation. The index, based on 52 indicators (both qualitative and quantitative), provides a snapshot of 25 countries and their current government-led efforts to anticipate the resulting changes and shape the outcomes of technological progress. The outlook of this covers the next 20-30 years, in which augmentation and substitution of human activity are expected with the adoption of more autonomous technologies in all areas of the economy and society. Some of the key observations of the study are summarized below in the following figure.

Defining Building Automation Systems (BAS)

Technical definitions describe Building Automation Systems (BAS), otherwise known as Building Management System (BMS), as a system or set of systems, that provides automated control and monitoring within a building. BAS, a network of microprocessor based wired or wireless controllers connected to diverse systems in a building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems provide access to information on equipment performance and utility metering, and gives users the ability to easily schedule equipment and control it at a more granular level.

From the workforce perspectives, it is prudent to state that BAS is an ecosystem of occupations comprising of diverse jobs that must be accurately classified to provide objective and clear definitions of responsibilities, skills, duties, tasks, and authority level of a job (Vyapari, 2019 pending publication).

Based on the occupational profiles provided by Employment Development Department, State of California (2019) and data gleaned from ACP's research, the following 16 are among the BAS occupational ecosystem jobs. The Bureau of Labor Statistics (BLS) of the United States Department of Labor (DoL) maintains and provides detailed occupational statistics on each one of these 16 occupations.

BAS occupational ecosystem: List of some diverse, yet interdependent occupations with portable skills

Heating / Air Conditioning and Refrigeration Workers (SOC CODE 49-9021)	Sheet Metal Workers (SOC CODE 47-2211)	Career / Technical Education, Secondary Schools (SOC CODE 25-2032)	Construction and Building Inspectors (SOC CODE 47-4011)
Maintenance and Repair Workers, General (SOC CODE 49-9071)	Mechanical Engineers (SOC CODE 17-2141)	Mechanics, Installers and Supervisors (SOC CODE 49-1011)	Sales Engineers (SOC CODE 41-9031)
Vocational Education Teachers, Postsecondary (SOC CODE 25-9411)	Electrical and Electronic Engineering Technicians (SOC CODE 17-3023)	Electricians (SOC CODE 47-2111)	Security and Fire Alarm Systems Installers (SOC CODE 49-2098)
Stationary Engineers and Boiler Operators (SOC CODE 51-8021)	Industrial Engineering Technicians (SOC CODE 17-3026)	Solar Photovoltaic Installers (SOC CODE 47-2231)	Wind Turbine Service Technicians (SOC CODE 49-9081)

867
# of detailed occupations in 2018 with Standard Occupational Classification (SOC) codes assigned by the BLS.

PAYING ATTENTION TO CHALLENGES: STRONGER BY DESIGN

Existing employment opportunities in building automation systems (BAS), and related career pathways, have greatly expanded in the past decade. Once considered a niche career under the Heating, Ventilation, and Air-Conditioning (HVAC) field, BAS systems now serve a broad and central role in mid- to large-sized facilities, analogous to the central nervous system in the human body. Centrality of the field offers students a plethora of career pathway opportunities, each enhanced through acquisition of BAS competencies.

The evolving landscape of automation and associated impact on the 21st-century-ready workforce is being discussed from regional to global levels by organizations, industries, businesses, government and educators. Often, lack of accurate information leads to speculations, confusions and concerns. It is, thus, prudent to identify the challenges and not underestimate potential threats. The following summary, based on studies by the Association for Advancing Automation (2017) and by McKinsey (2018) sheds light on 6 key automation related challenges.

6 Automation Related Challenges

Key skills required to overcome the barriers

1 Demand for advanced technological skills such as programming will grow rapidly. The skills gap study conducted by the Association for Advancing Automation showed an increasing skills gap with as many as two million jobs going unfilled in the manufacturing industry alone in the next decade.

Advanced Technology Skills

2 Growth of demands for social, emotional, and higher cognitive skills, such as creativity, critical thinking, and complex information processing will outpace the supply.

Emotional Cognitive Social Skills

3 Demand for physical and manual skills will decline, putting additional pressure on the already existing workforce-skills challenge, as well as the need for new credentialing systems. Innovative solutions that can match the scale of the challenge will be needed.

Scaling Up Innovative Solutions

4 The occupational mix shifts will likely put pressure on wages. The risk is that automation could exacerbate wage polarization, income inequality, and the lack of income advancement that has characterized the past decade across advanced economies, stoking social, and political tensions.

Equitable Wages

5 Declining spending on education and training. Spending on worker transition and dislocation assistance has also continued to shrink as a percentage of GDP in the Organisation for Economic Cooperation and Development countries. Bridging the skills gap with innovative training approaches was identified as a priority.

Fund Training & Education

6 The report by the Association for Advancing Automation also highlights changing job titles and how they reflect changing tasks. In the automation age, as in the computer age before it, job titles shift to reflect the impact of technology. The study concluded that occupations that have 10% more new job titles grow 5% faster.

Define Characterize Jobs

Automation related challenges listed above were summarized from two studies. A study conducted by the Association for Advancing Automation (2017) and an article by McKinsey (2018).

BAS OCCUPATIONAL ECOSYSTEM: CALIFORNIA OCCUPATIONAL DATA

A plethora of career pathways are closely related to the competencies taught in BAS curriculum. Some of these include HVAC technicians, electricians, stationary engineers, industrial engineering technicians, solar installers, and others. the Association of Controls Professionals (ACP) is finding through research that BAS skills are becoming commonly cited in various fields, which helps to explain the large numbers of positions found during searches.

The following data provided by the Employment Development Department, State of California (2018) and by the United States Bureau of Labor Statistics (2018), represent a number of viable career pathways, within well-established vocations, for prospective employees with building automation skills sets. Wind and solar technicians, projected to be among the fastest growing job occupations through 2026, are among those requiring BAS skill sets.

BAS occupational ecosystem data, California: Employment and Wages (2016-2026)

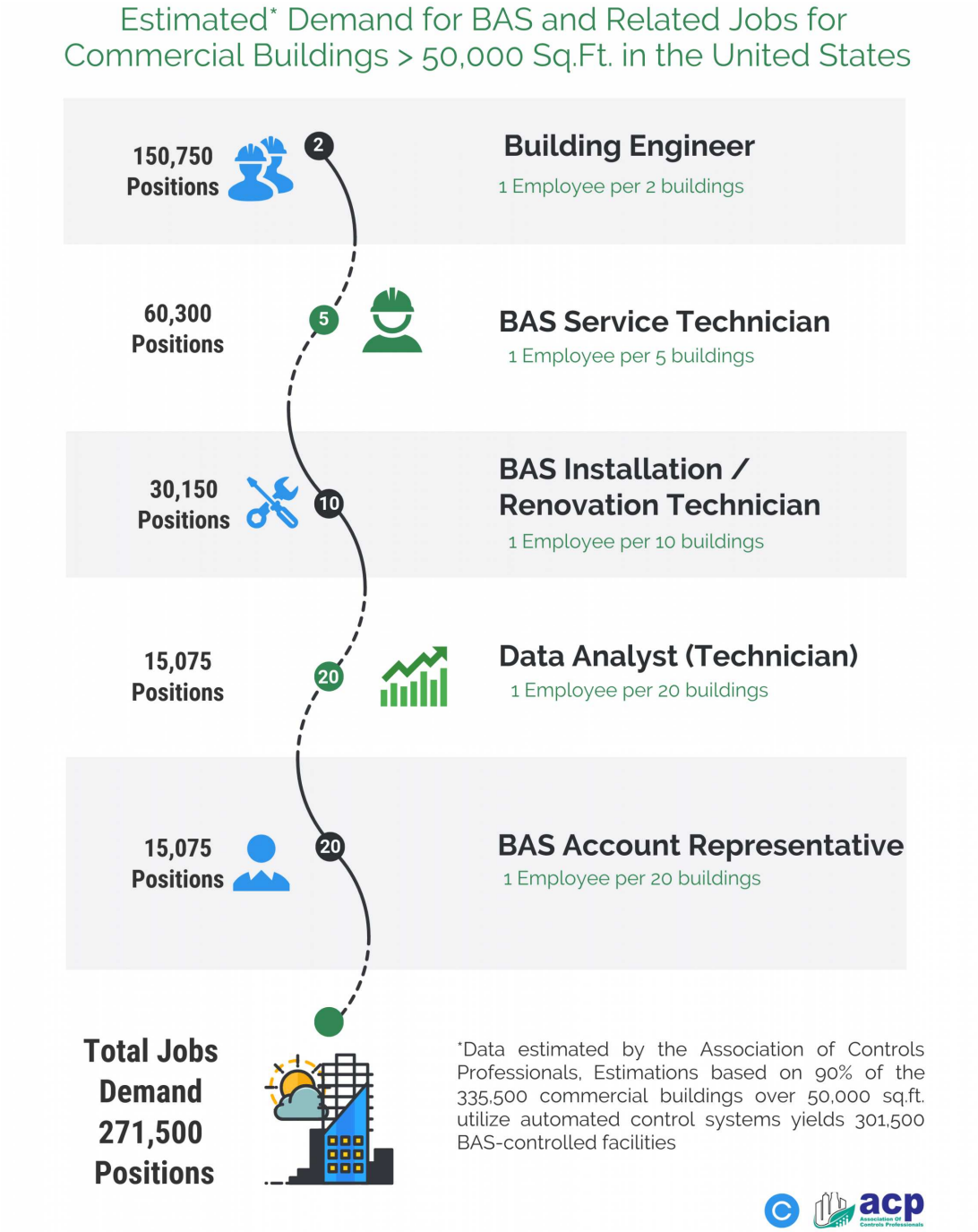
Occupation Title	Average Annual Openings	Estimated Employment (2016)	Projected Employment (2026)	Employment Change Rate (%)	Hourly Mean Wage ($)	Employers Expect
Career / Technical Education, Secondary Schools	330	4,300	4,600	7%	Not Available	Bachelor's degree
Construction and Building Inspectors	1,420	11,700	12,900	10.3%	$43.87	Work experience required
Electrical and Electronic Engineering Technicians	2,330	24,500	26,300	7.3%	$33.12	Associate's degree
Electricians	8,700	67,100	76,000	13.3%	$33.91	Long term on-the-job training
Heating/Air Conditioning and Refrigeration Workers	3,530	28,600	34,200	19.6%	$28.31	Post secondary vocational training
Industrial Engineering Technicians	380	4,000	4,300	7.5%	$33.68	Associate's degree
Maintenance and Repair Workers, General	14,040	126,400	139,000	10%	$22.30	Long term on-the-job training
Mechanical Engineers	1,890	25,200	27,800	10.3%	$52.52	Bachelor's degree
Mechanics, Installers and Supervisors	3,900	40,600	44,100	8.6%	$39.27	Work experience required
Sales Engineers	1,330	11,500	12,700	10.4%	$58.12	Bachelor's required
Security and Fire Alarm Systems Installers	980	7,300	8,600	17.8%	$25.18	Post secondary vocational training
Sheet Metal Workers	1,650	13,500	15,200	12.6%	$27.54	Moderate term on-the-job training
Solar Photovoltaic Installers	1,480	4,900	11,300	130.6%	$22.69	Moderate term on-the-job training
Stationary Engineers and Boiler Operators	440	3,900	4,200	7.7%	$41.38	Long term on-the-job training
Vocational Education Teachers, Postsecondary	1,000	11,600	12,500	7.8%	$34.87	Post secondary vocational training
Wind Turbine Service Technicians	Not available	Not available	Not available	Not available	$28.13	Moderate term on-the-job training

BAS JOBS: AN ADMISSIBLE MODEL FOR ACTUAL DEMAND

In 2016, the HVACR Workforce Development Foundation and the U.S. Department of Labor (DoL) estimated that 115,070 new HVACR workers must be trained by 2022 to meet an anticipated 14% growth rate in this occupation. According to the Advanced Energy Economy (2018), the state of California employs 542,100 workers in the advanced energy sectors. Of which, 310,400 (57%) were employed in the building energy efficiency sector. The Los Angeles County (CA) and the Orange County (CA) were the top two counties in CA employing 102,900 and 57,700 workers, respectively. As reported by the Advanced Energy Economy in 2018, California led the nation in advanced energy job growth at 10% growth rate.

33%
CA employers state that it is very difficult to find qualified candidates for advanced energy jobs according to the Advanced Energy Economy.

In the absence of data from the U.S. Department of Labor on BAS jobs, most predictions on the demand are driven by the employers' needs. Data in terms of job postings by commercial search engines (such as Indeed.com, ZipRecruiter.com, Glassdoor.com and LinkedIn.com) indicate the flourishing marketplace for BAS and related jobs. To better understand the significance of BAS and related jobs and marketplace opportunities for prospective employees, ACP estimated the demand (number) of building automation professionals using the commercial building sector as a proxy. The estimations were based on certain educated assumptions. As previously stated, according to the United States Energy Information Administration (2016), there were 5.6 million commercial buildings in the United States as of 2012. The Pacific Northwest National Laboratories at the U.S. Department of Energy (2014) makes comment on this data set that "over 90% of the commercial buildings are either small-sized (< 5000 sf), or medium-sized (between 5,000 sf and 50,000 sf)" and often do not have integrated control systems due to cost". Of the remaining commercial buildings, nearly all employ some means of automated control system.



BAS WORKFORCE AND RETIREMENT: VIEW FROM AN OPPORTUNITY LENS

According to the Bureau of Labor Statistics (2018) in the US, the retirement rate for all jobs is approximately 2 percent per year, but in the technical workforce, this rate is higher. Employing a conservative estimate of 3 percent per year, additional 8,140 BAS positions per year become available due to retirements. However, this is just one modifier of BAS openings.

According to the Pacific Northwest National Laboratories (2014), a "new revolution is underway within the buildings sector (primarily the commercial buildings sector), where application-based systems are presenting an opportunity to implement strategies in which highly-optimized control, capable of constantly increasing efficiency levels while improving resource allocation". This, coupled with the migration of BAS systems into commercial buildings less than 50,000 sf, and the boom in the construction industry are causing explosive demand for new BAS technicians.

The United States Energy Information Administration (2016) records a 14% increase in commercial buildings in the ten years from 2003 through 2012. Extrapolating this growth rate of 1.4% per year from 2013 through 2022 results in new BAS technician demand of 3,800 positions per year to service buildings over 50,000 square feet. When one adds growth of BAS positions to support the 332,000 commercial buildings between 25,000 to 50,000 square feet, the number of technicians required more than doubles to over 8,000 per year. Totalizing retirement replacements with new jobs due to commercial sector growth conservatively adds 16,000 BAS-specific jobs per year in commercial buildings alone. This estimate makes no accounting for related jobs in HVAC, electrical, renewables and others which also list BAS competencies in their job postings. Thus, a multitude of jobs requiring BAS skills outpace all conservative estimates. Also, it appears from all indicators that BAS skills are becoming central to a number of building trade vocations.

HIGH SALARY / HIGH WAGE JOBS WITH 2-YEARS EDUCATION: COMMUNITY COLLEGE IS THE ANSWER

Since 1991 nearly half of the states in the US added more jobs that did not require a bachelor's degree. According to a report published in 2017 by the Center on Education and the Workforce (CWE), Georgetown University, of the 123 million workers in the economy, there are 30 million workers with good jobs that pay well without a bachelor's degree. The national median earning of these jobs is $55,000. The report states that even though these jobs do not require a bachelor's degree, some education beyond high school is needed. The largest gains of 3.2 million new good jobs were reported for workers with associate's degree. Between 1991 and 2015, the growth of good jobs in the blue-collar industries was strongest in the Western states and weakest in the Northeast.

"The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency" - Bill Gates

Automation Study

Regional Perspective

Los Angeles County
Orange County
California

Career and Technical Education

California Community Colleges

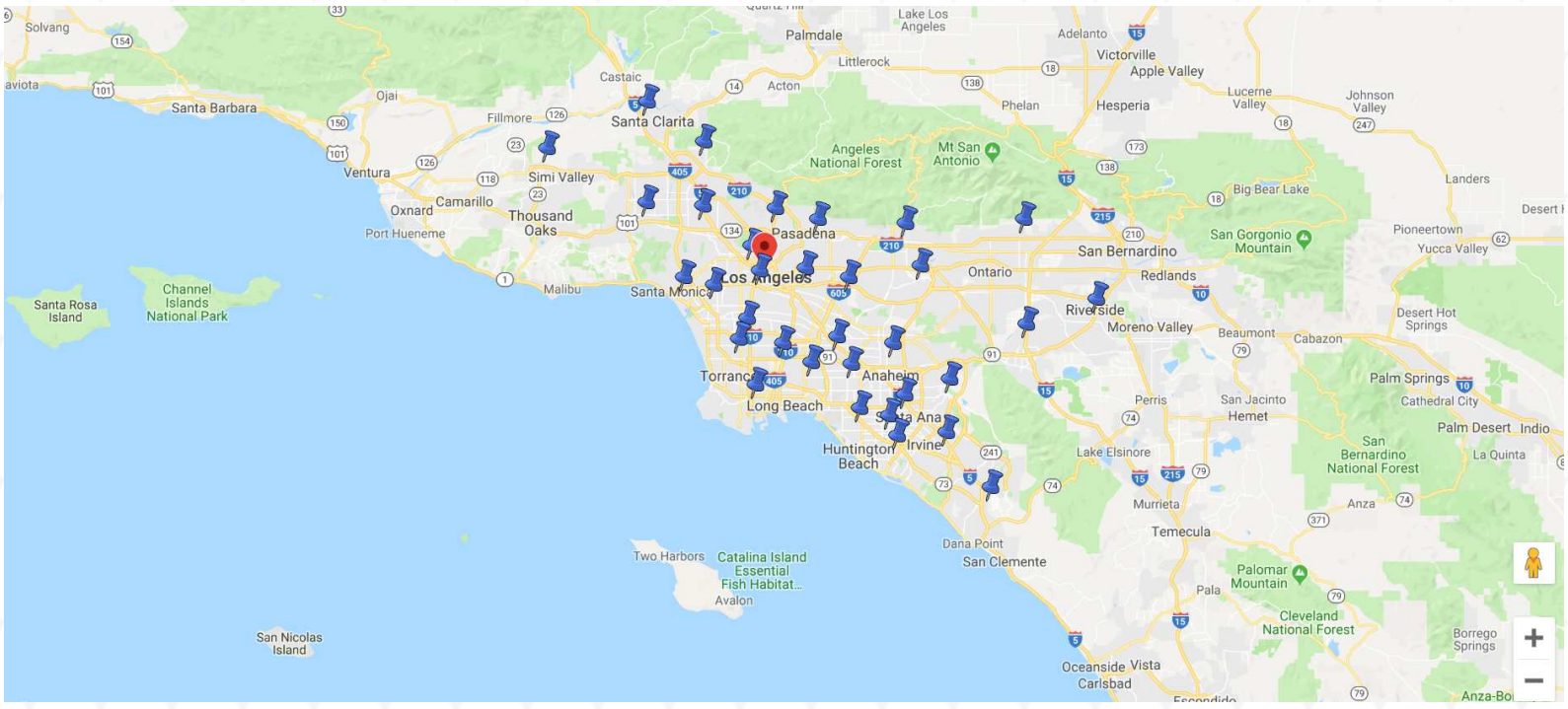
2.1 million students

115 colleges

384,377 # of course sections

50% students do not pay fees

34 Community Colleges in 50-mile Radius of Los Angeles, CA



Source https://www.cccco.edu/

acp Association Of Controls Professionals

NEED FOR THE STUDY

Most studies and reports published by reputed organizations, governments, and think tanks present broad-based information on impacts of automation or AI on workforce needs of the 21st century. Data and predictive analysis available in the reports, as mentioned above, are at a national or global scale. While the existing reports identify growth or decline in a few broad sectors of automation (such as health care and technology), sector-specific data is elusive. Further, lack of thorough assessment of the needs of the 21st century-ready automation workforce at the state or regional levels (in the United States) presents challenge among key stakeholders (such as educational institutions, businesses, industries, economic development organizations, government, etc.).

The scope of this study of automation employment opportunities in the Los Angeles County and the Orange County, CA serves an acute need for characterizing regional automation opportunities, often hidden behind confusing jargon resulting from marginally-defined career pathways into this emerging field. This study will bring some clarity on the part of job-seekers, program developers, and employers, as to how many opportunities exist, required skills of the positions, employment trends, and terminology used in job postings. Since the research will maintain focus on employment opportunities in geographic proximity in Los Angeles County and Orange County, CA, the process of research and the publication of outcomes will serve the needs of effective marketing activities for the nascent automation program at community colleges in the regions.

STUDY GOALS

Conduct comprehensive primary research focused on commercial and industrial automation employment opportunities in the Los Angeles County and the Orange County, CA.

1. Full characterization of automation employment opportunities in building automation systems (BAS) and industrial automation using programmable logic controllers (PLC) as proxy in the Los Angeles County, CA and the Orange County, CA.
2. Analysis of current employment opportunities utilizing a mixed methods approach and descriptive statistical analysis
3. Development of a matrix of automation employment opportunities vs. listed requirements for hire such as credentials, education, experience, etc.
4. Qualitative analysis of focus groups and interviews of prime automation employers in the Los Angeles County and the Orange County, CA.
5. Development of a scoping plan to widen the results and the methods of the study for application to the entire state of California

OUTCOMES DRIVEN METHODOLOGY

To comprehensively assess automation employment opportunities for BAS and PLC marketplace needs in the Los Angeles County and the Orange County, CA the following five (5) data collection strategies were used.

Quantitative data assessment for characterization of automation employment opportunities Job-specific data

Quantitative data assessment for characterization of automation employment opportunities General data

Assessment and quantification of key qualitative characteristics from job descriptions

Personal interviews and conversations with employers

Validation survey

Key Terms

BAS

Building Automation Systems (Technical) -Search term used for data collection
Technical definitions describe Building Automation Systems (BAS), otherwise known as Building Management System (BMS), as a system or set of systems, that provides automated control and monitoring within a building. BAS, a network of microprocessor based wired or wireless controllers connected to diverse systems in a building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems provide access to information on equipment performance and utility metering, and gives users the ability to easily schedule equipment and control it at a more granular level. (Diverse sources)

BAS

Building Automation Systems (Workforce)
From the workforce perspectives, it is prudent to state that BAS is an ecosystem of occupations comprising of diverse jobs that must be accurately classified to provide objective and clear definitions of responsibilities, skills, duties, tasks, and authority level of a job. (Vyapari, 2019).

G

Glassdoor.com
One of the four (4) web search engines used for data collection. Glassdoor.com provided data for greater Los Angeles(LA) only.

I

Indeed.com
One of the four (4) web search engines used for data collection. Indeed.com provided county-wise data.

L

LinkedIn.com
One of the four (4) web search engines used for data collection. LinkedIn.com provided data for greater Los Angeles(LA) only.

LA

Greater Los Angeles
Data on jobs posted by Glassdoor.com (G) and LinkedIn.com (L) search engine sources. Job location radius was set to 50 miles.

LAC

Los Angeles County
Data on jobs posted by Indeed.com (I) and Ziprecruiter.com (Z) search engine sources. Job location radius was set to 50 miles.

OC

Orange County
Data on jobs posted by Indeed.com (I) and Ziprecruiter.com (Z) search engine sources. Job location radius was set to 50 miles.

PLC

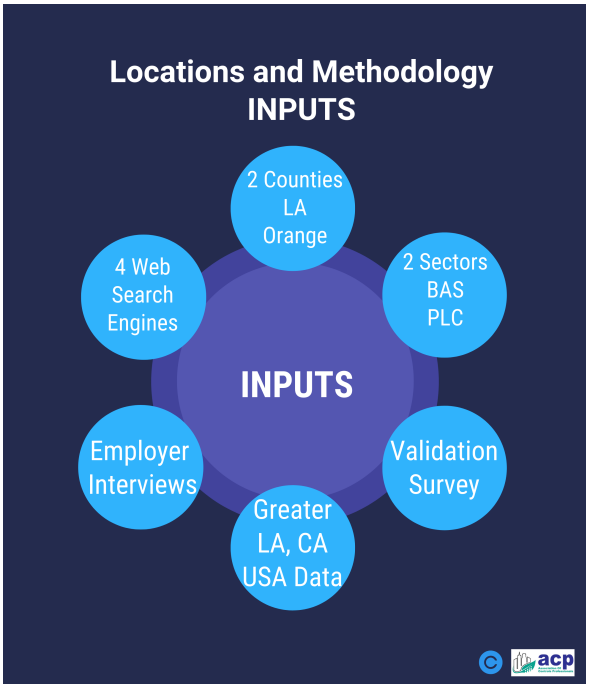
Programmable Logic Controllers - Search term used for data collection
Key term used as a proxy for data collection to assess industrial automation workforce opportunities.

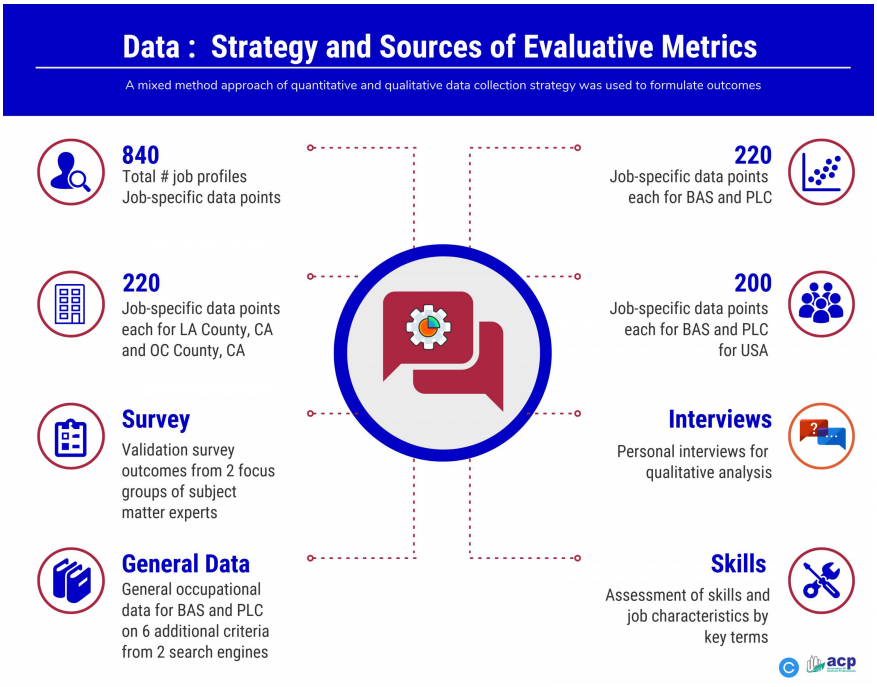
Z

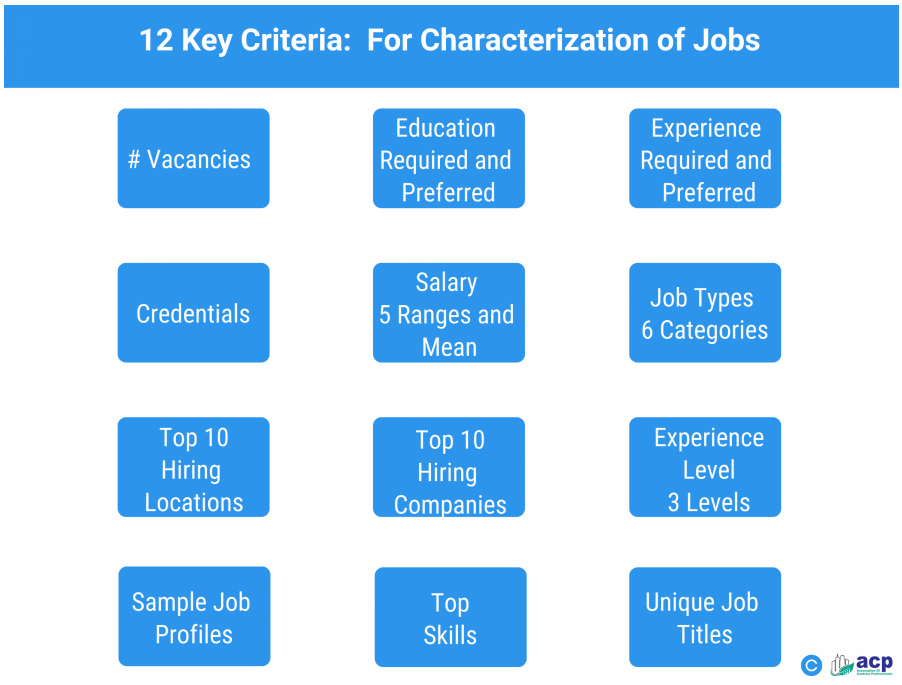
Ziprecruiter.com
One of the four (4) web search engines used for data collection. Ziprecruiter.com provided county-wise data.

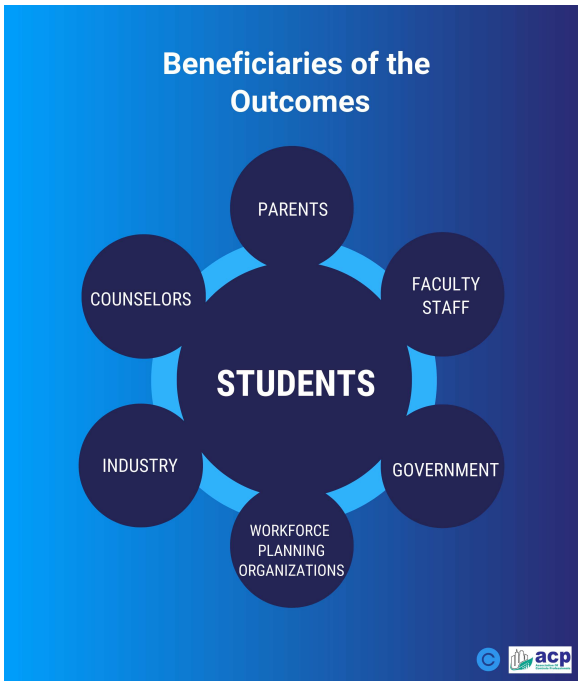
SUMMARY OF METHODOLOGY

Snapshots of inputs, metrics, specific criteria and intended audiences presented below provide the scope of the data collection strategy. Data was statistically analyzed for significance ($p < 0.05$), and recommendations were based on collective outcomes from both qualitative and quantitative assessments.



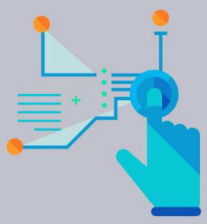






Study Goals and Key Automation Occupations

Using BAS and PLC Terms For Searching
21st -Century Automation Opportunities



BAS		PLC
Heating, Air Conditioning, Refrigeration Mechanics and Installers		Industrial Automation, General
Security and Fire System Installers		Electrical Electronics Engineering Technicians
Elevator Installers and Repairers		PLC Programmers
Construction and Building Inspectors		Hardware Engineering
Engineering Managers		Engineers, General
Control Systems, General (includes) Lighting, HVACR, Security & Access		Operations Managers, General
Management Software		Robotics and Nanotechnology

SUMMARY OF SIGNIFICANT FINDINGS

Key findings of the assessment, based upon analyses of the results, provide a clear understanding of the regional employment opportunities in the Los Angeles and the Orange counties, CA. The synopsis below focuses on usable information valued most for entry-level positions by high schools, technical colleges and associate`s (2-year) degree granting institutions.

EMPLOYMENT OPPORTUNITIES: CITY AND COUNTY PERSPECTIVE

BAS

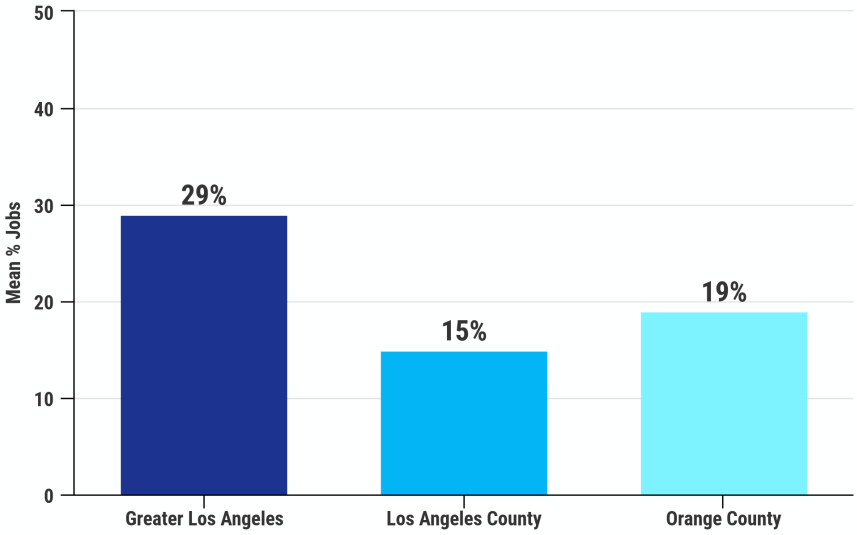
In the greater Los Angeles (LA) area, the high demand for BAS jobs is indicated by 1,285 mean # of postings appearing each day. County wise, 407 and 526 BAS mean # of postings appeared each day in the Los Angeles County (LAC) and the Orange County (OC), respectively. Over 90% the postings were Full-Time (FT) employment opportunities, and included entry-, mid-, and senior-level positions. Nearly one-half of the positions posted were mid-level BAS vacancies in both counties.

LAC and OC represent 15% and 19% of California's BAS marketplace share of job postings, respectively. When compared with the US, LAC and OC represent 3% and 4% marketplace share of job postings. The LA area represents 29% of the CA and 6% of the US BAS marketplace share of the jobs posted. Among the top cities in CA, Los Angeles ranked #4 in our study, and was not one of the top 10 ranked cities in the US. In both CA and the US, San Francisco has higher ranking and more BAS employment opportunities than LA.

6.4%

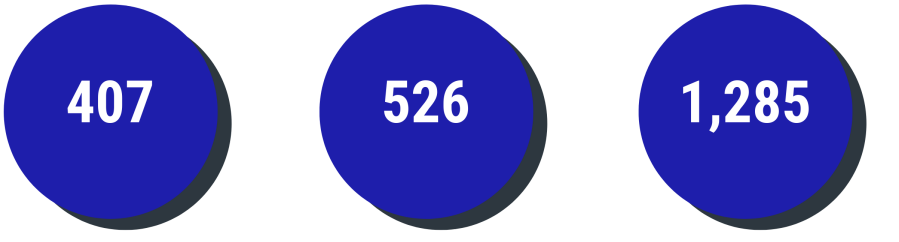
Projected growth in 2019 by the construction employment sector in Los Angeles, according to the LA Economic Development Corporation

Proportion of Mean (%) BAS Jobs in LA, LAC and OC As Compared with CA BAS Jobs Marketplace



Each bar represents an independent data point. Job search radius set to 50-miles from each location.
% calculated are based on non-duplicated numbers.
Data for Greater LA sourced from Glassdoor and LinkedIn. Data for LAC and OC sourced from Indeed and Ziprecruiter.

Mean # of Daily Vacancies Posted BAS



EMPLOYMENT OPPORTUNITIES: CITY AND COUNTY PERSPECTIVE

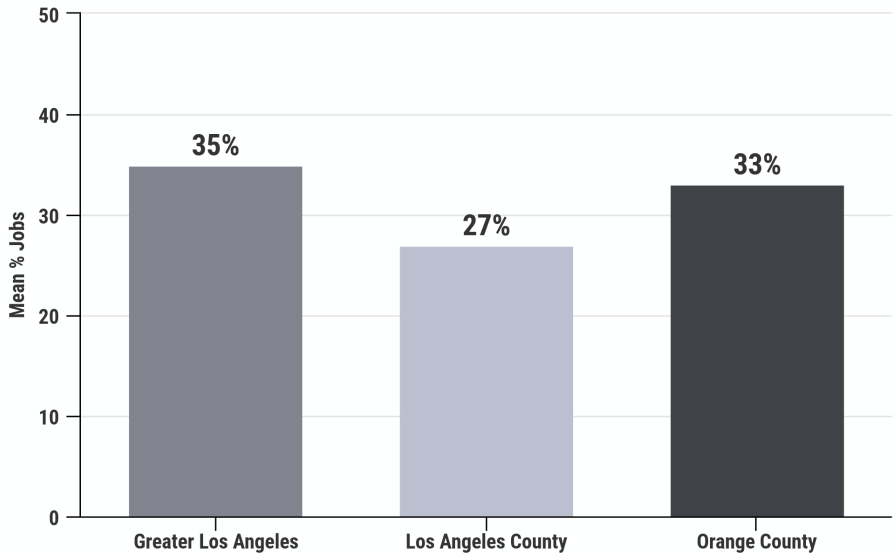
PLC

When PLC was used as a proxy to assess marketplace opportunities in industrial automation, 70 mean # of postings appeared each day in the greater Los Angeles (LA). County wise, a 76 and 93 mean # of postings appeared each day in the Los Angeles County (LAC) and the Orange County (OC), respectively. Similar to the BAS jobs, over 90% the postings were Full-Time (FT) employment opportunities, with more than one-half of those vacancies were being sought at mid-level experience.

LAC and OC represent 27% and 33% of California's PLC marketplace share of job postings, respectively. LAC and OC each represent 4% marketplace share of US job postings. Greater LA area represents 35% of the CA and 4% of the US PLC marketplace share of the jobs posted. Among the top cities in CA, Los Angeles ranked #1 in our study, and #5 among the top 10 ranked cities in the US.

Proportion of Mean (%) PLC Jobs in LA, LAC and OC

As Compared with CA PLC Jobs Marketplace

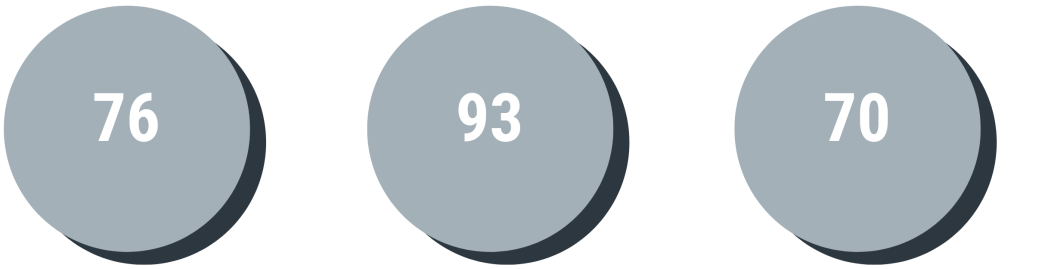


Each bar represents an independent data point. Job search radius set to 50-miles from each location.
% calculated are based on non-duplicated numbers.
Data for Greater LA sourced from Glassdoor and LinkedIn. Data for LAC and OC sourced from Indeed and Ziprecruiter.

#10 of 15

San Diego - Carlsbad
Ranked among large cities where manufacturing was thriving in 2018, according to Forbes

Mean # of Daily Vacancies Posted PLC



Data sourced from Indeed and Ziprecruiter

Data sourced from Indeed and Ziprecruiter

Data sourced from Glassdoor and LinkedIn

EDUCATION: REQUIRED VS. PREFERRED

BAS

Irrespective of the search engines used for assessment, significantly higher # of jobs posted in LAC (43%) and OC (41%) did not provide data on required or preferred education. However, the 'No Data' category was not significantly different from 4-year education required for both counties. The greater LA data also indicated that a 4-year degree is required for a higher # (41%) of the jobs posted.

Where education data was provided, and when the High School / GED categories were combined with 2-year categories, a mean of 34% (LAC) and 49% (OC) jobs reported 2-year or below as the minimum education requirement. In the greater LA area, 43% of the jobs stated a minimum of 2-year degree or HS requirement.

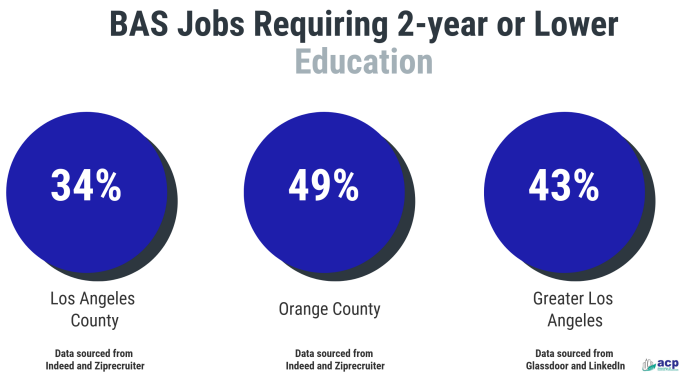
54%
Companies offer BAS internships (ACP Data)

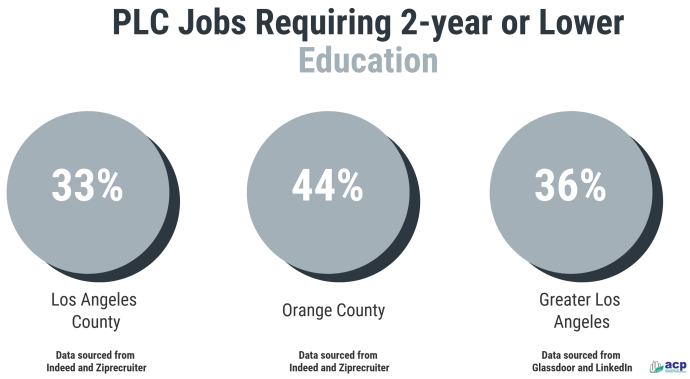
Outcomes of the qualitative assessments (interviews) of BAS education revealed that most employers prefer applicants with a completed post-secondary education (2-year degree, technical education, or apprenticeship program) for consideration of an entry-level position. However, given the urgency of filling numerous vacancies, companies were willing to consider applicants without post-secondary education. The lack of consideration of post-secondary education was often conditional, and mentioned in combination with required or preferred minimum experience. BAS employers indicated that companies do not necessarily include minimum education in job postings to encourage and increase the pool of applicants.

PLC

Significantly higher # of jobs posted in LAC (43%) and OC (44%) required 4-year education for PLC . Unlike BAS, 80% of the PLC postings included education preference or requirement in the job descriptions. Much like the counties of LA and OC, the greater LA and US data also indicated that a 4-year degree requirement was significantly higher than all categories.

When the High School / GED categories were combined with 2-year categories, a mean of 33% (LAC) and 44% (OC) jobs reported 2-year or below as the minimum education requirement. When 2-year preference were included in the above-mentioned combined categories, the means for LAC and OC increased to 36% and 49%, respectively. In the greater LA area, 36% of the jobs stated a minimum of 2-year degree or HS requirement.





Collectively, the quantitative and qualitative assessments indicate that a 2-year post-secondary education is preferred by BAS and PLC employers in the greater LA area. Employers are willing to provide students with long-term paid internships and hands-on experiential learning opportunities. Employers prefer candidates with strong mechanical aptitude, good communications skills, willingness to learn, ability to apply learned skills, and problem-solving skills. The top recommendations for academia included consideration of curricular needs that are relevant to the automation in BAS, providing real-world learning in a laboratory environment, and better relations with industry and stakeholders in the region.

Defining a Good Job!

According to the Center on Education and the Workforce, Georgetown University, a good job pays at least **$35,000** for workers **25-44** and at least **$45,000** for workers **45-64**.

These jobs pay median earnings of;

* **$56,000** for workers with **less** than a **bachelor's degree**
* **$65,000** for workers with an **earned bachelor's degree**

Data Source: https://cew.georgetown.edu/cew-reports/3pathways/

PROFESSIONAL EXPERIENCE: REQUIRED VS. PREFERRED

BAS

70%
Subject Matter Experts opined they prefer HS diploma or 2-year degree with 3-5 years experience for BAS jobs. (ACP Data)

Between 3-5 years of professional experiences were required for most of the BAS jobs posted online. In LAC, OC and the greater LA area, 3-5 years minimum requirement was highest among all categories of experiences studied. These outcomes align well with the fact that nearly one-half of all the jobs posed were mid-level positions.

A mean # of 14% and 20% jobs posted in LAC and OC counties, respectively did not provide any data on experiences requirement, indicating that entry-level positions may not necessarily require minimum experiences, and employers were willing to consider applicants without any prior experiences. Notwithstanding 'No Data' category, data for 1-2 year's experiences (required and preferred) were combined for the respective locations (LA, LAC, and OC). When combined, between 15% (OC) to 17% (LAC and LA each) of the jobs sought 1-2 year's experiences. Whereas, 39%, 34%, and 38% postings in LAC, OC and LA, respectively stated 3-5 years of experiences as a requirement.

When 1-2 years experiences (required and preferred) categories were combined with means from 'No Data' category, as many as 35%, 46%, and 43% jobs in LAC, OC, and LA, respectively required 0 -2 years experiences. A range of 35-46% jobs requiring 0 -2 years experiences are indicative of several entry-level employment opportunities in the greater LA. Based on the mean # of 1,285 vacancies per day in the greater LA area, 35 – 46 % jobs constitute 450 – 591 jobs posted per day in the greater LA area that require 0-2 year's experiences.

450 - 591
Number of daily vacancies posted in the greater LA area that requires 0 - 2 year's experiences.

PLC

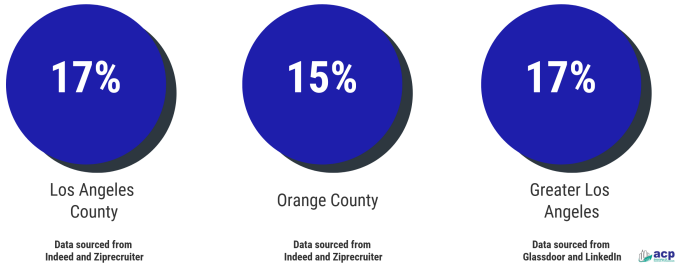
On an average, 78.5% of job posting by all search engines provided data on experiences. Similar to BAS, experience requirements between 3-5 years were required for most of the PLC jobs. In LAC, OC and the greater LA area, 3-5 years requirement were significantly higher than other categories within each category. These outcomes align well with the fact that more than one-half of all the jobs posed were mid-level positions.

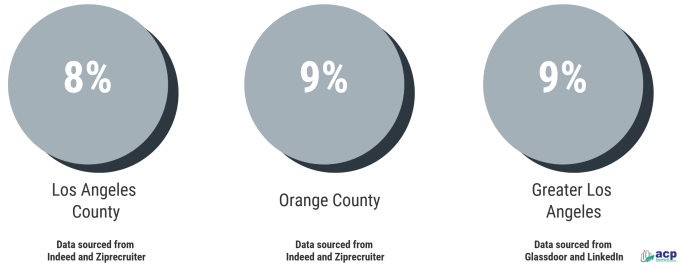
To assess opportunities for entry-level jobs, means for 1-2 years were combined (required and preferred) within each category. Only 8% (LAC) and 9% (OC and LA, each) job postings stated 1-2 years experienced. Comparatively, 30% (LAC), 42% (OC) and 31% (LA) postings stated 3-5 years of required experiences.

When 1-2 years experiences (required and preferred) categories were combined with means from 'No Data' category, as many as 27%, 25%, and 40% jobs in LAC, OC, and LA, respectively required 0-2 years experiences. A range of 25 – 40% % jobs requiring 0 -2 years experiences are indicative of ample entry-level employment opportunities in the greater LA. Based on the mean # of 70 vacancies posted per day in the greater LA area, 25 - 40 % jobs constitute 17 -28 jobs posted per day in the greater LA area that require 0-2 years experiences.

Similar to education, the qualitative assessment of the study showed that most employers prefer some experience but do not require any to fill up the existing vacancies. The assessment interviews demonstrated that employers are willing to provide on-the-job training as long as the new employees are willing to learn, apply learned knowledge for troubleshooting, and demonstrate mechanical aptitude.

Incumbent professionals, including managers, were concerned about the time it takes for employers to train a new employee. Thus, they emphasized the need to provide hands-on laboratory experiential learning opportunities in the high school and colleges. Also, employers are concerned about impending retirement (at 3% rate) and losing a wealth of experiential knowledge acquired by incumbent workers who have spent decades in this trade. This concern is impacting employment decisions made by the companies, consequently resulting in minimizing barriers by posting jobs without data on minimum experiences required. Based on the combined quantitative and qualitative assessments, it is clear that numerous entry-level jobs in the greater LA area are found that require 0-2 years experiences.



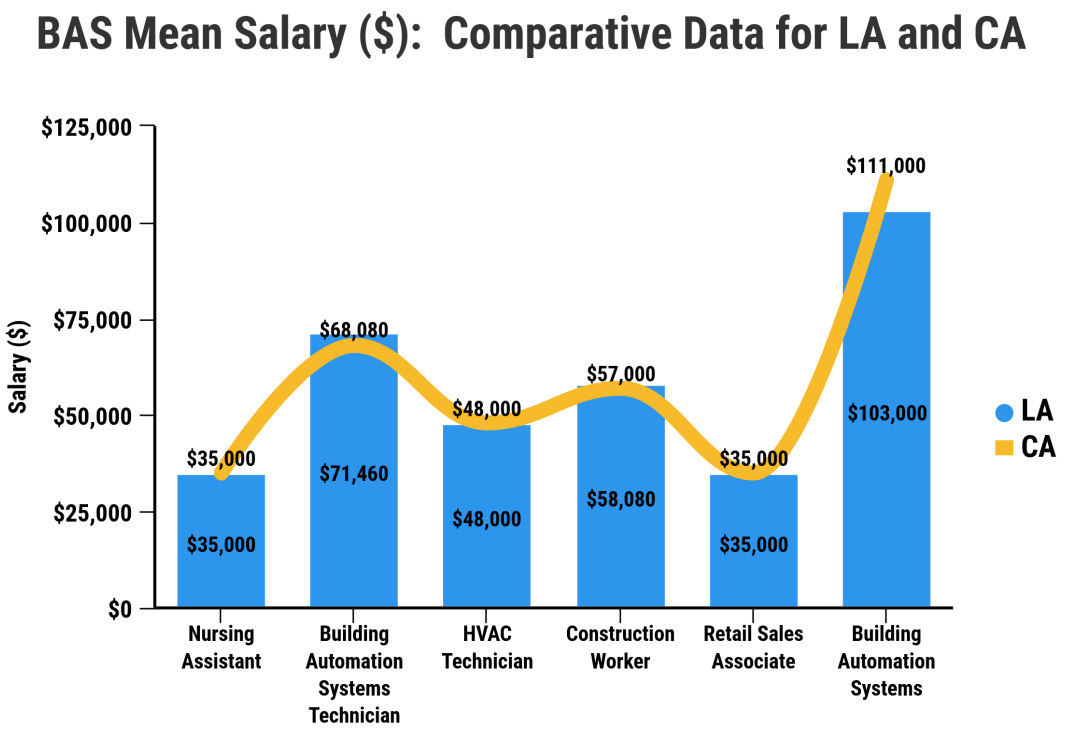


HIGH SALARY, HIGH WAGE, FT POSITIONS: TRIFECTA OF GOOD OCCUPATIONS

BAS

BAS jobs marketplace is robust in the greater LA area, and is characterized by an overall 93-95% full-time jobs. The projected 15% national growth rate of the HVACR industry combined with thousands of daily advertised vacancies, and high turn-over rate makes this field a lucrative one for those seeking BAS career pathways. Students completing post-secondary education (associate's degree or technical program) in BAS or closely related field with some professional experience may expect entry-level salaries that are higher when compared with several other professions.

In the greater Los Angeles, the average annual salary for BAS jobs was $103, 250 (based on a mean # of 934 jobs). During the same period of the study, average BAS salary in CA was $113,800 (based on a mean # of 4,358 jobs) and the average salary in the US was $99,100 (based on a mean # of 21,949 jobs). The following figure compares mean BAS salary (includes all experience levels) with entry-level salaries provided by Indeed.com on July 21, 2019.



Source: Indeed.com, July 21, 2019.

What is BAS?

Technical definitions describe Building Automation Systems (BAS), otherwise known as Building Management System (BMS), as a system or set of systems, that provides automated control and monitoring within a building. BAS, a network of microprocessor based wired or wireless controllers connected to diverse systems in a building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems provide access to information on equipment performance and utility metering, and gives users the ability to easily schedule equipment and control it at a more granular level (Diverse sources).

From the workforce perspectives, it is prudent to state that BAS is an ecosystem of occupations comprising of diverse jobs that must be accurately classified to provide objective and clear definitions of responsibilities, skills, duties, tasks, and authority level of a job (Vyapari, 2019 pending publication).

Who are BAS Technicians?

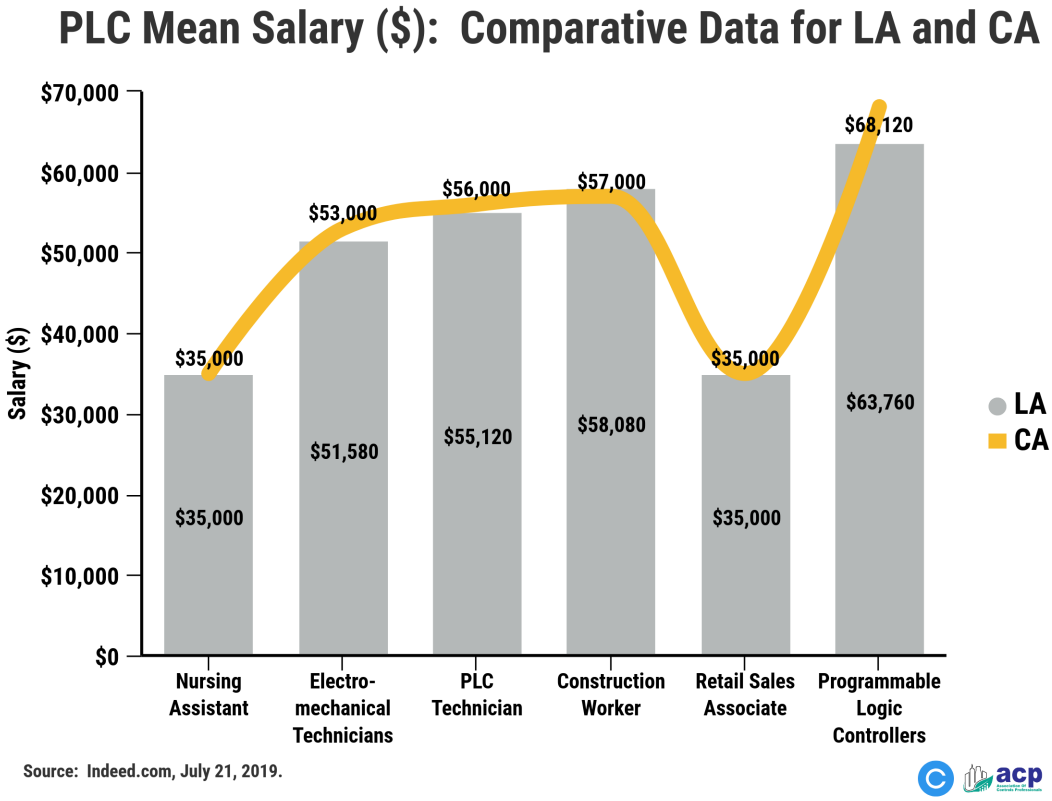
Building Automation Technicians perform a variety of duties related to the design, development, and improvement of building automation systems (BAS). They inspect, troubleshoot, and maintain BAS, involving trades or contract personnel when necessary to make repairs or adjustments. Building Automation Technicians also review the existing BAS and recommend, assist with the design of, or revise existing systems (Diverse sources).

HIGH SALARY, HIGH WAGE, FT POSITIONS: TRIFECTA OF GOOD OCCUPATIONS

PLC

Similar to BAS jobs, PLC marketplace opportunities are abundant in the greater LA area. According to a 2018 report by Research and Markets on the global PLC marketplace outlook, by 2023 the PLC market is estimated to reach to $14.21 billion from the existing $11.53 billion market when calculated at a rate of 3.57%. Interestingly, as per the BLS (Department of Labor) Occupational Outlook Data (2018), the estimated rate of growth (2016-26) of the Electro-mechanical Technicians (SOC CODE 17-3024.00) in the united states is 4% as well. Electro-mechanical Technicians with PLC/automation skills earn between $38,378 - $71,205 in the United States (Payscale, 2019).

According to our study, the average annual salary of PLC jobs in the greater LA was $78,625 (based on a mean # of 85 jobs). During the same period of the study, average PLC salary in CA was $80,750 (based on a mean # of 244 jobs) and the average salary in the US was $68,500 (based on a mean # of 1,750 jobs). The following figure compares mean PLC salary (includes all experience levels) with entry-level salaries provided by Indeed.com on July 21, 2019.



Source: Indeed.com, July 21, 2019.

What is PLC?

Technical definitions describe A programmable logic controller (PLC) is an industrial solid-state computer that monitors inputs and outputs, and makes logic-based decisions for automated processes or machines ((Diverse sources).

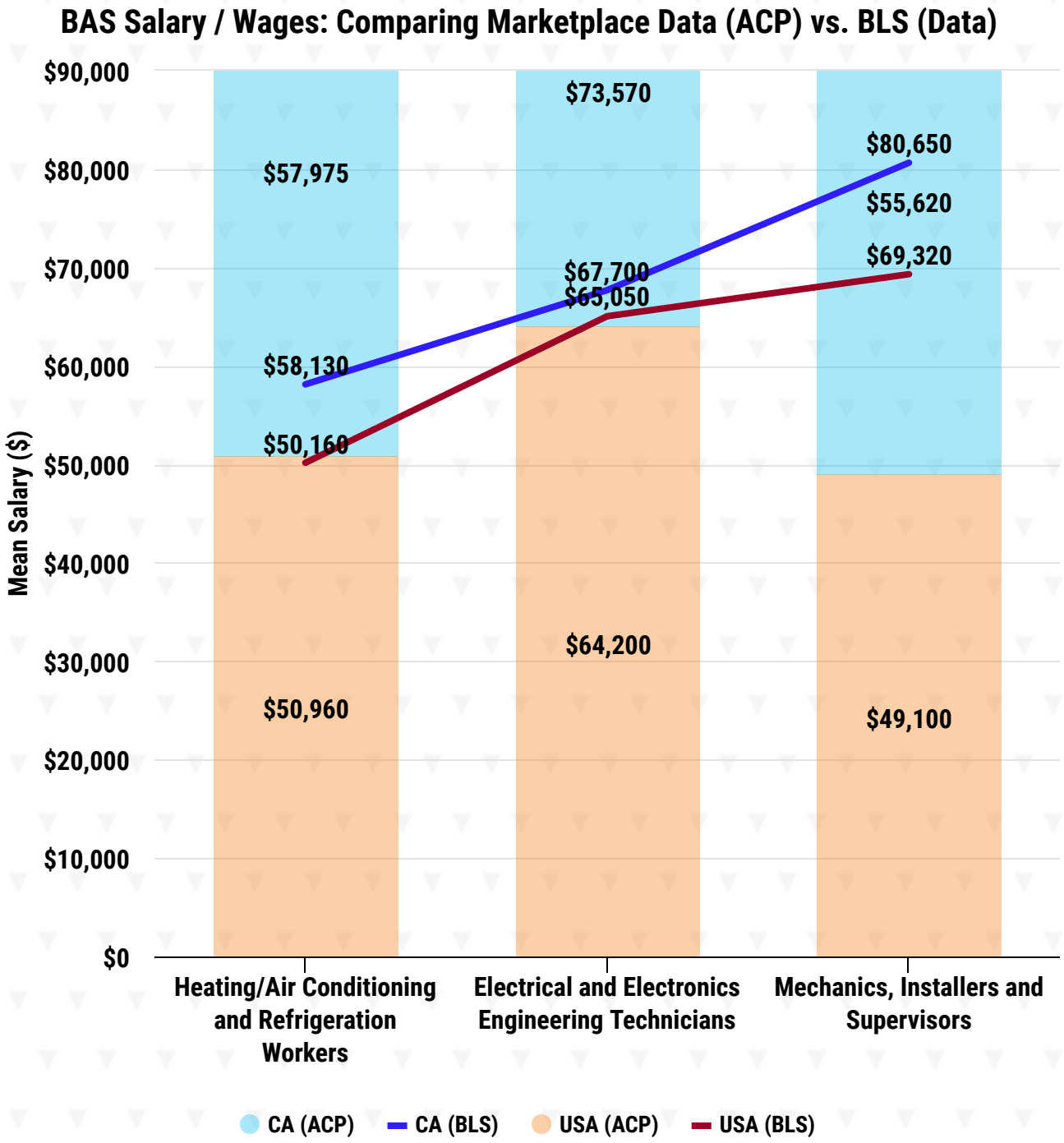
When used as a proxy in our study, PLC keyword populated any/all jobs opportunities in the industrial automation employment sector.

Who are PLC Technicians?

According to Wikipedia (2019) PLC technicians design, program, repair and maintain programmable logic controller (PLC) systems used within manufacturing and service industries ranging from industrial packaging to commercial car washes and traffic lights.

According to Chron,com job duties and responsibilities for programmable logic controller technicians and engineers also include system monitoring, debugging and troubleshooting operational problems, making repairs and performing preventive maintenance activities.

How well does the marketplace* data compares with the BLS** data?
BAS Occupational Ecosystem Jobs



Sources and Assessment: To compare the marketplace data with the BLS data, a few (3) occupations among the BAS occupations were selected. Mean salaries in each occupation were either noted from the BLS source or calculated from marketplace sources.

* Marketplace data: ACP Data = Mean salaries from analyzed from Indeed.com and Ziprecruiter. com on July 21, 2019
** BLS data: BLS Data = Data sourced from BLS (Bureau of Labor Statistics, United States Department of Labor, May 2018) reflects the Annual Mean Salaries of each occupation shown here.

INTERNSHIPS AND CREDENTIALS: ACCESSORIZING BAS AND PLC JOB PROFILES

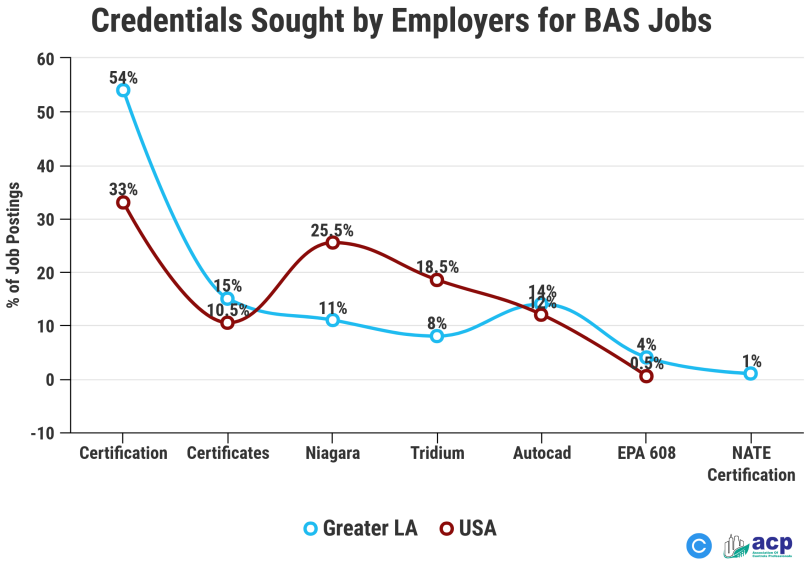
The intrinsic value of experiential learning, through hands-on internship opportunities, were highly valued by employers. Companies are offering internships to high school and college students, with an eventual possibility of hiring the interns for a full-time position in their organizations.

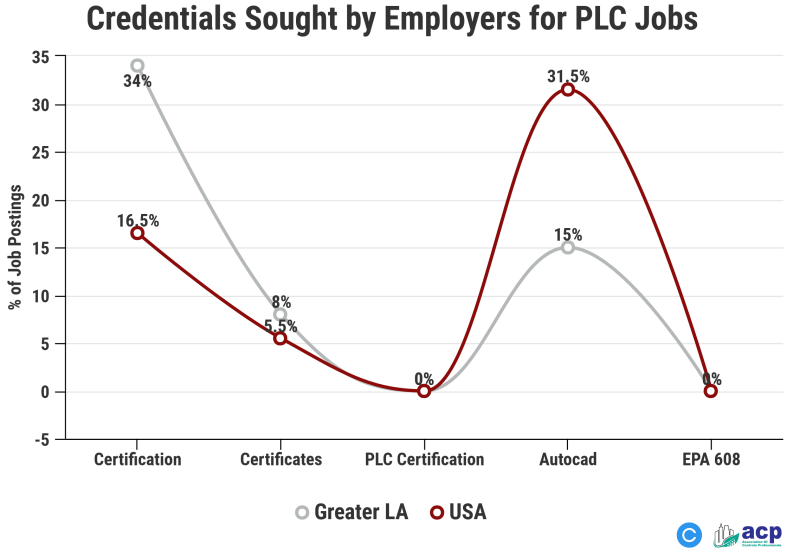
13
Paid BAS entry-level internships posted by Indeeed.com in Los Angeles, CA (ACP Data, August 2, 2019)

The key concern expressed by most employers was the short-term duration (1-3 months) of the internships. Career professionals strongly believe that acquiring diverse and multi-dimensional skills to perform duties requires 6 months – 2 years experiences. An internship longer than at least 6-months is preferred by the employers. Several experts opined that short-term internships were 'waste of time'. A Director of HR (mega-global conglomerate building automation company) expressed willingness to custom create internship models designed as 'on' and 'off' periods to help students complete a long-term internship program at their company. The 'on' and 'off' model would enable students complete their internships in between pursuing their academic or related programs. Employers stated that most internships were paid and provided students with a greater understanding of the emerging needs of automation in the BAS sector.

Among the BAS job profiles studied in the greater LA area, 'certification' and 'certificate' terms were mentioned in 54% and 15% job postings, respectively. Specifically, 11% of the postings required Niagara Certification, 8% stated Tridium, 14% AutoCAD, and 4% EPA 608.

Similarly, 34% and 8% PLC job postings stated certification or certificate requirement, respectively. Autocad was the most popular PLC certification stated by 15% of the job postings.





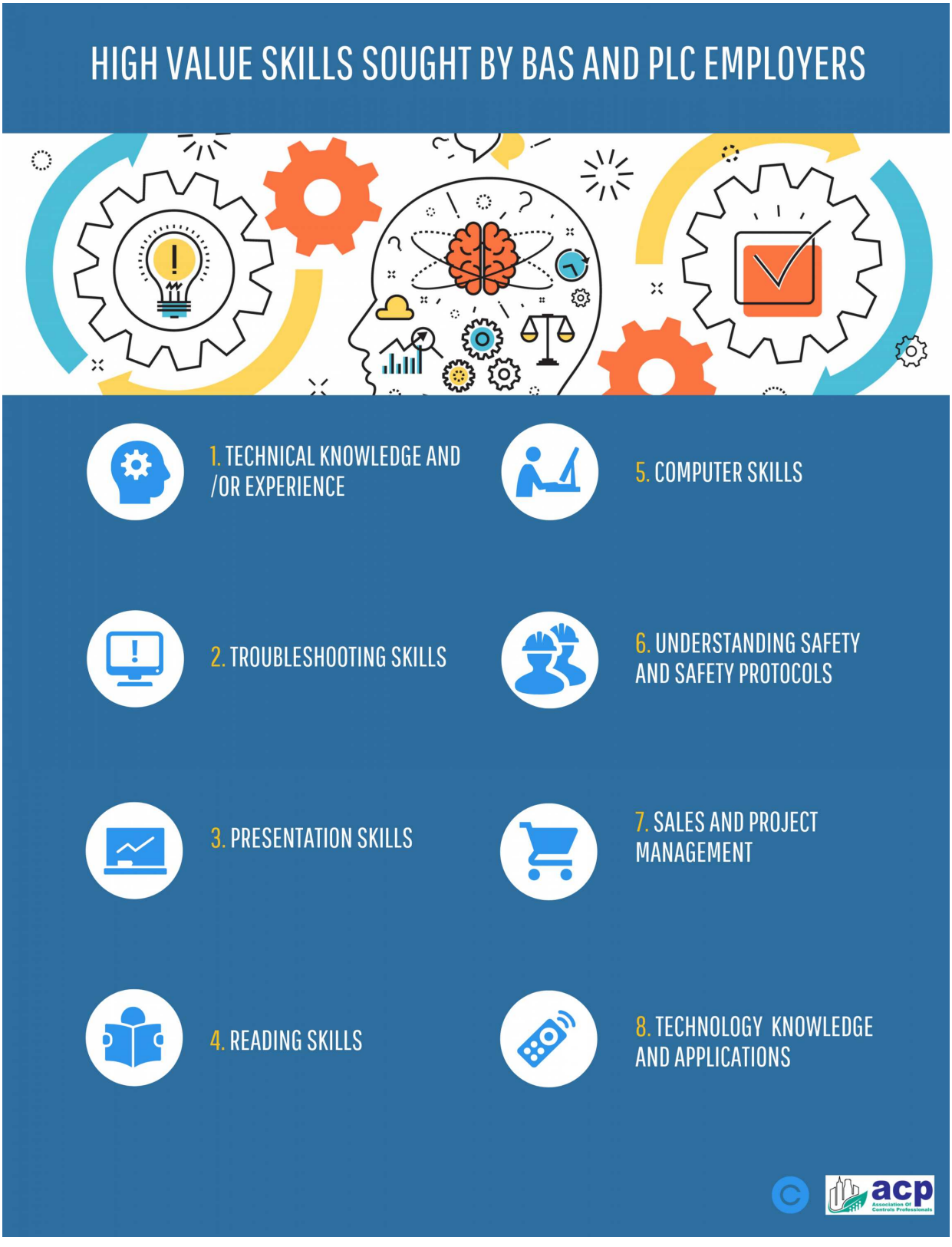
KNOWLEDGE, SKILLS AND ABILITIES - VALUED TOOLS TO ACQUIRE PORTABLE SKILLS AND AGILITY

An assessment of Knowledge, Skills and Abilities (KSA's) from 40 BAS and 40 PLC job profiles, selected randomly from the greater LA area, revealed the following KSA's as most valued. Based upon the frequency of occurrence of the top 10 key words, BAS and PLC jobs placed high value on the following skills.

The qualitative (interviews) assessments indicated that employers prefer candidates with good communication skills. However, most employers were not clear about the importance of social skills in the automation era where significant workload will shift from human capital to digital nature.

92%
Postings stated that prior HVAC knowledge and/or experience is highly valued

Programming
Computer skills range from basic computing skills, knowledge of Word, Excel, and similar programs. Programming skills in languages such as Java is highly valued.



Top Ten BAS Knowledge, Skills and Abilities (KSA) Key Terms

1. HVAC
2. Troubleshoot
3. Troubleshooting
4. Present
5. Read
6. Computer
7. CAD
8. Safety
9. Sales
10. Technology

Top Ten PLC Knowledge, Skills and Abilities (KSA) Key Terms

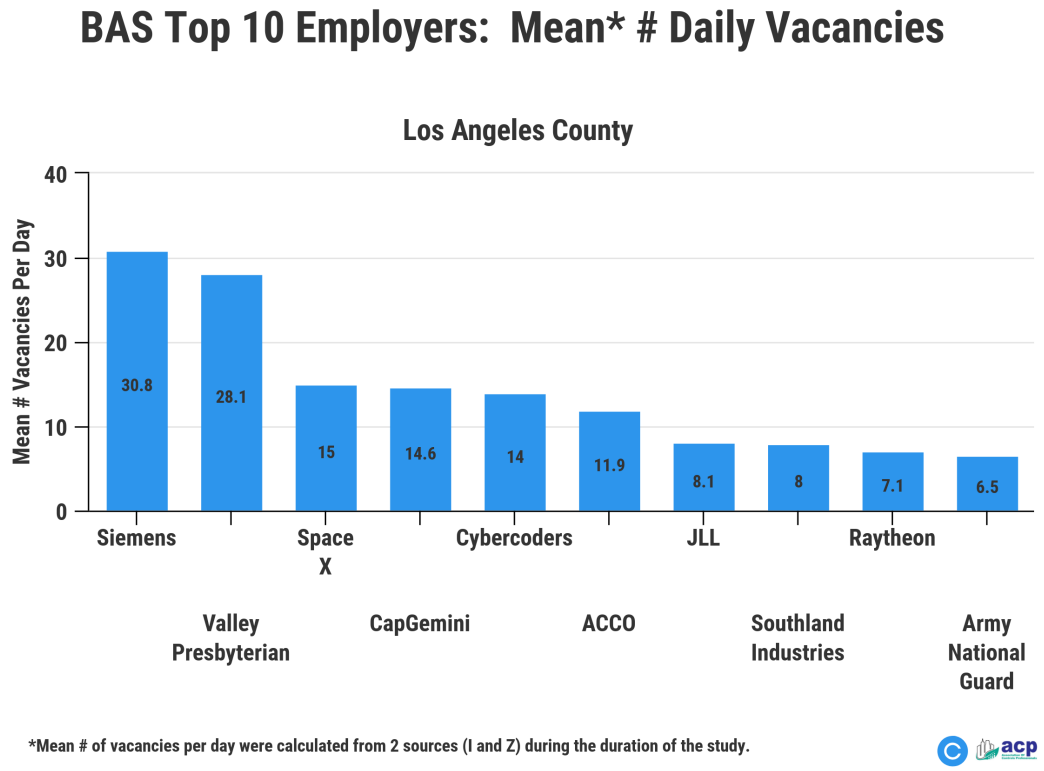
1. Troubleshoot and Troubleshooting
2. Safety
3. Read and Computer
4. CAD
5. Technology
6. Planning
7. Instruct
8. Analyze
9. Electrical Systems
10. Project Management

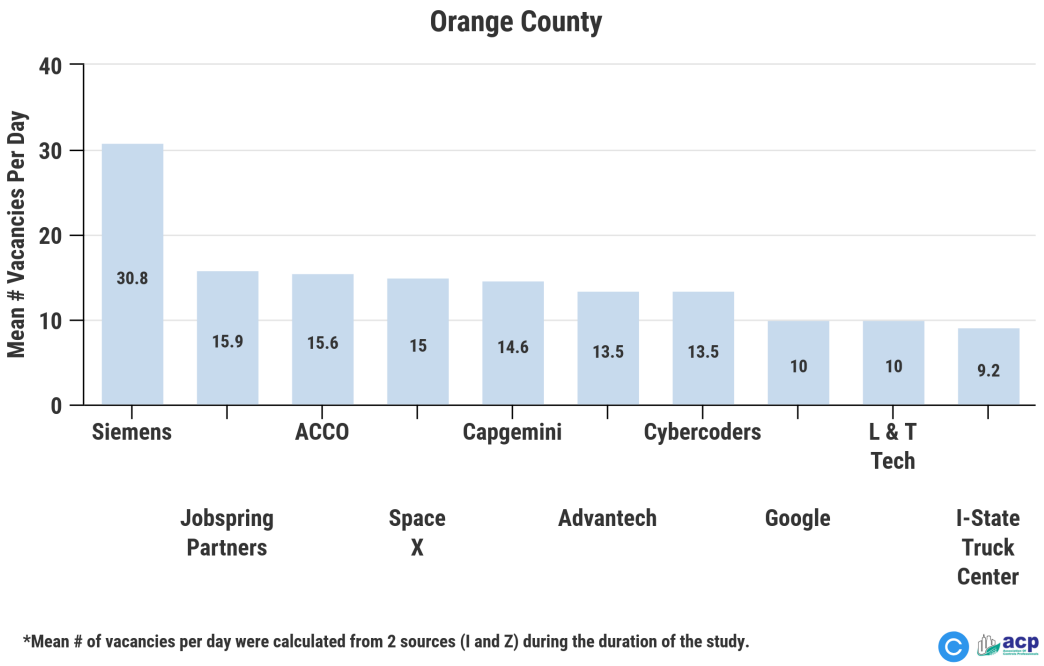
BAS: WHO IS HIRING?

Among the many BAS employers in the greater LA area, the top 10 ranked employers included Siemens (#1), Valley Presbyterian, ACCO, SpaceX, Capgemini, Business UTC, and Google. These top 10 companies posted between 6-31 jobs per day, per employer. The figure below provides details of the employers along with mean # jobs posted by employers.

#15 of Top 100

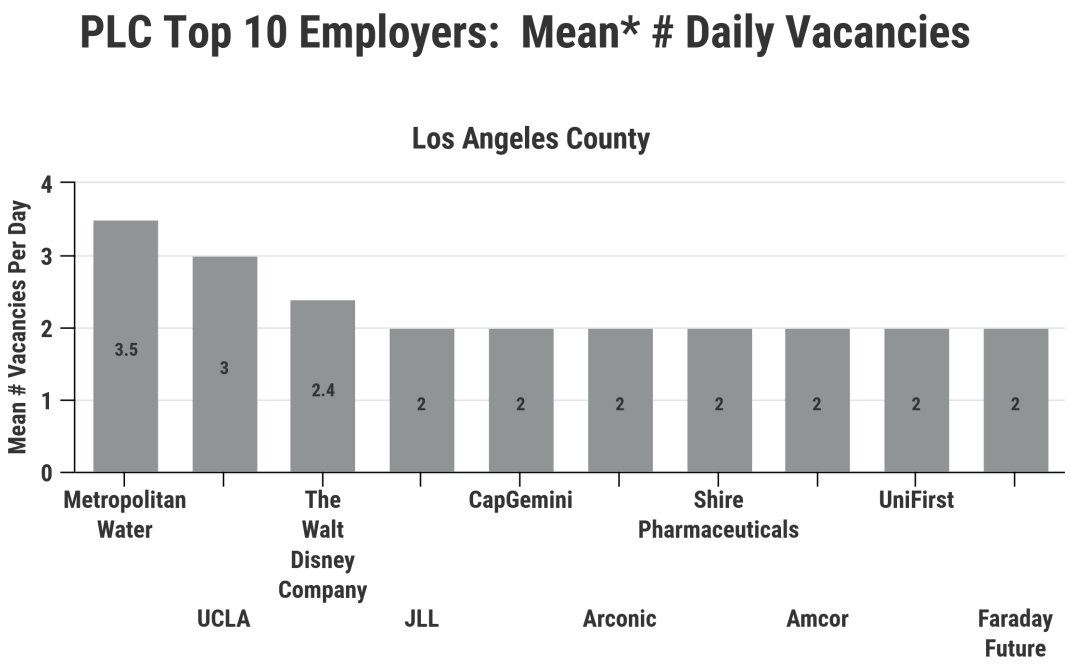
Siemens
2019 America's best large employers according to Forbes.





PLC: WHO IS HIRING?

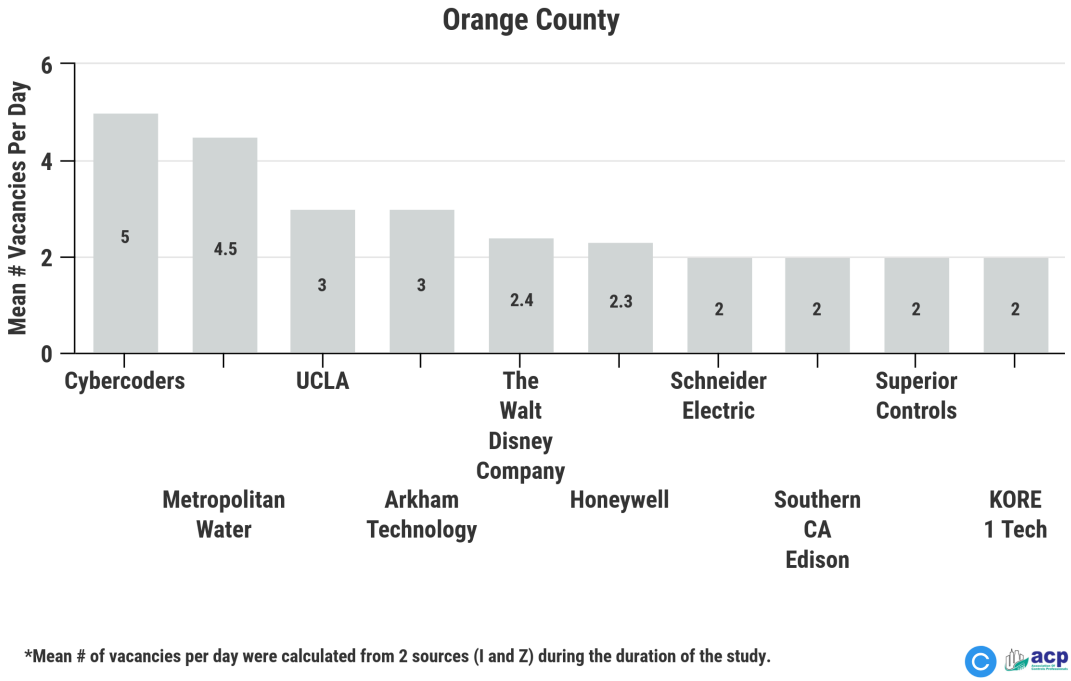
The top 10 PLC employers in the greater LA included Metropolitan Water District of Southern California, UCLA, The Walt Disney Company, Honeywell, JLL, Southern CA Edison, and Schnieder Electric.



23

Industrial automation employment vacancies posted by ACCO Engineered Systems on August 2, 2019. (ACP Data)

*Mean # of vacancies per day were calculated from 2 sources (I and Z) during the duration of the study.



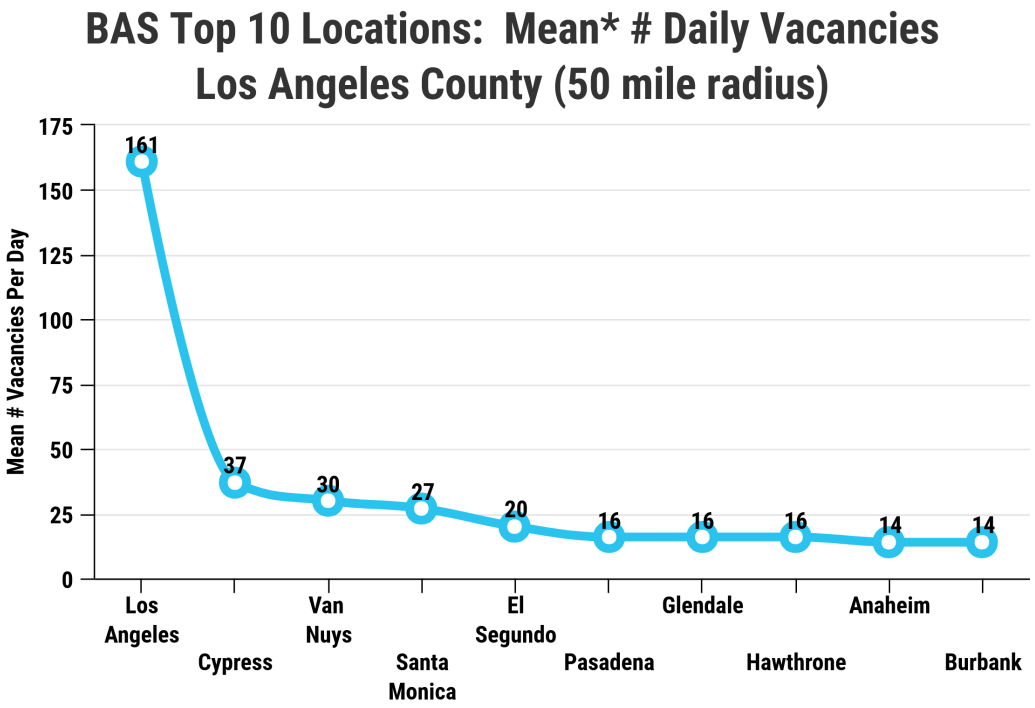
*Mean # of vacancies per day were calculated from 2 sources (I and Z) during the duration of the study.

BAS HIRING : LOCATION! LOCATION! LOCATION

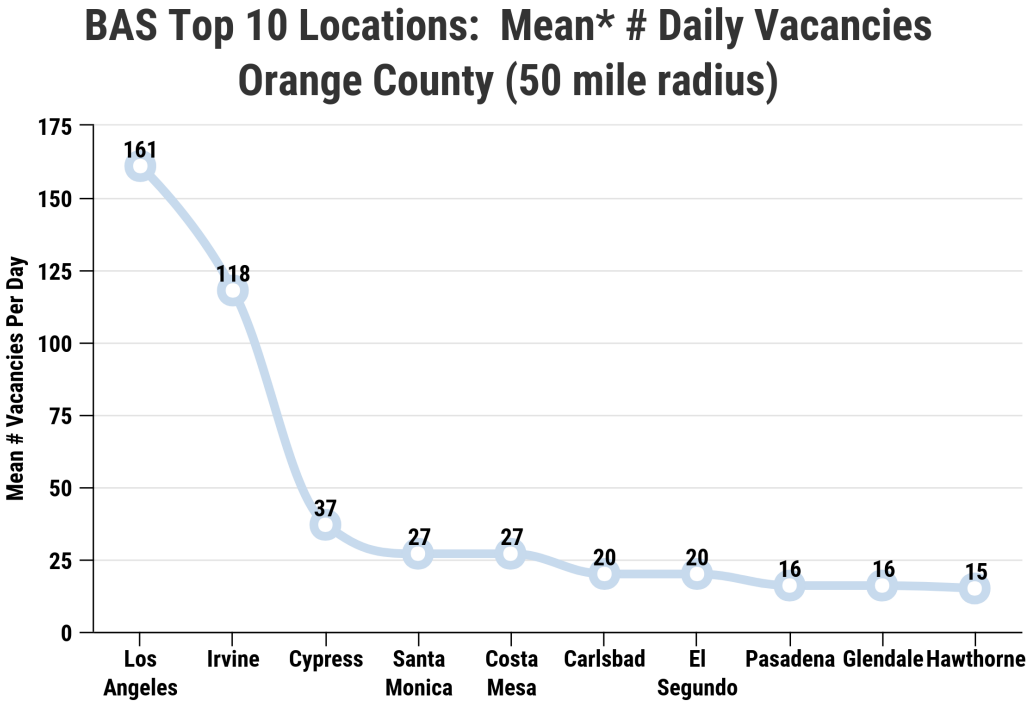
Top 10 BAS hiring locations in the greater Los Angeles included Los Angeles, Irvine, Cypress, Van Nuys, Santa Monica, Costa Mesa, El Segundo, Pasadena, Glendale and Hawthorne.

50 mile

Radius
Majority of the BAS subject matter experts opined that candidates apply to jobs within 50-mile radius



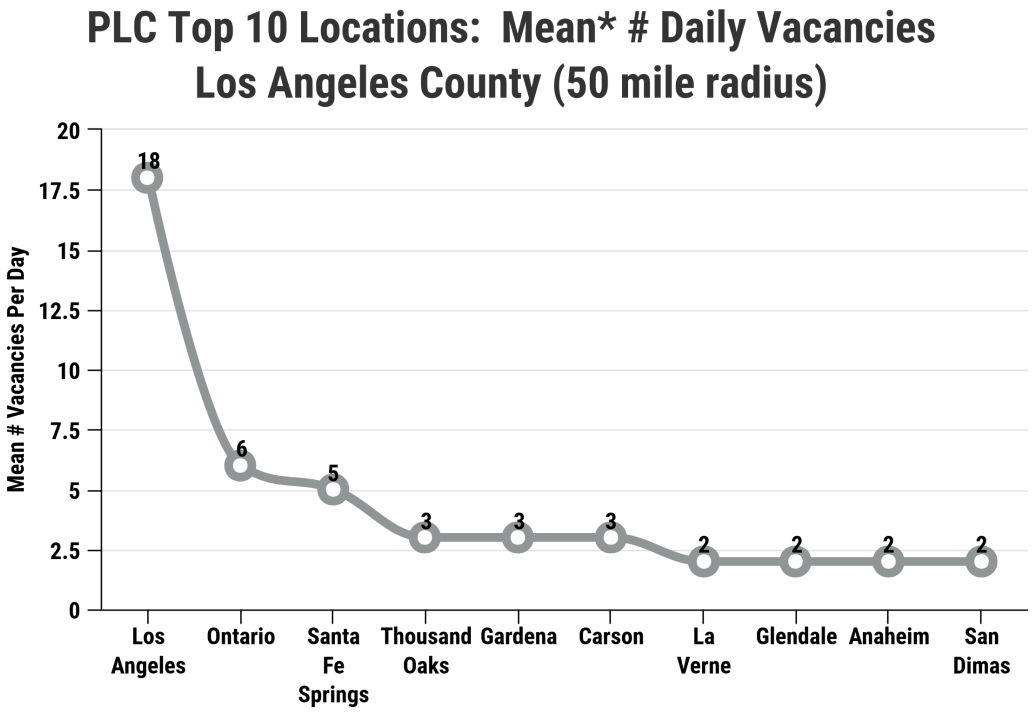
*Mean # of vacancies per day were calculated from Indeed.com during the duration of the study.



*Mean # of vacancies per day were calculated from Indeed.com during the duration of the study.

PLC HIRING : LOCATION! LOCATION! LOCATION

Top 10 PLC hiring locations in the greater Los Angeles included Los Angeles, Riverside, Ontario, Santa Fe Springs, Oceanside, Irvine, Thousand Oaks, Gardena, La Verne and Carson.



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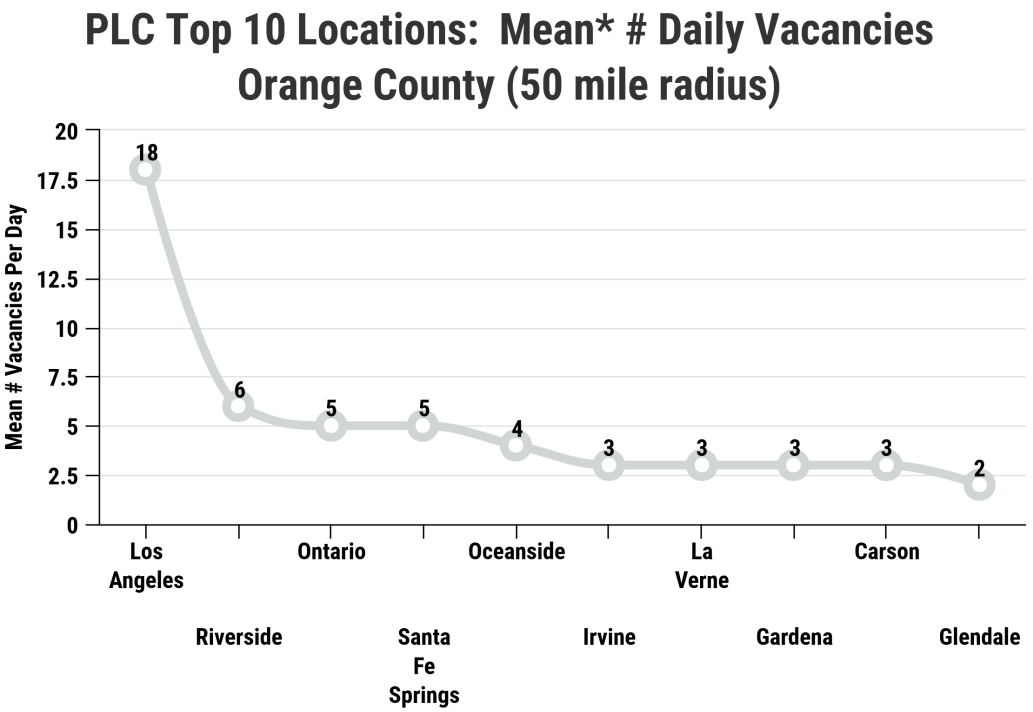


*Mean # of vacancies per day were calculated from Indeed.com during the duration of the study.

12 Recommendations for Community & Technical Colleges

1	Employers are willing to fill vacancies without any education or experience	Many Jobs
2	Research focused on all BAS jobs, not just entry-level technicians. Data thus reflects existing and emerging needs	Emerging Needs
3	High 'No Data' numbers suggest that employers are not using any specific education and experience qualifications in job descriptions	2 Y Education is valued
4	Plan and promote long-term internship models to provide training to students to acquire necessary 21st-century skills	Long-term Internships
5	Colleges must provide better hands-on, laboratory based skills and experiences to students, to apply the acquired knowledge	Laboratory Skills
6	Communication skills, reading and multitasking skills highly valued	Soft Skills Important
7	Invite companies at participate in on-campus career day events to promote the BAS/PLC careers, better marketing campaigns	Career Days Events
8	Colleges can provide training to meet the industry training needs in emerging automation sectors	Train Industry Customers
9	High wage, high salary jobs within 50-mile radius	High Wage High Salary
10	Innovative automation curriculum and careers, emphasizing portable skills applicable to multiple sectors being automated	Automation Portable Skills
11	Creating robust conduits to connect high school to 4-year programs to promote a cohesive marketing message about pathways to automation careers	Coherent Message
12	Change at a rapid pace	Change and Velocity

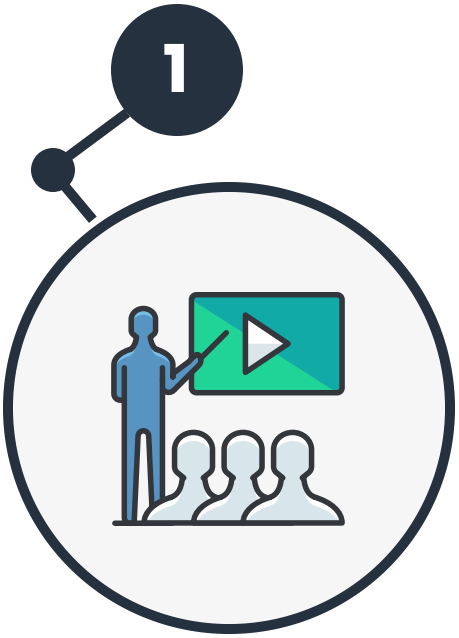
And the experts say...

Qualitative Assessment

A summary of interviews and conversations

Results of the qualitative assessment conducted through personal interviews of employers are presented in the form of a collective summary of responses, organized by topics. A limited number of BAS and PLC employers were able to share their perspectives and professional outlook on questions asked during personal interviews. All interviews were held with individuals who were directly or indirectly responsible for BAS and PLC sectors in LAC and OC. With the exception of one group conversation, all other interviews were held one-on-one in person or via a conference call. Interview and conversation participants were HR Director, Senior Managers, Project Managers, Sales Associate, Technicians, and Global Policy Director. Due to enhanced security reasons of company privacy policies, the names of the companies and individuals are not shared. A total # of 12 participants to date have shared their perspectives. The following summary does not include reflections of opinions gathered after the study period ended.

Education and Experience



Most participants stated that a 2-year, technical college degree or certification is preferred for entry level positions. While some experience was preferred, participants stated that given the need to fill up the existing vacancies, they would hire a new employee without any experience.

Most participants were unaware of BAS programs offered by community colleges in LAC and OC. A few participants knew of HVAC and/or Air Conditioning and Refrigeration programs offered in OC and LAC.

BAS Curriculum

Most participants agreed that a robust BAS curriculum is necessary to prepare students for BAS jobs. Participants emphasized the need to provide real-world training and learning in a laboratory environment at the colleges.

Internships

Participants strongly favor the internship opportunities and believe that students completing internships will be better prepared for the 21st century jobs in automation sectors. However, some participants strongly voiced their concern about a limited summer internship of 1-2 months duration. Inadequate time to train an intern in 1-2 months for skills that require 6 months to a year were their main concerns. Some opined that most limited 1-2 months duration internships tend to waste the time of employers, especially when the interns do not return for additional internship opportunities in their companies. All internships discussed were paid. In terms of outreach by the employers to hire interns, there appears to be a weak (if any) marketing program. Mostly, interns are hired through the traditional word-of-mouth strategy. None of the participants had ever attended a formal event at college(s) to promote internship at their companies. However, one individual had taught a few courses as a HVAC instructor and was able to promote internships among the students enrolled in his classes.

The HR Director's perspective on internships is worth noting. This participant, a national leader of one of the largest companies serving BAS industry needs, is willing to consider internships that best meet the needs of students and colleges. The HR Director is aware of the challenges and limitations of a short 1-2 months internships, as well as acknowledges the reality that interns may or may not be able to stay out of college for a straight 6 months - 2 years to complete an internship. However, he is willing to consider models that would allow student to complete an extended internship program, with the necessary breaks to complete college education.

Entry-level Vacancies

Every participant stated that they can't find enough people to fill up the entry-level positions. One participant (a Senior Manager) quoted "we will hire anyone that is breathing and has a pulse. That's how critical our needs are". Some participants 'assumed' that their company website was the primary outlet of job postings (vacancies). Most participants were aware of commercial search engines such as Indeed, ZipRecruiter, and LinkedIn. Most stated that they were not sure about HR practices on drafting job descriptions or factors considered in posting jobs. Some participants agreed that the job descriptions are 'all over the place' and often do not state all required or desired qualifications in a job posting.

Retaining Employees

Retention of employees was considered a major challenge. Some participants stated that low salaries at their company was the primary cause of losing valued employees.

Knowledge, Skills and Abilities (KSA's)

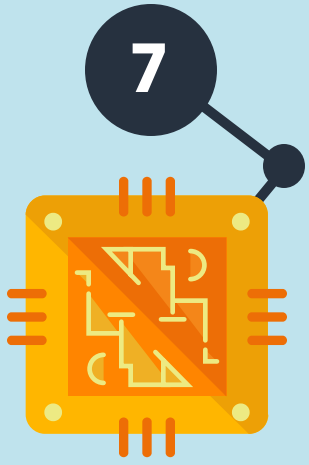
In response to required or desired skills of an entry-level employee, the responses from most participants were similar. Everyone agreed that it is easy to 'onboard' a new employee who possesses and understands the fundamentals of basic technical skills. Participants stated that they spend their time in teaching and training new employees, regardless of the level of the preparedness of new employees. Lack of understanding of the basic technical skills was mentioned as the most difficult challenge. Some participants said they were willing to be a mentor, as long as the new employees showed an interest in learning. Technician participants stated that their own busy schedules does not lend to mentorship opportunities. Among technical skills, a greater understanding of mechanical and electrical skills were emphasized.

In response to specific skills necessary for the automation jobs, most participants discussed need to have a background in basic computer science, IT, networking, and some programming courses. Two courses mentioned included advanced HTML coding and Java. An understanding of various operating systems was mentioned.

Among other skills mentioned were good verbal (spoken) communication skills, logical mindset, ability to apply knowledge in an independent setting, problem solving (troubleshoot), grit ("not an office job"), be able to read and properly interpret documents, and time management.

Impact of Automation

The opinions varied among the participants from being 'unsure', 'concerned about loss of employment opportunities'', 'more concerned about existing vacancies', 'it's already happening', to 'we are strategizing to prepare for the automation era'. Some participants believe that advanced IT and networking skills are essential for the automation age. One participant spoke at length about the need to offer and receive training programs to learn about advances in IT. Particularly pointing to BAS as a security function.



The HR Director participant spent most time discussing the impact of automation. One outcome of the conversation on this topic has led to an opportunity the HR Director has facilitated for ACP to have a further deeper conversations with the HR Talent Acquisition team of this global company.

Certifications and Certificates

Some participants stated that Tridium certificates were desired, but not required. The hands-on learning and ability to apply knowledge were considered more valuable for entry-level positions.

Sales Perspective

Perspective of a Sales Associate were noteworthy. This participant, a millennial who has graduated recently and currently in their 2nd year in this position, did not have any engineering or BAS background. Personal experiences growing up in a family with mechanics and electricians has helped this participant acquire an understanding of BAS technologies to the point where they feel that within another year or less their level of knowledge may be considered 'dangerous'. Aside from acknowledging the existing opportunities and future of BAS in automation era, this participant discussed the need to create better marketing campaign for careers in BAS, to help develop training programs at community colleges where non-technical people can acquire basic technical understanding of the BAS sector, and to strengthen internal communications within companies for more effective team dynamics. This participant believed that time spent with technicians in the field is valuable to sales teams. The participant has a college degree in business background, and wished he knew more about fields like BAS during their college years.

Global Policy - Automation Workforce

An opportunity to meet with and discuss the BAS and PLC automation workforce needs with the Director of Global Policy of a significant global company revealed that their company is up-to-speed with automation and workforce needs. Most of the engineers in the company are evolving fast to keep up with the pace of technology. Their company does not serve HVAC or BAS services, but owns several buildings and properties globally and in the USA, with a headquarter in Los Angeles, CA. From a policy standpoint, the perspective were ambitious. The participant stated that automation is the key for the survival of their products and functions. To the extent of their understanding, most of the jobs in their companies (particularly related to automation) require a 4-year college degree in computer science, engineering or other fields strong in STEM.

CONTACT

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