COE — CENTERS OF EXCELLENCE FOR LABOR MARKET RESEARCH

Cloud and Internet of Things Administration and Support

Inland Empire/Desert Region (Riverside-San Bernardino-Ontario MSA)

This workforce demand report uses state and federal job projection data developed before the economic impact of COVID-19. The COE is monitoring the situation and will provide more information as it becomes available. Please consult with local employers to understand their current employment needs.

Introduction

This report provides information on the occupations and programs related to the administration and support of internet of things and cloud computing systems. The Internet of Things (IoT) is defined as any stand-alone internet-connected device that can be monitored or controlled from a remote location (Business Insider, 2018). According to Microsoft, "cloud computing is the delivery of computing services – including servers, storage, databases, networking, software, analytics, and intelligence – over the Internet "cloud" to offer faster innovation, flexible resources, and economies of scale" (Microsoft Azure, 2021). As distributed technology systems, these fields require similar skills out of their workforce.

These technologies generate a variety of employment opportunities related to information technology. The IoT ecosystem is large and evolving, including fields such as IoT software (platforms, cloud, apps), hardware (sensors, devices, networks), rules (standards, industry groups, government), and services/administration (integration, IT management, analytics, and security) (CompTia, 2019). This report focuses on the administration and support and software development areas of employment within IoT and cloud computing.

Job advertisements reveal that the primary employment areas for IoT and cloud computing, are within administration and support and software development. The number of job advertisements for software development positions was nearly three times greater than the number of ads posted for administration and support positions. There are two community college programs included in this report related to these two areas of employment. The related California Community College programs are:

- Computer Software Development (TOP 0707.00)
- Computer Infrastructure and Support (TOP 0708.00)

The **computer software development** program prepares students for employment through the instruction of the design and development of computer-based applications. These programs include systems analysis, design, specification, programming, database analysis and design, user interface development, maintenance, and testing. The **computer infrastructure and support** program prepare students for employment through the instruction of network and operation systems design and administration, including certification preparation (Taxonomy of Programs, 2012). The knowledge, skills, and abilities trained by

these programs may lead to the following occupations. These occupations are collectively referred to as the cloud computing and IoT occupational group in this report:

- Information Security Analysts (SOC 15-1212)
- Computer User Support Specialists (15-1232)
- Computer Network Architects (15-1241)
- Network and Computer Systems Administrators (15-1244)
- Database Administrators and Architects (15-1245)
- Software Developers and Software Quality Assurance Analysts and Testers (15-1256)

These occupations are considered essential critical infrastructure occupations, as identified by the Public Policy Institute of California. This classification of occupations is vital in supporting California's basic health, safety, and economic needs or may have the ability to social distance (Bohn et al.).

Please note that all the occupations in the cloud computing and IoT occupational group, except *computer user support specialists,* typically require workers to obtain a four-year degree prior to employment, indicating that community college program completers would not be qualified for employment in these occupations. However, national-level educational attainment data indicates that between 12% and 37% of workers in the field have completed some college or an associate degree as their highest level of educational attainment.

Job Opportunities

In 2019, there were 10,976 cloud computing and IoT jobs in the Inland Empire/Desert Region. The cloud computing and IoT occupational group is projected to have 1,121 annual job openings to fill new jobs and backfill jobs that workers are permanently vacating (includes occupational transfers and retirements). This occupational group is expected to increase employment by 11% through 2024. Exhibit 1 displays five-year projected job growth, and Exhibit 2 displays historical (2014 to 2019) and projected (2019-2024) jobs for the cloud computing and IoT occupational group.

Exhibit 1: Five-year job projections, 2019-2024

Occupation	2019 Jobs	2024 Jobs	5-Yr % Change (New Jobs)	5-Yr Openings (New + Replacement Jobs)	Annual Openings (New + Replacement Jobs)	% of workers age 55+
Software Developers and Software Quality Assurance Analysts and Testers	4,141	4,750	15%	2,759	460	15%
Computer User Support Specialists	3,561	3,916	10%	2,245	374	16%

Occupation	2019 Jobs	2024 Jobs	5-Yr % Change (New Jobs)	5-Yr Openings (New + Replacement Jobs)	Annual Openings (New + Replacement Jobs)	% of workers age 55+
Network and Computer Systems Administrators	1,733	1,849	7%	874	146	14%
Computer Network Architects	679	711	5%	327	55	13%
Database Administrators and Architects	557	611	10%	309	52	20%
Information Security Analysts	304	364	20%	210	35	16%
Total	**10,976**	**12,201**	**11%**	**6,724**	**1,121**	**15%**

Source: Emsi 2020.4

Exhibit 2: Historical and projected jobs for the cloud computing and IoT occupational group, 2014 – 2024
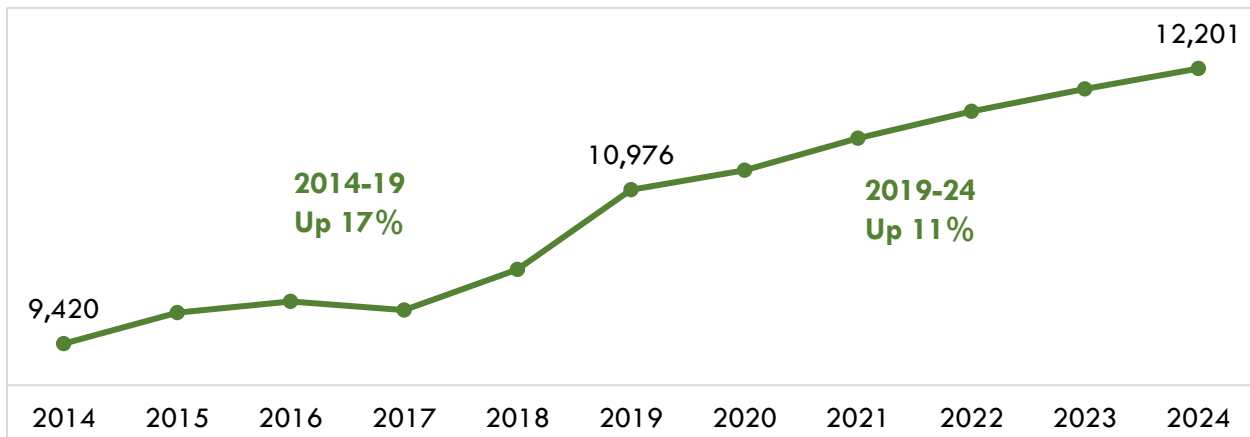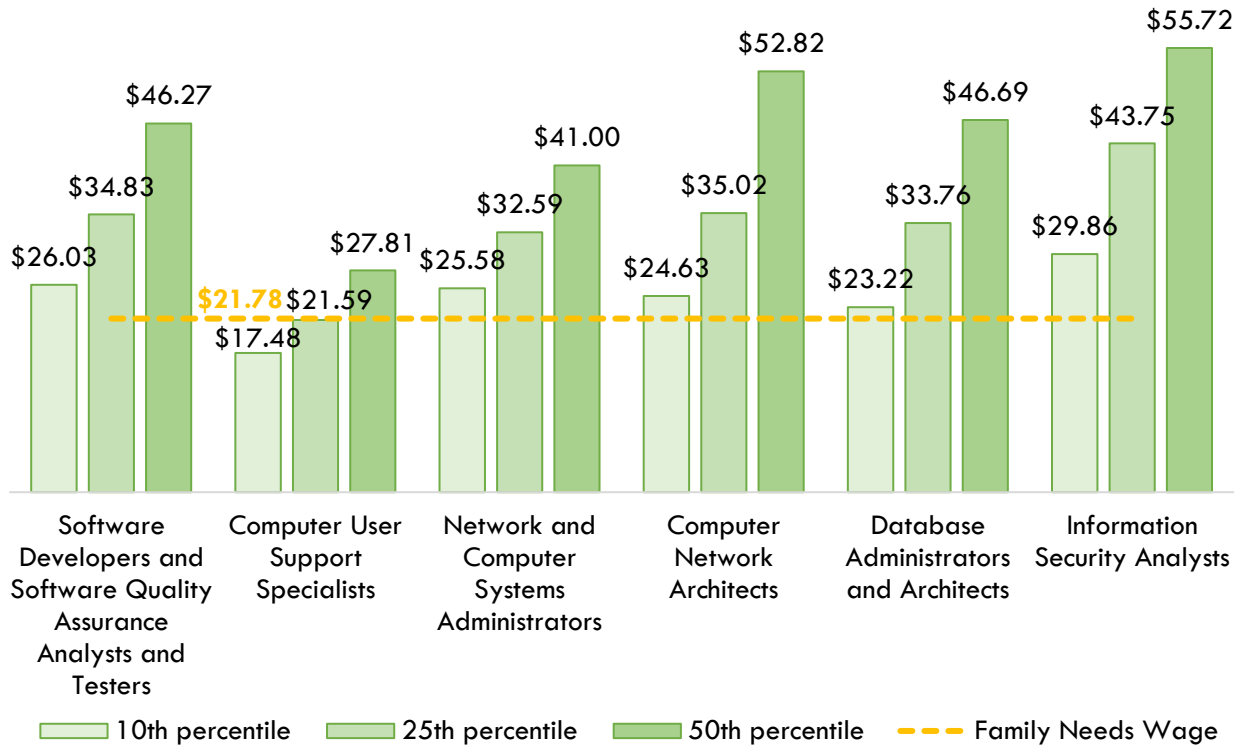

Source: Emsi 2020.4

Earnings and Benefits

Community colleges should ensure their training programs lead to employment opportunities that provide a self-sufficient income level. The University of Washington estimates that a self-sufficiency wage for a single adult with one school-age child is $21.78 per hour or $45,992 annually in Riverside County, $21.24 per hour, or $44,867 annually in San Bernardino County (Pearce, 2020). For this study, the higher hourly wage requirement in Riverside County is adopted as the self-sufficiency standard for the two-county region.

The 10th percentile hourly wages for the cloud computing and IoT occupational group, except *computer user support specialists*, are above the self-sufficiency standard. The median hourly earnings for *computer user support specialists* is $27.81 per hour, above the self-sufficiency standard. Exhibit 3 displays the hourly earnings for the region.

Exhibit 3: Hourly earnings by percentile for cloud computing and IoT occupations

Source: Emsi 2020.4

According to occupational guides developed by the California Labor Market Information Division, The occupations in this group typically receive medical, dental, and life insurance; vacation; sick leave; and retirement plans from their employer (Detailed Occupational Guides, 2020).

Administration and Support for Cloud Computing and Internet of Things

Exhibit 4 displays the number of online job ads posted during the last 12 months, along with the regional and statewide average time to fill for administration and support positions within the cloud computing and IoT occupational group. To ensure sufficient job advertisements from which to obtain real-time job posting information, this search was expanded to include all California advertisements. Job advertisements in the local region accounted for nearly 1% (27 of 2,821) of job advertisements listed in the state over the last 12 months.

On average, local employers fill online job advertisements for the cloud computing and IoT administration and support occupational group within 51 days, one day longer than the statewide average of 50 days, indicating that local employers may face similar challenges when filling open positions as other employers in California as a whole.

Exhibit 4: Job ads and time to fill

Occupation	Job Ads	Regional Average Time to Fill (Days)	California Average Time to Fill (Days)
Software Developers and Software Quality Assurance Analysts and Testers	1,342	51	51
Information Security Analysts	645	59	51
Network and Computer Systems Administrators	290	51	48
Computer Network Architects	267	-	50
Database Administrators and Architects	139	57	52
Computer User Support Specialists	138	47	46
Total	**2,821**	**51**	**50**

Source: Burning Glass – Labor Insights

Advertised Salary

Exhibit 5 displays advertised salary data from the cloud computing and IoT administration and support occupational group online job ads over the last 12 months. There appears to be a significant difference between the average advertised wages for the community college-level occupation, *computer user support specialists*, and the four-year degree-level occupations. Consider the salary information with caution since only 9% (281 out of 2,821) online job postings for these occupations provided salary information. The salary figures are prorated to reflect full-time, annual wage status. There were too few postings for *database administrators and architects* to obtain reliable salary information.

Exhibit 5: Advertised salary information

Job Title	Real-Time Salary Information					
	Number of job postings	Less than $35,000	$35,000 to $49,999	$50,000 to $74,999	More than $75,000	Average Annual Salary
Software Developers and Software Quality Assurance Analysts and Testers	*115*	21%	1%	2%	75%	$104,000
Information Security Analysts	*66*	6%	-	6%	88%	$107,000
Network and Computer Systems Administrators	*44*	4%	-	16%	80%	$91,000

| Real-Time Salary Information | | | | | | |
Job Title	Number of job postings	Less than $35,000	$35,000 to $49,999	$50,000 to $74,999	More than $75,000	Average Annual Salary
Computer Network Architects	14	36%	-	-	64%	$96,000
Database Administrators and Architects	3	N/A	N/A	N/A	N/A	N/A
Computer User Support Specialists	39	8%	38%	36%	18%	$60,000

Source: Burning Glass – Labor Insights

Employers, Skills, Education, and Work Experience

Exhibit 6 displays the employers posting the most online job advertisements for the cloud computing and IoT administration and support occupational group over the last 12 months.

Exhibit 6: Employers posting the most job ads

Occupation	Employers	
Software Developers and Software Quality Assurance Analysts and Testers (n=1,342)	• Deloitte • Palo Alto Networks • Accenture	• Oracle • Amazon
Information Security Analysts (n=645)	• Deloitte • Dell • IBM	• Accenture • Palo Alto Networks
Network and Computer Systems Administrators (n=290)	• Raytheon • VMware, Inc.	
Computer Network Architects (n=267)	• Amazon • Deloitte	• Humana • Nvidia Corporation
Database Administrators and Architects (n=139)	• 8K Miles Software Service Ltd • Deloitte • Amazon	
Computer User Support Specialists (n=138)	• Samsung America, Inc. • Samsara	• Zepl • Wind River Systems

Source: Burning Glass – Labor Insights

Exhibit 7 displays a sample of specialized, employability, and software and programming skills employers seek when looking for workers to fill cloud computing and IoT administration and support positions. Specialized skills are occupation-specific skills that employers request for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job postings may be utilized to guide curriculum development.

Exhibit 7: Sample of in-demand skills from employer online job ads

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Software Developers and Software Quality Assurance Analysts and Testers *(n=1,342)*	• Cloud Computing • Software Engineering • Internet of Things (IoT) • Cloud Engineering	• Communication Skills • Teamwork/ Collaboration • Troubleshooting	• Python • Java • Linux • AWS Elastic Compute Cloud (EC2)
Information Security Analysts *(n=645)*	• Cloud Computing • Information Systems • Network Security • Cryptography	• Communication Skills • Teamwork/ Collaboration • Research	• Python • Linux • Java • Vulnerability Assessment
Network and Computer Systems Administrators *(n=290)*	• Cloud Computing • Customer Service • Virtualization • Disaster Recovery Planning	• Troubleshooting • Communication Skills • Problem Solving	• Linux • Python • VMware • Microsoft PowerShell • AWS Elastic Compute Cloud (EC2)
Computer Network Architects *(n=267)*	• Cloud Computing • Internet of Things (IoT) • Virtualization • Business Development	• Teamwork/ Collaboration • Communication Skills • Troubleshooting	• Python • Java • AWS Elastic Compute Cloud (EC2) • Linux
Database Administrators and Architects *(n=139)*	• Cloud Computing • Big Data • Relational Databases • Performance Tuning	• Troubleshooting • Communication Skills • Teamwork/ Collaboration	• Python • AWS Elastic Compute Cloud (EC2) • SQL • Linux • Amazon Redshift
Computer User Support Specialists *(n=138)*	• Technical Support • Internet of Things (IoT) • Customer Service • Cloud Computing	• Troubleshooting • Communication Skills • Teamwork/ Collaboration	• Microsoft Windows • Linux • Virtual Private Networking (VPN) • SQL

Source: Burning Glass – Labor Insights

Exhibit 8 displays the entry-level education typically required to gain employment in the cloud computing and IoT administration and support occupational group according to the Bureau of Labor Statistics (BLS), educational attainment for incumbent workers with "some college, no degree" and an "associate degree" according to the US Census (2016-17) and the real-time minimum advertised education requirement from employer job ads. All occupations in this group, except *computer user support specialists*, typically require a bachelor's degree to enter employment. Job posting data confirmed that most employers were seeking a candidate with a bachelor's degree as a minimum education requirement, including the *computer user support specialists* occupation.

Exhibit 8: Typical entry-level education, educational attainment, and minimum advertised education requirements

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Software Developers and Software Quality Assurance Analysts and Testers	Bachelor's degree	12%	932	2%	3%	95%
Information Security Analysts	Bachelor's degree	27%	476	7%	1%	92%
Network and Computer Systems Administrators	Bachelor's degree	37%	184	4%	1%	95%
Computer Network Architects	Bachelor's degree	37%	198	1%	2%	97%
Database Administrators and Architects	Bachelor's degree	22%	71	1%	-	99%
Computer User Support Specialists	Some college, no degree	41%	82	10%	6%	84%

Source: Emsi 2020.4, Burning Glass – Labor Insights
*Percentage of incumbent workers with a Community College Award or Some Postsecondary Coursework

Exhibit 9 displays the work experience typically required for the cloud computing and IoT occupational group and the real-time work experience requirements from employer job ads.

Exhibit 9: Work experience required and real-time work experience requirements

Occupation	Work Experience Typically Required	Real-Time Work Experience			
		Number of Job Ads	*0 − 2 years*	*3 − 5 years*	*6+ years*
Software Developers and Software Quality Assurance Analysts and Testers	None	940	8%	45%	47%
Information Security Analysts	Less than five years	476	12%	42%	46%
Network and Computer Systems Administrators	None	201	12%	53%	35%
Computer Network Architects	Five years or more	193	2%	21%	77%
Database Administrators and Architects	None	84	6%	49%	45%
Computer User Support Specialists	None	72	51%	36%	13%

Source: Emsi 2020.4, Burning Glass – Labor Insights

Certifications

Exhibit 10 displays the certifications required by employers posting job ads for the cloud computing and IoT administration and support occupational group in California. Please note that only 26% (725 ads) of the 2,821 total ads for this occupational group included certification requirements.

The certification most frequently included in employer job advertisements for this occupational group was Certified Information Systems Security Professional (CISSP), emphasizing the role of security within cloud computing and IoT administration and support positions. The CISSP certification is issued by (ISC)[2], a nonprofit organization aiming to provide standardization and certifications for the cybersecurity industry. To qualify for the CISSP certification, an individual must pass the exam and have at least five years of cumulative, paid work experience in a related field. For more information regarding the CISSP certification, visit the (ISC)[2] website ((ISC)[2],2021).

Exhibit 10: Certifications required by employer job ads

Occupation	Certifications
Software Developers and Software Quality Assurance Analysts and Testers *(n=121)*	• IT Infrastructure Library (ITIL) Certification • AWS Certified Solutions Architect (AWS-CSA) • Certified OpenStack Administrator (COA) • Microsoft Certified: Azure Solutions Architect Expert

Occupation	Certifications
Information Security Analysts (n=401)	• Certified Information Systems Security Professional (CISSP) • Certified Information Security Manager (CISM) • Certified Information Systems Auditor (CISA) • Cisco Certified Security Professional
Network and Computer Systems Administrators (n=110)	• CompTIA Security+ • IT Infrastructure Library (ITIL) Certification • Microsoft Certified Solutions Associate (MCSA) • Microsoft Certified Network Expert (MCSE)
Computer Network Architects (n=57)	• Cisco Certified Internetwork Expert (CCIE) • Cisco Certified Network Professional (CCNP) • AWS Certified Solutions Architect (AWS-CSA)
Database Administrators and Architects (n=14)	• Oracle Certification • Microsoft Certified Technology Specialist (MCTS) • IT Infrastructure Library (ITIL) Certification • Google Certified Professional Cloud Architect
Computer User Support Specialists (n=22)	• IT Infrastructure Library (ITIL) Certification • Cisco Certified Network Associate (CCNA) • CompTIA A+

Source: Burning Glass – Labor Insights

Software Development for Cloud Computing and Internet of Things

Exhibit 11 displays the number of online job ads posted during the last 12 months, along with the regional and statewide average time to fill for software development positions in the cloud computing and IoT occupational group. To ensure sufficient job advertisements from which to obtain real-time job posting information, this search was expanded to include all California advertisements. Job advertisements in the local region accounted for approximately 1% (104 of 8,758) of job advertisements listed in the state over the last 12 months.

On average, local employers fill online job advertisements for the cloud computing and IoT software development occupational group within 52 days, one day longer than the statewide average of 51 days, indicating that local employers may face similar challenges filling open positions as other employers in California as a whole.

Exhibit 11: Job ads and time to fill

Occupation	Job Ads	Regional Average Time to Fill (Days)	California Average Time to Fill (Days)
Software Developers and Software Quality Assurance Analysts and Testers	6,785	51	51
Information Security Analysts	788	59	51
Database Administrators and Architects	774	57	52
Computer Network Architects	250	-	50
Network and Computer Systems Administrators	92	51	48
Computer User Support Specialists	69	47	46
Total	**8,758**	**52**	**51**

Source: Burning Glass – Labor Insights

Advertised Salary

Exhibit 12 displays advertised salary data from cloud computing and IoT software development online job ads over the last 12 months. Consider the salary information with caution since only 8% (691 out of 8,758) online job postings for these occupations provided salary information. The salary figures are prorated to reflect full-time, annual wage status. There were too few online job advertisements for *network and computer systems administrators* and c*omputer user support specialist* job advertisements with software development skills to obtain reliable salary information.

Exhibit 12: Advertised salary information

Job Title	Real-Time Salary Information					
	Number of job postings	Less than $35,000	$35,000 to $49,999	$50,000 to $74,999	More than $75,000	Average Annual Salary
Software Developers and Software Quality Assurance Analysts and Testers	*561*	19%	1%	4%	76%	$105,000
Information Security Analysts	*51*	14%	2%	2%	82%	$109,000
Database Administrators and Architects	*51*	43%	2%	-	55%	$80,000
Computer Network Architects	*12*	17%	-	8%	75%	$114,000
Network and Computer Systems Administrators	*8*	N/A	N/A	N/A	N/A	N/A
Computer User Support Specialists	*8*	N/A	N/A	N/A	N/A	N/A

Source: Burning Glass – Labor Insights

Employers, Skills, Education, and Work Experience

Exhibit 13 displays the employers posting the most online job advertisements for the cloud computing and IoT software development occupational group during the last 12 months.

Exhibit 13: Employers posting the most job ads

Occupation	Employers	
Software Developers and Software Quality Assurance Analysts and Testers (*n=6,785*)	• Amazon • Deloitte • Salesforce • Cisco Systems Inc.	• Qualcomm • CrowdStrike • Palo Alto Networks
Information Security Analysts (*n=788*)	• Deloitte • Dell • Accenture	• Palo Alto Networks • IBM • Cisco Systems Inc.
Database Administrators and Architects (*n=774*)	• Anthem Blue Cross • Applied Materials	• 8K Miles Software Services, Inc. • Amazon
Computer Network Architects (*n=250*)	• Amazon • Humana • Deloitte	

Occupation	Employers	
Network and Computer Systems Administrators *(n=92)*	• VMware Inc. • Esri	• Scientific Research Corporation • The Aerospace Corporation
Computer User Support Specialists *(n=69)*	• Samsung America, Inc. • Zepl	• Wind River Systems Incorporated

Source: Burning Glass – Labor Insights

Exhibit 14 displays a sample of specialized, employability, and software and programming skills employers seek when looking for workers to fill positions in the cloud computing and IoT software development occupational group. Specialized skills are occupation-specific skills that employers are requesting for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job postings may be utilized to guide curriculum development.

Exhibit 14: Sample of in-demand skills from employer online job ads

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Software Developers and Software Quality Assurance Analysts and Testers *(n=6,785)*	• Software Engineering • Cloud Computing • Internet of Things (IoT) • Debugging • Scalability Design	• Communication Skills • Teamwork/ Collaboration • Problem Solving	• Python • Java • AWS Elastic Compute Cloud (EC2) • Linux
Information Security Analysts *(n=788)*	• Software Development • Cloud Computing • Network Security • Cryptography	• Teamwork/ Collaboration • Communication Skills • Research	• Python • Linux • Java • Software as a Service (SaaS)
Database Administrators and Architects *(n=774)*	• Big Data • Data Science • Data Warehousing • Data Engineering	• Communication Skills • Teamwork/ Collaboration • Problem Solving	• Python • SQL • AWS Elastic Computer Cloud (EC2) • Apache Hadoop • AWS Redshift

Occupation	Specialized Skills	Employability Skills	Software and Programming Skills
Computer Network Architects (*n=250*)	• Network Engineering • Cloud Computing • Internet of Things (IoT) • Software Development	• Communication Skills • Troubleshooting • Teamwork/ Collaboration	• Python • Linux • Border Gateway Protocol • AWS Elastic Compute Cloud (EC2)
Network and Computer Systems Administrators (*n=92*)	• Cloud Computing • Software Engineering • Virtualization • Scalability Design	• Troubleshooting • Problem Solving • Communication Skills	• Linux • Python • Java • AWS Elastic Compute Cloud (EC2)
Computer User Support Specialists (*n=69*)	• Internet of Things (IoT) • Customer Service • Technical Support • Cloud Computing	• Communication Skills • Troubleshooting • Teamwork/ Collaboration	• C++ • SQL • Python • Linux

Source: Burning Glass – Labor Insights

Exhibit 15 displays the entry-level education typically required to gain employment in the cloud computing and IoT software development occupational group according to the Bureau of Labor Statistics (BLS), educational attainment for incumbent workers with "some college, no degree" and an "associate degree" according to the US Census (2016-17) and the real-time minimum advertised education requirement from employer job ads.

Exhibit 15: Typical entry-level education, educational attainment, and minimum advertised education requirements

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Software Developers and Software Quality Assurance Analysts and Testers	Bachelor's degree	12%	4,707	1%	1%	98%
Information Security Analysts	Bachelor's degree	27%	535	4%	-	96%

Occupation	Typical Entry-Level Education Requirement	CC-Level Educational Attainment*	Real-Time Minimum Advertised Education Requirement			
			Number of Job Ads	High school diploma or vocational training	Associate degree	Bachelor's degree or higher
Database Administrators and Architects	Bachelor's degree	22%	472	2%	-	98%
Computer Network Architects	Bachelor's degree	37%	163	1%	3%	96%
Network and Computer Systems Administrators	Bachelor's degree	37%	51	6%	-	94%
Computer User Support Specialists	Some college, no degree	41%	49	2%	-	98%

Source: Emsi 2020.4, Burning Glass – Labor Insights
*Percentage of incumbent workers with a Community College Award or Some Postsecondary Coursework

Exhibit 16 displays the work experience typically required for the cloud computing and IoT software development occupational group and the real-time work experience requirements from employer job ads.

Exhibit 16: Work experience required and real-time work experience requirements

Occupation	Work Experience Typically Required	Real-Time Work Experience			
		Number of Job Ads	0 – 2 years	3 – 5 years	6+ years
Software Developers and Software Quality Assurance Analysts and Testers	None	4,977	11%	51%	38%
Information Security Analysts	Less than five years	551	12%	48%	40%
Database Administrators and Architects	None	600	10%	65%	25%
Computer Network Architects	Five years or more	181	4%	43%	53%
Network and Computer Systems Administrators	None	59	24%	57%	19%
Computer User Support Specialists	None	35	29%	51%	20%

Source: Emsi 2020.4, Burning Glass – Labor Insights

Certifications

Exhibit 17 displays the certifications required by employers posting job ads for the cloud computing and IoT software development occupational group in California. Please note that only 10% (838 ads) of the 8,758 total ads for this occupational group included certification requirements. Similar to the

administration and support group, the certification most frequently included in employer advertisements for software development group was the Certified Information Systems Security Professional (CISSP). For more information regarding the CISSP certification, visit the (ISC)[2] website ((ISC)[2],2021).

Exhibit 17: Certifications required by employer job ads

Occupation	Certifications
Software Developers and Software Quality Assurance Analysts and Testers *(n=382)*	• AWS Certified Solutions Architect (AWS-CSA) • Certified Information Systems Security Professional (CISSP) • AWS Certified SysOps Administrator • IT Infrastructure Library (ITIL) Certification
Information Security Analysts *(n=341)*	• Certified Information Systems Security Professional (CISSP) • Certified Information Security Manager (CISM) • Cisco Certified Security Professional • Certified Information Systems Auditor (CISA)
Database Administrators and Architects *(n=20)*	• Microsoft Certified Solutions Developer (MCSD) • Microsoft Certified Solutions Associate (MCSA) • Microsoft Certified: Azure Solutions Architect Expert • AWS Certified Solutions Architect (AWS-CSA)
Computer Network Architects *(n=72)*	• Cisco Certified Network Professional (CCNP) • Cisco Certified Internetwork Expert (CCIE) • Cisco Certified Network Associate (CCNA)
Network and Computer Systems Administrators *(n=15)*	• Microsoft Certified Solutions Associate (MCSA) • CompTIA Security + • Cisco Certified Network Associate (CCNA)
Computer User Support Specialists *(n=8)*	• Cisco Certified Network Associate (CCNA)

Source: Burning Glass – Labor Insights

Student Completions and Program Outcomes

The community college program most closely associated with cloud and internet of things administration is TOP 0708.00 computer infrastructure and support, although only one regional college assigns there cloud computing program under this TOP. There are three programs offered in the local region that provide training specific to cloud computing and the internet of things. Crafton Hills College and Riverside City College offer cloud computing programs, and Moreno Valley offers an IoT program. Crafton Hills' cloud technology specialist program is coded under computer infrastructure and support (TOP 0708.00, as noted

above) and has not conferred awards over the three most recent academic years. Riverside City's amazon web services (AWS) cloud computing program is coded under computer networking (TOP 0708.10). Riverside offers four other programs that utilize this program code, making it challenging to identify the number of cloud computing program completers. Moreno Valley College offers internet of things (IoT): embedded systems and microcontroller program coded under the computer programming (TOP 0707.10) program code. Moreno Valley offers four other programs that utilize this program code, the number of program completions specifically for the cloud computing program is unknown.

Exhibit 18 displays the annual average awards for computer infrastructure and support (TOP 0708.00) programs in the region. There were no regional awards conferred in regional computer software development (TOP 0707.00) programs.

Exhibit 18: 2016-19, Annual average community college awards for the computer infrastructure and support programs in the Inland Empire/Desert Region

0708.00 – Computer Infrastructure and Support (local program title)	Certificate requiring 6 to <18 semester units	Total CC Annual Average Awards, Academic Years 2016-19
Chaffey (Cyber Security: Analyst, Defender, Professional)	0	0
Crafton Hills (Cloud Technology Specialists, Cybersecurity Specialist)	0	0
Moreno Valley (IT Tehnician: Information Security and Cyber Defense)	0	0
Mt. San Jacinto (N/A)	1	1
Riverside (Cyber Defense)	0	0
Total	**1**	**1**

Source: MIS Data Mart

California program outcome data may provide a useful insight into the likelihood of success for the proposed program. Community college student outcome information based on the selected TOP codes and region is provided in Exhibit 19. The outcome methodology is available in the appendix section of this report. Dashes indicate there were too few students to obtain program outcome information.

Exhibit 19: 0708.00 – Computer infrastructure and support strong workforce program outcomes

Strong Workforce Program Metrics: 0708.00 – Computer Infrastructure and Support Academic Year 2017-18, unless noted otherwise	Inland Empire/Desert Region	California
Unduplicated count of enrolled students (2018-19)	183	5,571
Completed 9+ career education units in one year (2018-19)	54%	42%
Perkins Economically disadvantaged students (2018-19)	80%	71%

Strong Workforce Program Metrics: 0708.00 – Computer Infrastructure and Support Academic Year 2017-18, unless noted otherwise	Inland Empire/Desert Region	California
Students who attained a noncredit workforce milestone in a year (2018-19)	-	42%
Students who earned a degree, certificate, or attained apprenticeship (2018-19)	-	225
Transferred to a four-year institution (transfers)	-	286
Job closely related to the field of study (2016-17)	-	69%
Median annual earnings (all exiters)	$40,978	$44,642
Median change in earnings (all exiters)	28%	21%
Attained a living wage (completers and skills-builders)	81%	64%

Sources: LaunchBoard Community College Pipeline and Strong Workforce Program Metrics

Recommendation

Community college computer infrastructure and support (0708.00) programs provide the knowledge, skills, and abilities that lead to six occupations related to the administration and support of the cloud and internet of things training. The combined occupations in the cloud computing and internet of things occupational group are expected to grow by 11% and have 1,121 annual job openings over the next five years. Over this period, the community college-level occupation, *computer user support specialists*, is expected to grow by 10% and have 374 annual job openings.

The 50th percentile hourly wages for each occupation in the cloud computing and internet of things group are between $27.81 and $55.72, above the $21.78 per hour self-sufficiency standard needed for a single adult one child in the region. Each occupation in this group typically requires a bachelor's degree to enter employment, except the *computer user support specialists* occupation, which requires an associate degree.

The community college computer infrastructure and support (TOP 0708.00) program is most closely associated with cloud and internet of things administration training. Mount San Jacinto College offers this program and reported an annual average of **one award** over the last three academic years. Cloud computing programs are present at Crafton Hills College (TOP 0708.00) and Riverside City College (070810). Moreno Valley College offers an Internet of Things program (TOP 0707.10). The number of qualified students exiting these programs is unknown due to TOP reporting limitations.

The Centers of Excellence recommends expanding computer infrastructure and support (TOP 0708.00) to meet the demand for more community college-level *computer user support specialists*. It should be noted that most of the occupations associated with cloud and internet of things administration typically require a bachelor's degree to enter employment. Furthermore, while there is evidence of demand related to cloud and internet of things administration workers in California, there is little evidence of demand for these workers in the local region. Colleges considering the computer infrastructure and support should train for a broad range of skills related to this field beyond cloud and internet of things administration. Colleges specifically considering cloud and internet of things administration specialty programs should partner with employers to determine the local demand for this field and the necessary skills, education level, and certifications needed to secure employment.

Contact
Michael Goss & Paul Vaccher
Centers of Excellence, Inland Empire/Desert Region
michael.goss@chaffey.edu
January 2021

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Appendix: Occupation definitions, sample job titles, five-year projections for cloud computing and IoT support and administration occupations

Information Security Analysts (15-1212)

Plan, implement, upgrade, or monitor security measures for the protection of computer networks and information. Assess system vulnerabilities for security risks and propose and implement risk mitigation strategies. May ensure appropriate security controls are in place that will safeguard digital files and vital electronic infrastructure. May respond to computer security breaches and viruses.

Sample job titles: Information Security Officer, Information Security Specialist, Information Systems Security Analyst, Information Systems Security Officer (ISSO), Information Technology Security Analyst (IT Security Analyst), Information Technology Specialist, Network Security Analyst, Security Analyst, Systems Analyst

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 27%

Computer User Support Specialists (15-1232)

Provide technical assistance to computer users. Answer questions or resolve computer problems for clients in person, via telephone, or electronically. May provide assistance concerning the use of computer hardware and software, including printing, installation, word processing, electronic mail, and operating systems.

Sample job titles: Computer Specialist, Computer Support Specialist, Computer Technician, Desktop Support Technician, Help Desk Analyst, Help Desk Technician, Information Technology Specialist (IT Specialist), Support Specialist, Technical Support Specialist

Entry-Level Educational Requirement: Some college, no degree
Training Requirement: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 41%

Computer Network Architects (15-1241)

Design and implement computer and information networks, such as local area networks (LAN), wide area networks (WAN), intranets, extranets, and other data communications networks. Perform network modeling, analysis, and planning, including analysis of capacity needs for network infrastructures. May also design network and computer security measures. May research and recommend network and data communications hardware and software.

Sample job titles: Design Engineer, Network Analyst, Network and Security Engineer, Network Consultant, Network Systems Consultant, Networking Systems and Distributed Systems Engineer, Solutions Architect, Telecommunications Analyst

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 37%

Network and Computer Systems Administrators (15-1244)

Install, configure, and maintain an organization's local area network (LAN), wide area network (WAN), data communications network, operating systems, and physical and virtual servers. Perform system monitoring and verify the integrity and availability of hardware, network, and server resources and systems. Review system and application logs and verify completion of scheduled jobs, including system backups. Analyze network and server resource consumption and control user access. Install and upgrade software and maintain software licenses. May assist in network modeling, analysis, planning, and coordination between network and data communications hardware and software.

Sample job titles: Information Analyst, Information Systems Manager (IS Manager), Information Technology Specialist (IT Specialist), LAN Specialist (Local Area Network Specialist), Local Area Network Administrator (LAN Administrator), Network Administrator, Network Coordinator, Network Manager, Systems Administrator

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 37%

Database Administrators and Architects (15-1245)

Administer, test, and implement computer databases, applying knowledge of database management systems. Coordinate changes to computer databases. Identify, investigate, and resolve database performance issues, database capacity, and database scalability. May plan, coordinate, and implement security measures to safeguard computer databases. Design strategies for enterprise databases, data warehouse systems, and multidimensional networks. Set standards for database operations, programming, query processes, and security. Model, design, and construct large relational databases or data warehouses. Create and optimize data models for warehouse infrastructure and workflow. Integrate new systems with existing warehouse structure and refine system performance and functionality.

Sample job titles: Database Administration Manager, Database Administrator (DBA), Database Analyst, Database Coordinator, Information Systems Manager, System Administrator, Data Officer, Database

Architect, Database Consultant, Database Developer, Database Programmer, Information Architect, Information Modeling Engineer Specialist, Information Technology Architect (IT Architect), System Engineer

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 22%

Software Developers and Software Quality Assurance Analysts and Testers (15-1256)
Develop and execute software tests to identify software problems and their causes. Test system modifications to prepare for implementation. Document software and application defects using a bug tracking system and report defects to software or web developers. Create and maintain databases of known defects. May participate in software design reviews to provide input on functional requirements, operational characteristics, product designs, and schedules.

Sample job titles: Application Integration Engineer, Computer Consultant, Information Technology Analyst (IT Analyst), Product Assurance Engineer, Quality Assurance Analyst (QA Analyst), Software Quality Assurance Engineer (SQA Engineer), Software Quality Engineer, Software Test Engineer, Systems Engineer, Test Engineer

Entry-Level Educational Requirement: Bachelor's degree
Training Requirement: None
Incumbent workers with a Community College Award or Some Postsecondary Coursework: 12%

Appendix: Program Completion and Outcome Methodology

Exhibit 18 displays the average annual California Community College (CCC) awards conferred during the three academic years between 2016 and 2019, from the California Community Colleges Chancellor's Office Management Information Systems (MIS) Data Mart. Awards are the combined total of associate degrees and certificates issued during the timeframe, divided by three in this case to calculate an annual average. This is done to minimize the effect of atypical variation that might be present in a single year.

Community college student outcome information is from LaunchBoard and based on the selected TOP code and region. These metrics are based on records submitted to the California Community Colleges Chancellor's Office Management Information Systems (MIS) by community colleges, which come from self-reported student information from CCC Apply and the National Student Clearinghouse. Employment and earnings metrics are sourced from records provided by California's Employment Development Department's Unemployment Insurance database. When available, outcomes for completers are reported to demonstrate the impact that earning a degree or certificate can have on employment and earnings. For more information on the types of students included for each metric, please see the web link for LaunchBoard's Strong Workforce Program Metrics Data Element Dictionary in the References section (LaunchBoard, 2020a). Finally, employment in a job closely related to the field of study comes from self-reported student responses on the CTE Employment Outcomes Survey (CTEOS), administered by Santa Rosa Junior College (LaunchBoard, 2020a).

Job postings data is limited to the information provided by employers and the ability of artificial intelligence search engines to identify this information. Additionally, preliminary calculations by Georgetown Center on Education and the Workforce found that "just 30 to 40 percent of openings for candidates with some college or an associate degree, and only 40 to 60 percent of openings for high school diploma holders appear online" (Carnevale et al., 2014). Online job postings often do not reveal the hiring intentions of employers; it is unknown if employers plan to hire one or multiple workers from a single online job posting, or if they are collecting resumes for future hiring needs. A closed job posting may not be the result of a hired worker.

Table 1: 2019 to 2024 job growth, wages, education, training, and work experience required, Inland Empire/Desert Region

Occupation (SOC)	2019 Jobs	5-Yr Change	5-Yr % Change	Annual Openings (New + Replacement Jobs)	Entry-Experienced Hourly Wage Range (10th to 90th percentile)	Median Hourly Wage (50th percentile)	Average Annual Earnings	Typical Entry-Level Education & On-The-Job Training Required	Work Experience Required
Software Developers and Software Quality Assurance Analysts and Testers (15-1256)	4,141	609	15%	460	$26.03 to $73.55	$46.27	$100,700	Bachelor's degree & None	None
Computer User Support Specialists (15-1232)	3,561	355	10%	374	$17.48 to $46.30	$27.81	$62,700	Some college, no degree & None	None
Network and Computer Systems Administrators (15-1244)	1,733	115	7%	146	$25.58 to $62.04	$41.00	$87,100	Bachelor's degree & None	None
Computer Network Architects (15-1241)	679	31	5%	55	$24.63 to $78.37	$52.82	$107,300	Bachelor's degree & None	5 years or more
Database Administrators and Architects (15-1245)	557	54	10%	52	$23.22 to $73.89	$46.69	$98,700	Bachelor's degree & None	None
Information Security Analysts (15-1212)	304	60	20%	35	$29.86 to $79.75	$55.72	$100,700	Bachelor's degree & None	Less than 5 years
Total	**10,976**	**1,225**	**11%**	**1,121**	-	-	-	-	-

Source: Emsi 2020.4