CYBERSECURITY OCCUPATIONS

March 2021
San Diego County

COE CENTERS OF EXCELLENCE FOR LABOR MARKET RESEARCH

COMMUNITY COLLEGES
SAN DIEGO & IMPERIAL COUNTIES
CAREER EDUCATION

California Community Colleges

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Summary and Findings

In 2018, the Centers of Excellence for Labor Market Research (COE) published a statewide study on *Cybersecurity Occupations*.[1] This report includes updated labor market information for *Cybersecurity Occupation*s in San Diego County to assist the community college system with program development and strategic planning. Due to the complexity in this industry, the San Diego-Imperial COE analyzed traditional labor market information (LMI) and online job postings (real-time LMI) for *Cybersecurity Occupations* and grouped them into two categories from the statewide study: 1) information technology or information systems (IT/IS) jobs requiring cybersecurity skills and 2) specialized cybersecurity jobs. Based on the available LMI, the San Diego-Imperial COE found that:

- There is a labor market supply gap for *Cybersecurity Occupations* in San Diego County.

- Entry-level and median wages for *Cybersecurity Occupations* are above the living wage for San Diego County. This suggests that with enough education and experience, workers in these positions could earn sustainable wages.

- Employers posted a minimum of a bachelor's degree for *Cybersecurity Occupations*.

- Programs in the following Taxonomy of Programs (TOP) codes had a higher proportion of students earn a living wage than Career Education programs in general across the region: *Computer Infrastructure and Support (0708.00)*, *Computer Networking (0708.10), Computer Software Development (0707.00)*, *Computer Support (0708.20)*, *Software Applications (0702.10)*, and *World Wide Web Administration (0709.00)*.

- Similarly, programs in the following TOP codes had a higher percentage of students who obtained a job closely related to their field of study than Career Education programs in general across the region: *Computer Information Systems (0702.00), Computer Infrastructure and Support (0708.00)*, *Computer Networking (0708.10)*, and *Software Applications (0702.10)*.

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[1] "Cybersecurity: Labor Market Analysis and Statewide Survey Results from California Employers and Postsecondary Institutions," The California Community Colleges Centers of Excellence for Labor Market Research, June 2018, March 4, 2021, http://coeccc.net/reports/cybersecurity.

Introduction

To address the statewide cybersecurity labor shortage, the California Community Colleges Centers of Excellence for Labor Market Research (COE) analyzed two key types of *Cybersecurity Occupations* in 2018: 1) information technology or information systems (IT/IS) jobs requiring cybersecurity skills and 2) specialized cybersecurity jobs.[2] In this updated study, the San Diego-Imperial COE analyzed **traditional**[3] labor market information for the following occupational codes in the Standard Occupational Classification (SOC)[4] system and grouped them into these two categories.

IT/IS jobs requiring cybersecurity skills include:

- Computer User Support Specialists (SOC 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.

- Computer Network Support Specialists (SOC 15-1231): Analyze, test, troubleshoot, and evaluate existing network systems, such as local area networks (LAN), wide area networks (WAN), cloud networks, servers, and other data communications networks. Perform network maintenance to ensure networks operate correctly with minimal interruption.

- Network and Computer Systems Administrators (SOC 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.

- Software Developers and Software Quality Assurance Analysts and Testers (SOC 15-1256): Research, design, and develop computer and network software or specialized utility programs. Analyze user needs and develop software solutions, applying principles and techniques of computer science, engineering, and mathematical analysis. Update software or

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[2] "Cybersecurity: Labor Market Analysis and Statewide Survey Results from California Employers and Postsecondary Institutions," The California Community Colleges Centers of Excellence for Labor Market Research, June 2018, March 4, 2021, coeccc.net/reports/cybersecurity.

[3] Traditional labor market research consists of a longitudinal analysis of historical and projected occupational data.

[4] The Standard Occupational Classification (SOC) system is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. bls.gov/soc.

enhance existing software capabilities. May work with computer hardware engineers to integrate hardware and software systems, and develop specifications and performance requirements. May maintain databases within an application area, working individually or coordinating database development as part of a team. 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.

Specialized cybersecurity jobs include:

- Information Security Analysts (SOC 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.

Collectively, these occupations are referred to as *Cybersecurity Occupations*. The following sections provide an overview of their labor market need, wages, and knowledge, skills and abilities.

Supply Gap Analysis

The following sections provide details on employer demand, educational supply, and supply gap analysis. A supply gap suggests that employers have more labor market demand than workers supplied by educational institutions.

EMPLOYER DEMAND

Between 2020 and 2025, *Cybersecurity Occupations* are projected to increase by 3,751 net jobs or 12 percent (Exhibit 1). During this period, employers in San Diego County are projected to hire 2,849 workers annually to fill new jobs and backfill jobs due to attrition caused by turnover and retirement, for example.

Exhibit 1: Number of Jobs (Employment) for *Cybersecurity Occupations* in San Diego County, 2009-2025 [5]

Labor Market Demand

2,849 annual job openings (2019-2024)
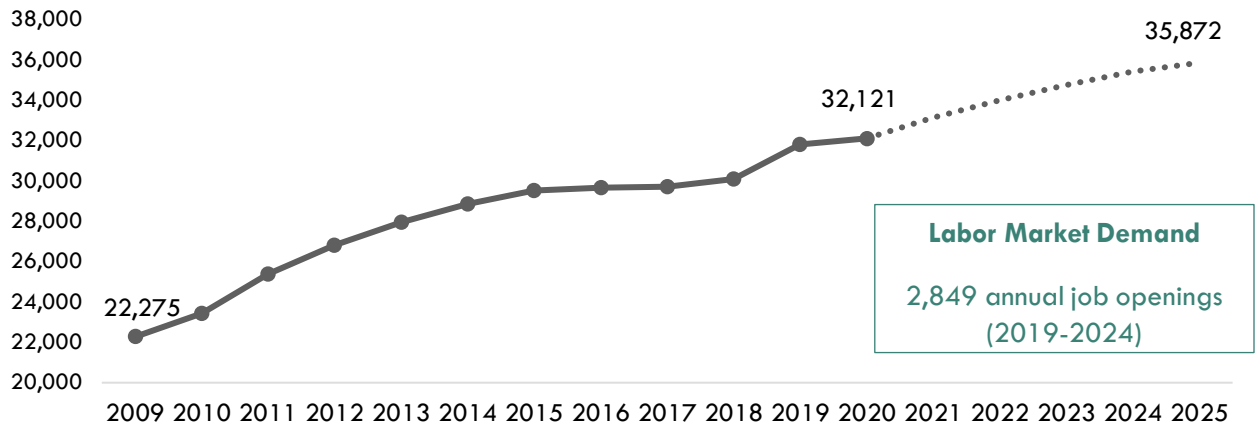
Exhibit 2 provides more detailed information for each occupation, including projected employment change and labor market demand between 2020 and 2025. Labor market demand is defined by the number of job openings that employers expect to fill due to attrition (caused by turnover and retirement, for example). Employers in San Diego County are projected to hire 2,849 workers annually between 2020 and 2025 for *Cybersecurity Occupations*.

Exhibit 2: Number of Jobs for *Cybersecurity Occupations* in San Diego County (2020-2025)[6]

Occupational Title	2020 Jobs	2025 Jobs	2020 - 2025 Net Jobs Change	2020-2025 % Net Jobs Change*	Annual Job Openings* (Demand)
Software Developers and Software Quality Assurance Analysts and Testers	21,101	23,836	2,735	13%	1,908
Computer User Support Specialists	5,076	5,566	490	10%	454
Network and Computer Systems Administrators	3,157	3,348	191	6%	226
Information Security Analysts	1,390	1,616	225	16%	142
Computer Network Support Specialists	1,396	1,506	110	8%	119
Total Projected (2020-2025) Annual Job Openings					**2,849**

*Percentages and numbers are rounded up

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[6] Emsi 2021.01; QCEW, Non-QCEW, Self-Employed.

EDUCATIONAL SUPPLY

Educational supply for an occupation can be estimated by analyzing the number of awards in related Taxonomy of Programs (TOP) or Classification of Instructional Programs (CIP) codes.[7] There are 12 TOP codes and 36 CIP codes related to *Cybersecurity Occupations* (Exhibit 3).

Exhibit 3: Related TOP and CIP Codes for *Cybersecurity Occupations*

Cybersecurity Occupations
TOP 0701.00: Information Technology, General
TOP 0702.00: Computer Information Systems
TOP 0702.10: Software Applications
TOP 0707.00: Computer Software Development
TOP 0707.10: Computer Programming
TOP 0707.30: Computer Systems Analysis
TOP 0708.00: Computer Infrastructure and Support
TOP 0708.10: Computer Networking
TOP 0708.20: Computer Support
TOP 0709.00: World Wide Web Administration
TOP 0934.30: Telecommunications Technology
TOP 2105.40: Forensics, Evidence, and Investigation
CIP 11.0101 Computer and Information Sciences, General
CIP 11.0102 Artificial Intelligence
CIP 11.0103 Information Technology
CIP 11.0104 Informatics
CIP 11.0199 Computer and Information Sciences, Other
CIP 11.0201 Computer Programming/Programmer, General
CIP 11.0202 Computer Programming, Specific Applications
CIP 11.0299 Computer Programming, Other
CIP 11.0401 Information Science/Studies
CIP 11.0501 Computer Systems Analysis/Analyst
CIP 11.0601 Data Entry/Microcomputer Applications, General
CIP 11.0701 Computer Science

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[7] TOP data comes from the California Community Colleges Chancellor's Office MIS Data Mart (datamart.cccco.edu) and CIP data comes from the Integrated Postsecondary Education Data System (nces.ed.gov/ipeds/use-the-data).

Cybersecurity Occupations
CIP 11.0801 Web Page, Digital/Multimedia and Information Resources Design
CIP 11.0802 Data Modeling/Warehousing and Database Administration
CIP 11.0899 Computer Software and Media Applications, Other
CIP 11.0901 Computer Systems Networking and Telecommunications
CIP 11.1001 Network and System Administration/Administrator
CIP 11.1002 System, Networking, and LAN/WAN Management/ Manager
CIP 11.1003 Computer and Information Systems Security/Information Assurance
CIP 11.1004 Web/Multimedia Management and Webmaster
CIP 11.1005 Information Technology Project Management
CIP 11.1006 Computer Support Specialist
CIP 11.1099 Computer/Information Technology Services Administration and Management, Other
CIP 11.9999 Computer and Information Sciences and Support Services, Other
CIP 15.1201 Computer Engineering Technology/Technician
CIP 15.1202 Computer Technology/Computer Systems Technology
CIP 15.1203 Computer Hardware Technology/Technician
CIP 15.1204 Computer Software Technology/Technician
CIP 15.1299 Computer Engineering Technologies/Technicians, Other
CIP 29.0207 Cyber/Electronic Operations and Warfare
CIP 43.0116 Cyber/Computer Forensics and Counterterrorism
CIP 43.0301 Homeland Security
CIP 43.0303 Critical Infrastructure Protection
CIP 52.1201 Management Information Systems, General
CIP 52.1206 Information Resources Management
CIP 52.2101 Telecommunications Management

According to TOP data, nine community colleges supply the region with awards for this occupation: Cuyamaca College, Grossmont College, MiraCosta College, Palomar College, San Diego City, San Diego Continuing Education, San Diego Mesa College, San Diego Miramar and Southwestern College. According to CIP data, 14 non-community colleges supply the region with awards: Advanced Training Associates, Argosy University-The Art Institute of California-San Diego, Ashford University, Associated Technical College-San Diego, California College San Diego, California Institute of Arts & Technology, California Miramar University, California State University-San Marcos, Coleman University, National University, Point Loma Nazarene University, San Diego State University, University of California-San Diego, and University of San Diego (Exhibit 4).

Exhibit 4: Number of Awards (Certificates and Degrees) Conferred by Postsecondary Institutions (Program Year 2014-15 through PY2018-19 Average)[8]

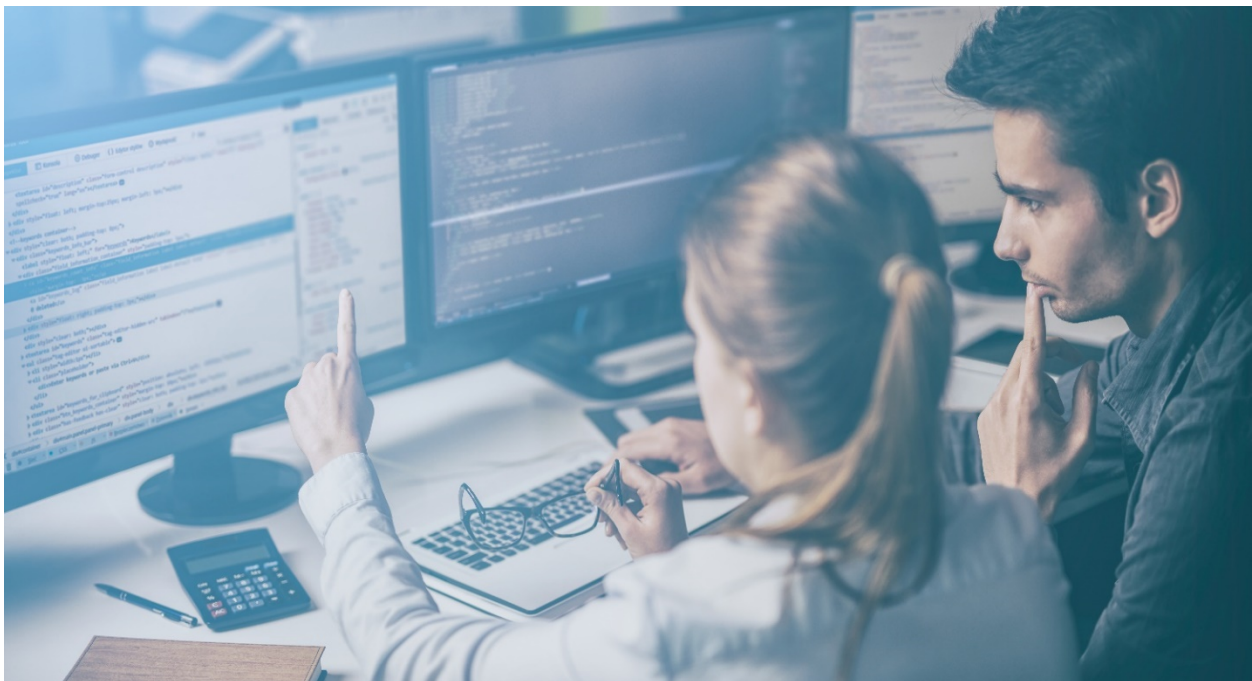| TOP6 or CIP	TOP6 or CIP Title	3-Yr Annual Average CC Awards (PY16-17 to PY18-19)	Other Educational Institutions 3-Yr Annual Average Awards (PY14-15 to PY16-17)	3-Yr Total Average Supply (PY14-15 to PY18-19)
0701.00	Information Technology, General	**8**	**0**	**8**
	• Southwestern	8	0	
0702.00	Computer Information Systems	**78**	0	**78**
	• MiraCosta	2	0	
	• Palomar	15	0	
	• San Diego City	2	0	
	• San Diego Cont. Ed.	25	0	
	• San Diego Mesa	24	0	
	• San Diego Miramar	7	0	
	• Southwestern	3	0	
0702.10	Software Applications	**71**	**0**	**71**
	• Grossmont	2	0	
	• MiraCosta	11	0	
	• San Diego Cont. Ed.	47	0	

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[8] "Supply and Demand," Centers of Excellence for Labor Market Research, coeccc.net/Supply-and-Demand.aspx. Note: Data is derived from the California Community Colleges Chancellor's Office (CCCCO) MIS Data Mart.

TOP6 or CIP	TOP6 or CIP Title	3-Yr Annual Average CC Awards (PY16-17 to PY18-19)	Other Educational Institutions 3-Yr Annual Average Awards (PY14-15 to PY16-17)	3-Yr Total Average Supply (PY14-15 to PY18-19)
	• San Diego City	4	0	
	• San Diego Miramar	6	0	
	• Southwestern	1	0	
0707.00	Computer Software Development	**30**	**0**	**30**
	• Palomar	30	0	
0707.10	Computer Programming	**49**	**0**	**49**
	• Grossmont	13	0	
	• MiraCosta	8	0	
	• Palomar	4	0	
	• San Diego City	21	0	
	• San Diego Mesa	1	0	
	• Southwestern	2	0	
0708.00	Computer Infrastructure and Support	**87**	**0**	**87**
	• MiraCosta	1	0	
	• San Diego City	26	0	
	• San Diego Cont Ed	60	0	
0708.10	Computer Networking	**87**	**0**	**87**
	• Cuyamaca	11	0	
	• Grossmont	7	0	
	• MiraCosta	15	0	
	• Palomar	38	0	
	• San Diego City	8	0	
	• San Diego Cont Ed	7	0	
	• Southwestern	1	0	
0708.20	Computer Support	**220**	**0**	**220**
	• MiraCosta	1	0	

TOP6 or CIP	TOP6 or CIP Title	3-Yr Annual Average CC Awards (PY16-17 to PY18-19)	Other Educational Institutions 3-Yr Annual Average Awards (PY14-15 to PY16-17)	3-Yr Total Average Supply (PY14-15 to PY18-19)
	• San Diego Cont Ed	217	0	
	• Southwestern	2	0	
0709.00	World Wide Web Administration	**16**	**0**	**16**
	• Grossmont	7	0	
	• Palomar	7	0	
	• San Diego Cont. Ed.	2	0	
2105.40	Forensics, Evidence, and Investigation	**82**	**0**	**82**
	• Grossmont	63	0	
	• Palomar	6	0	
	• San Diego Miramar	9	0	
	• Southwestern	4	0	
11.0101	Computer and Information Sciences, General	**0**	**34**	**34**
	• Advanced Training Associates	0	27	
	• Associated Technical College-San Diego	0	7	
11.0201	Computer Programming/Programmer, General	**0**	**30**	**30**
	• California College San Diego	0	8	
	• Coleman University	0	22	
11.0602	Word Processing	**0**	**0**	**0**
	• California Institute of Arts & Technology	0	0	
11.0701	Computer Science	**0**	**733**	**733**
	• Ashford University	0	5	
	• California College San Diego	0	63	
	• California State University-San Marcos	0	67	
	• National University	0	23	

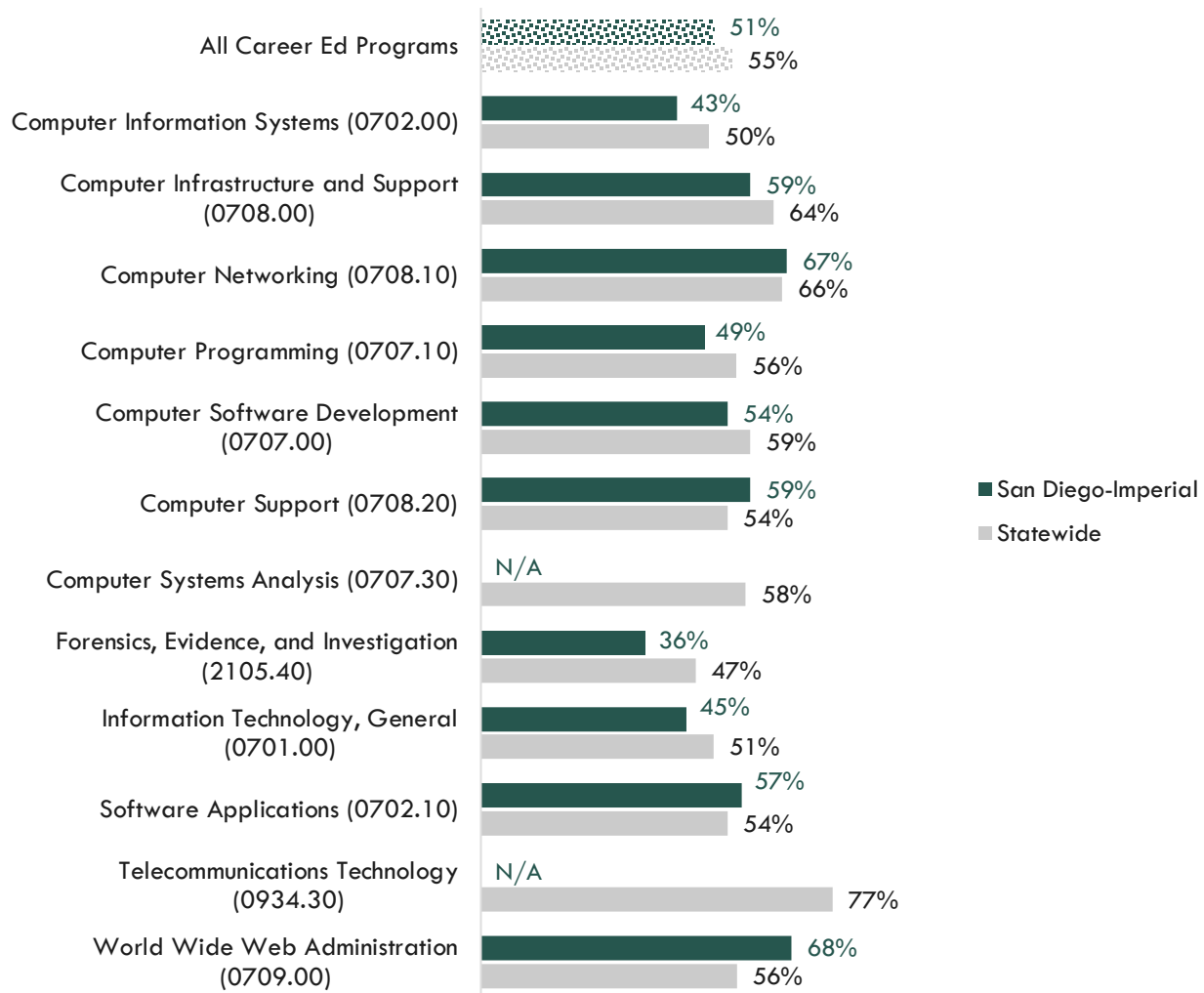| TOP6 or CIP	TOP6 or CIP Title	3-Yr Annual Average CC Awards (PY16-17 to PY18-19)	Other Educational Institutions 3-Yr Annual Average Awards (PY14-15 to PY16-17)	3-Yr Total Average Supply (PY14-15 to PY18-19)
	• Point Loma Nazarene University	0	7	
	• San Diego State University	0	95	
	• University of California-San Diego	0	462	
	• University of San Diego	0	11	
11.0801	Web Page, Digital/Multimedia and Information Resources Design	**0**	**38**	**38**
	• Argosy University-The Art Institute of California-San Diego	0	36	
	• California Institute of Arts & Technology	0	0	
	• Coleman University	0	2	
11.0901	Computer Systems Networking and Telecommunications	**0**	**35**	**35**
	• Coleman University	0	35	
11.1001	Network and System Administration/Administrator	**0**	**2**	**2**
	• California Institute of Arts & Technology	0	2	
11.1002	System, Networking, and LAN/WAN Management/Manager	**0**	**1**	**1**
	• California Institute of Arts & Technology	0	1	
11.1005	Information Technology Project Management	**0**	**72**	**72**
	• National University	0	72	
11.9999	Computer and Information Sciences and Support Services, Other	**0**	**14**	**14**
	• Associated Technical College-San Diego	0	14	
15.1202	Computer Technology/Computer Systems Technology	**0**	**1**	**1**

TOP6 or CIP	TOP6 or CIP Title	3-Yr Annual Average CC Awards (PY16-17 to PY18-19)	Other Educational Institutions 3-Yr Annual Average Awards (PY14-15 to PY16-17)	3-Yr Total Average Supply (PY14-15 to PY18-19)
	• California Institute of Arts & Technology	0	1	
43.0301	Homeland Security	**0**	**53**	**53**
	• California Miramar University	0	2	
	• National University	0	51	
52.1201	Management Information Systems, General	**0**	**230**	**230**
	• Ashford University	0	183	
	• National University	0	45	
	• Point Loma Nazarene University	0	2	
			Total	**1,971**

STUDENT OUTCOMES

According to the California Community Colleges LaunchBoard, programs in the following TOP codes had a higher proportion of students earn a living wage than Career Education programs in general across the region: *Computer Infrastructure and Support (0708.00)*, *Computer Networking (0708.10)*, *Computer Software Development (0707.00)*, *Computer Support (0708.20)*, *Software Applications (0702.10)*, and *World Wide Web Administration (0709.00)* (Exhibit 5).[9]

Exhibit 5: Proportion of Students Who Earned a Living Wage by Program, PY2017-18[10]
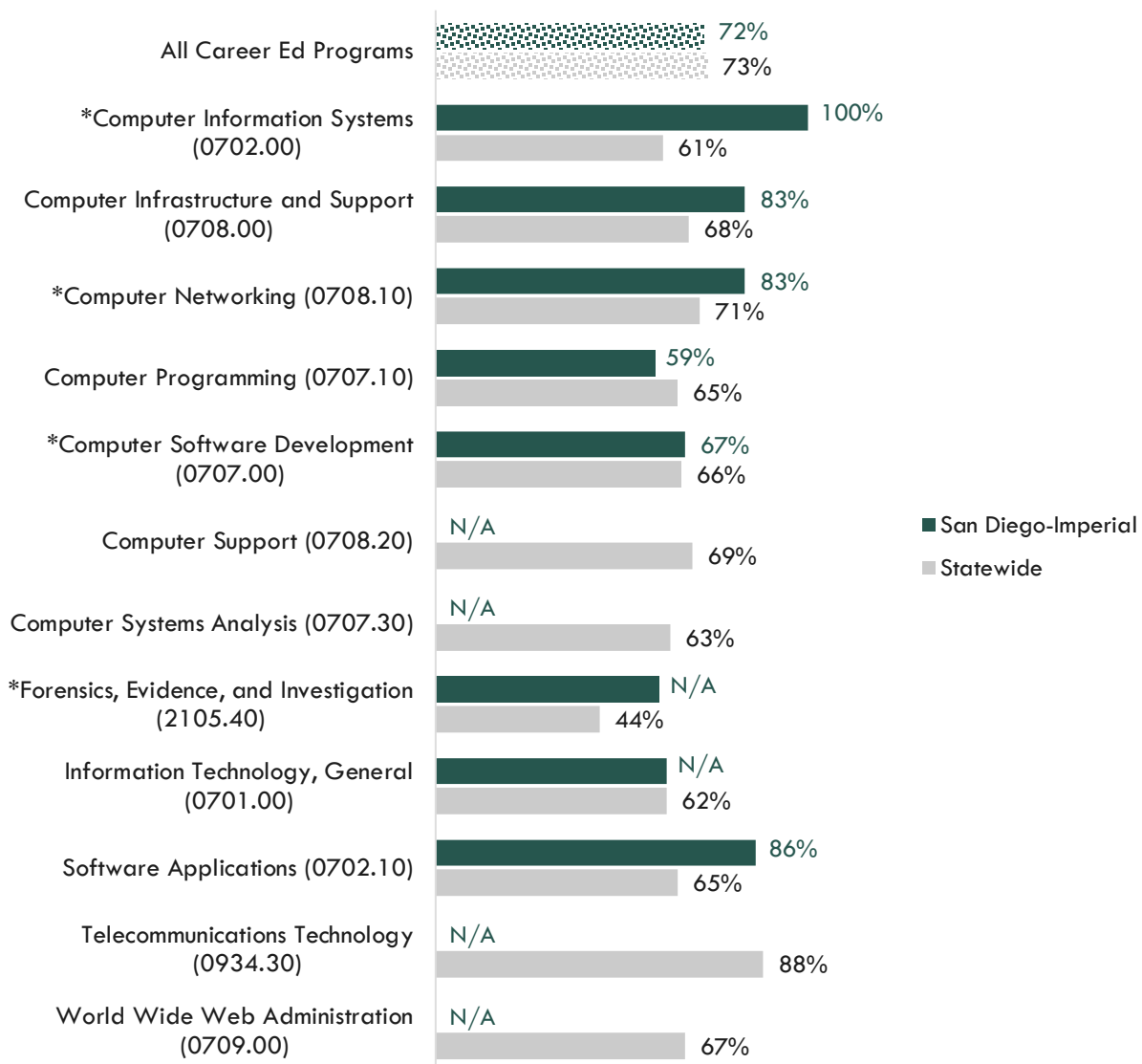
Program	San Diego-Imperial	Statewide
All Career Ed Programs	51%	55%
Computer Information Systems (0702.00)	43%	50%
Computer Infrastructure and Support (0708.00)	59%	64%
Computer Networking (0708.10)	67%	66%
Computer Programming (0707.10)	49%	56%
Computer Software Development (0707.00)	54%	59%
Computer Support (0708.20)	59%	54%
Computer Systems Analysis (0707.30)	N/A	58%
Forensics, Evidence, and Investigation (2105.40)	36%	47%
Information Technology, General (0701.00)	45%	51%
Software Applications (0702.10)	57%	54%
Telecommunications Technology (0934.30)	N/A	77%
World Wide Web Administration (0709.00)	68%	56%

*sample size had fewer than 10 students
"N/A" indicates insufficient data

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[9] "California Community Colleges Strong Workforce Program," California Community Colleges, calpassplus.org/LaunchBoard/SWP.aspx.
[10] Among completers and skills builders who exited, the proportion of students who attained a living wage.

Similarly, according to the California Community Colleges LaunchBoard, programs in the following TOP codes had a higher percentage of students who obtained a job closely related to their field of study than Career Education programs in general across the region: *Computer Information Systems (0702.00)*, *Computer Infrastructure and Support (0708.00)*, *Computer Networking (0708.10)*, and *Software Applications (0702.10)* (Exhibit 6).[11]

Exhibit 6: Percentage of Students in a Job Closely Related to Field of Study by Program PY2016-17[12]

Program	San Diego-Imperial	Statewide
All Career Ed Programs	72%	73%
*Computer Information Systems (0702.00)	100%	61%
Computer Infrastructure and Support (0708.00)	83%	68%
*Computer Networking (0708.10)	83%	71%
Computer Programming (0707.10)	59%	65%
*Computer Software Development (0707.00)	67%	66%
Computer Support (0708.20)	N/A	69%
Computer Systems Analysis (0707.30)	N/A	63%
*Forensics, Evidence, and Investigation (2105.40)	N/A	44%
Information Technology, General (0701.00)	N/A	62%
Software Applications (0702.10)	86%	65%
Telecommunications Technology (0934.30)	N/A	88%
World Wide Web Administration (0709.00)	N/A	67%

*sample size had fewer than 10 students
"N/A" indicates insufficient data

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[11] "California Community Colleges Strong Workforce Program," California Community Colleges, calpassplus.org/LaunchBoard/SWP.aspx.
[12] Most recent year in which data is available. Percentage of Students in a Job Closely Related to Field of Study: Among students who responded to the CTEOS, the percentage reporting employment in the same or similar field as their program of study.

DEMAND VS. SUPPLY

Comparing labor demand (annual openings) with labor supply[13] suggests that there is a supply gap for these occupations in San Diego County, with 2,849 annual openings and 1,971 awards. Comparatively, there are 38,521 annual openings in California and 4,804 awards, suggesting that there is also a supply gap across the state (Exhibit 7).

Exhibit 7: Demand (Annual Openings) vs. Supply (Average Annual Awards)[14]

	Demand (Annual Openings)	Supply (Total Annual Average Supply)	Supply Gap or Oversupply
Imperial	2,849	1,971	**878**
California	38,521	4,804	**33,717**

NOTE: This is a basic analysis of supply and demand of labor. The data does not include workers currently in the labor force who could fill these positions or workers who are not captured by publicly available data. This data should be used to discuss the potential gaps or oversupply of workers; however, it should not be the only basis for determining whether a program should be developed.

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[13] Labor supply can be found from two different sources: EMSI or the California Community Colleges Chancellor's Office MIS Data Mart. EMSI uses CIP codes while MIS uses TOP codes. Different coding systems result in differences in the supply numbers.
[14] "Supply and Demand," Centers of Excellence for Labor Market Research, coeccc.net/Supply-and-Demand.aspx.

Occupational Overview

Due to the complexity of the industry, employers use various job titles for positions with similar functions. In the 2018 statewide study, the COE used the job titles shown in the exhibit below, which are representative of the occupational titles from the SOC system analyzed in this updated report.

Exhibit 8: Job Titles Used for *Cybersecurity Occupations* in Past and Current Reports

Occupational Titles in This Updated Report	Job Titles in 2018 Statewide Study
Computer User Support Specialists	Technical Support Specialists
Computer Network Support Specialists	Network Operations Specialists
Network and Computer Systems Administrators	System Administrators
Software Developers and Software Quality Assurance Analysts and Testers	Software Developers
Information Security Analysts	Systems Security Analysts Cyber Defense Analysts Cyber Defense Infrastructure Support Specialists Vulnerability Assessment Analysts Cyber Defense Forensic Analysts

The San Diego-Imperial COE analyzed both *traditional labor market information* and *online job postings* to identify educational requirements, wages, and skills for these occupations. The following sections provide a comparison of these two data sources for the various job titles in Exhibit 8.

TYPICAL ENTRY-LEVEL EDUCATION

Traditional labor market information indicates that more than half of *Cybersecurity Occupations* identified in the SOC system require a bachelor's degree (Exhibit 9a).

Exhibit 9a: Typical Educational Requirements for *Cybersecurity Occupations* in San Diego County (Traditional Labor Market Information for SOC Occupational Titles)

SOC Code	Occupational Title	Typical Entry-Level Education
15-1212	Information Security Analysts	Bachelor's degree
15-1244	Network and Computer Systems Administrators	Bachelor's degree
15-1256	Software Developers and Software Quality Assurance Analysts and Testers	Bachelor's degree
15-1231	Computer Network Support Specialists	Associate degree
15-1232	Computer User Support Specialists	Some college, no degree

As previously mentioned, employers use a variety of job titles for *Cybersecurity Occupations*. Using the 2018 statewide report's job titles (see Exhibit 8), the San Diego-Imperial COE found that employers posted a minimum educational requirement of a bachelor's degree for most of these occupations in online job postings (Exhibit 9b).

Exhibit 9b: Typical Educational Requirements for *Cybersecurity Occupations* in San Diego County (Percentage* of Online Job Postings for Statewide Report Jobs Titles, Jan 2016 - Dec 2020)[15]

Occupational Title	Associate Degree or Less	Bachelor's Degree+
Technical Support Specialist	28%	72%
Network Operations Specialist	83%	17%
System Administrator	N/A	N/A
Software Developer	4%	96%
Systems Security Analyst	16%	84%
Cyber Defense Analyst	0%	100%
Cyber Defense Infrastructure Support Specialist	N/A	N/A
Vulnerability Assessment Analyst	0%	100%
Cyber Defense Forensic Analyst	N/A	N/A

May not add up to 100% due to rounding

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[15] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

WAGES

According to traditional LMI, entry-level hourly earnings of *Cybersecurity Occupations* range from $21.90 to $43.69 (Exhibit 10a). This is more than the living wage for a single adult in San Diego County, which is $15.99 per hour.[16]

Exhibit 10a: Hourly* Earnings for *Cybersecurity Occupations* in San Diego County
(Traditional Labor Market Information for SOC Occupational Titles)[17]

SOC Code	SOC Occupational Title	Entry-Level Hourly Earnings (25th Percentile)	Median Hourly Earnings
15-1256	Software Developers and Software Quality Assurance Analysts and Testers	$43.69	$55.50
15-1212	Information Security Analysts	$41.99	$49.29
15-1244	Network and Computer Systems Administrators	$36.16	$45.71
15-1231	Computer Network Support Specialists	$24.94	$34.52
15-1232	Computer User Support Specialists	$21.90	$28.00

*To annualize these salaries, hourly earnings may be multiplied by 2080 hours; however, it's important to recognize that not all employers offer full-time employment for these occupations

Exhibit 10b provides average salary estimates for online job postings between January 01, 2016 and December 31, 2020, using the job titles from the 2018 statewide report for *Cybersecurity Occupations*. According to Burning Glass Technologies, the data source for online job postings, "actual compensation may vary based on individual employer salary practices and experience. Market salary is calculated using a machine learning model built off of millions of job postings every year, and accounting for adjustments based on locations, industry, skills, experience, education requirements, among other variables. Market salary provides insight into the likely salary of workers within a specific occupation, as well as further detail on the impact of additional skills on salary."[18]

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[16] "California Family Needs Calculator (formerly the Self-Sufficiency Standard)," Insight: Center for Community Economic Development, last updated 2018. insightcced.org/2018-self-sufficiency-standard.
[17] Emsi 2021.01; QCEW, Non-QCEW, Self-Employed.
[18] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

Exhibit 10b: Estimated Market Salary and Hourly Wages for *Cybersecurity Occupations* in San Diego County (Online Job Postings for Statewide Report Job Titles, Jan 2016 - Dec 2020)[19]

Occupational Title	Market Annual Salary (Median)	Estimated Hourly Wage*
Technical Support Specialist	$41,525	$19.96
Network Operations Specialist	$48,484	$23.31
System Administrator	N/A	N/A
Software Developer	$91,732	$44.10
Systems Security Analyst	$80,063	$38.49
Cyber Defense Analyst	$69,208	$33.27
Cyber Defense Infrastructure Support Specialist	N/A	N/A
Vulnerability Assessment Analyst	$94,759	$45.56
Cyber Defense Forensic Analyst	N/A	N/A

*The San Diego-Imperial COE derived hourly wages by dividing the median market annual salaries by 2080 hours.

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[19] Ibid.

KNOWLEDGE, SKILLS AND ABILITIES

Based on the SOC occupational titles from traditional LMI, Exhibit 11a lists the top specialized, soft and software skills found in online job postings between January 1, 2016 and December 31, 2020.

Exhibit 11a: Top Skills for *Cybersecurity Occupations* in San Diego County
(Online Job Postings for SOC Occupational Titles)[20]

Specialized Skills	Soft Skills	Software Skills
1. Software Engineering	1. Communication Skills	1. Java
2. Software Development	2. Troubleshooting	2. SQL
3. Technical Support	3. Teamwork / Collaboration	3. Linux
4. Information Systems	4. Problem Solving	4. JavaScript
5. Object-Oriented Analysis and Design	5. Writing	5. Python
6. Debugging	6. Planning	6. C++
7. Project Management	7. Research	7. Microsoft C#
8. Unit Testing	8. Written Communication	8. Git
9. Scrum	9. Detail-Oriented	9. Oracle
10. System Administration	10. Organizational Skills	10. Agile Development
11. DevOps	11. Creativity	11. .NET
12. Agile Development	12. Verbal / Oral Communication	12. UNIX
13. Software Architecture	13. Multi-Tasking	13. Software Architecture
14. Computer Engineering	14. Self-Starter	14. Extensible Markup Language
15. Scheduling	15. Physical Abilities	15. Computer Engineering
16. Web Application Development	16. Mentoring	16. SQL Server
17. Quality Assurance and Control	17. Computer Literacy	17. MySQL
18. Hardware and Software Configuration	18. Time Management	18. AngularJS
19. Repair	19. Presentation Skills	19. PERL Scripting Language
20. Network Hardware/Software Maintenance	20. Leadership	20. VMware
21. Continuous Integration	21. Building Effective Relationships	21. jQuery
22. Configuration Management	22. English	22. Atlassian JIRA
23. Hardware and Software Installation	23. Analytical Skills	23. JavaScript Object Notation
24. Customer Contact	24. Oral Communication	24. Active Server Pages
25. Systems Engineering	25. Meeting Deadlines	25. Systems Development Life Cycle

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[20] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

Based on the 2018 statewide report job titles, Exhibit 11b lists the top specialized, soft and software skills found in online job postings between January 1, 2016 and December 31, 2020.

Exhibit 11b: Top Skills for *Cybersecurity Occupations* in San Diego County
(Online Job Postings for Statewide Report Job Titles, Jan 2016 – Dec 2020)[21]

Specialized Skills	Soft Skills	Software Skills
1. Software Development	1. Communication Skills	1. SQL
2. Software Engineering	2. Problem Solving	2. Java
3. Object-Oriented Analysis and Design	3. Troubleshooting	3. JavaScript
4. Information Systems	4. Teamwork / Collaboration	4. C++
5. Debugging	5. Planning	5. Microsoft C#
6. Technical Support	6. Writing	6. Linux
7. Unit Testing	7. Research	7. Python
8. Scrum	8. Written Communication	8. Git
9. Web Application Development	9. Organizational Skills	9. .NET
10. Agile Development	10. Detail-Oriented	10. jQuery
11. Data Management	11. Verbal / Oral Communication	11. Extensible Markup Language (XML)
12. Software Architecture	12. Creativity	12. SQL Server
13. Project Management	13. Time Management	13. Active Server Pages (ASP)
14. Network Hardware/Software Maintenance	14. Multi-Tasking	14. AngularJS
15. Computer Engineering	15. Leadership	15. MySQL
16. Web Development	16. Self-Starter	16. ASP.NET
17. Lifecycle Management	17. Analytical Skills	17. Visual Studio
18. Quality Assurance and Control	18. Physical Abilities	18. Oracle
19. Relational Databases	19. Computer Literacy	19. JavaScript Object Notation (JSON)
20. Bootstrapping	20. Presentation Skills	20. HTML5
21. Continuous Integration	21. Meeting Deadlines	21. Atlassian JIRA
22. Technical Writing / Editing	22. Typing	22. Microsoft Excel
23. Transmission Control Protocol / Internet Protocol	23. English	23. PostgreSQL
24. User Interface Design	24. Mentoring	24. NoSQL
25. Scheduling	25. Building Effective Relationships	25. React JavaScript

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[21] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

TOP CERTIFICATIONS

Based on the SOC occupational titles from traditional LMI, Exhibit 12a lists the top certifications that appeared in online job postings between January 1, 2016 and December 31, 2020.

Exhibit 12a: Top Certifications for *Cybersecurity Occupations* in San Diego County (Online Job Postings for SOC Occupational Titles, Jan 2016 - Dec 2020)[22]

Top Certifications in Online Job Postings	
1. Security Clearance	7. SANS/GIAC Certification
2. CompTIA Security+	8. CompTIA Network+
3. Certified Info. Systems Security Professional	9. Microsoft Certified Solutions Associate
4. IT Infrastructure Library Certification	10. Certified Information Systems Auditor
5. Cisco Certified Network Associate	11. Certified Information Security Manager
6. Certified A+ Technician	12. Microsoft Certified Solutions Expert

Based on statewide report job titles, Exhibit 12b lists the top certifications that appeared in online job postings between January 1, 2016 and December 31, 2020.

Exhibit 12b: Top Certifications for *Cybersecurity Occupations* in San Diego County (Online Job Postings for Statewide Report Job Titles, Jan 2016 - Dec 2020)[23]

Top Certifications in Online Job Postings	
1. Security Clearance	7. IT Infrastructure Library Certification
2. CompTIA Security+	8. Microsoft Certified Solutions Associate
3. Certified A+ Technician	9. Microsoft Certified Professional
4. Certified Info. Systems Security Professional.	10. Microsoft Certified Technology Specialist
5. Cisco Certified Network Associate	11. Gaming & Vending Technician
6. CompTIA Network+	12. SANS/GIAC Certification

Exhibits 12a and 12b show the top certifications for *Cybersecurity Occupations* in this report. However, the 2018 statewide cybersecurity study indicated that employers prefer the following certifications: Microsoft Certified System Administrator (MCSA), CISCO Certified Network Professional (CCNP), CISCO Certified Network Associate (CCNA), Certified Information Systems Security Professional (CISSP), Certified Information Security Manager (CISM), Network+, Certified Information Systems Auditor (CISA), Security+, Security Clearance, and SANS/GIAC Certification.

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[22] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.
[23] Ibid.

In analyzing the certifications from the 2018 statewide cybersecurity study for San Diego County, *CISCO Certified Network Associate (CCNA)*, *Certified Information Systems Security Professional (CISSP)*, *Security+*, *Security Clearance*, and *SANS/GIAC Certification* consistently made the top five certifications with the most online job postings each year between 2016 and 2018 (Exhibit 13). After 2018, however, *Network+* surpassed *SANS/GIAC Certification*, with the fifth most number of online job postings in 2019 and 2020. This suggests that employers are increasingly in need with individuals with *Network+* certifications; it jumped from 758 online job postings in 2018 to 1,208 online job postings in 2019, which was a 59 percent increase (Exhibit 13).

Exhibit 13: Number of Cybersecurity Certifications from Statewide Report in Online Job Postings

(San Diego County, Jan 2016 - Dec 2020) [24]

Cybersecurity Certifications Identified in Statewide Report	Number of online job postings (2016)	Number of online job postings (2017)	Number of online job postings (2018)	Number of online job postings (2019)	Number of online job postings (2020)
Microsoft Certified System Administrator (MCSA)	533	545	646	925	866
CISCO Certified Network Professional (CCNP)	482	536	711	910	549
CISCO Certified Network Associate (CCNA)	1,082	1,033	1,349	1,964	1,627
Certified Information Systems Security Professional (CISSP)	1,215	1,362	1,578	2,289	1,781
Certified Information Security Manager (CISM)	298	309	379	665	476
Network+	496	434	758	1,208	1,004
Certified Information Systems Auditor (CISA)	427	446	559	802	650
Security+	1,927	2,333	2,638	3,900	3,027
Security Clearance	10,111	11,997	16,078	21,850	16,850
SANS/GIAC Certification	426	624	721	1,033	914

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[24] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

TOP EMPLOYERS

Based on the SOC occupational titles from traditional LMI, Exhibit 14a lists the top employers who posted online job postings between January 1, 2016 and December 31, 2020.

Exhibit 14a: Top 25 Employers for *Cybersecurity Occupations* in San Diego County
(Online Job Postings for SOC Occupational Titles, Jan 2016 - Dec 2020)[25]

Top Employers in Online Job Postings	
1. Qualcomm	14. Accenture
2. CACI International	15. SAIC
3. Northrop Grumman	16. Cubic Corporation
4. General Atomics	17. Sony Electronics Incorporated
5. Booz Allen Hamilton Inc.	18. Illumina Incorporated
6. Teradata Operations, Inc.	19. Thermo Fisher Scientific Inc.
7. University of California San Diego	20. Via Technical
8. Intuit	21. Best Buy
9. BAE Systems	22. Becton Dickinson
10. Leidos	23. Anthem Blue Cross
11. Viasat	24. Deloitte
12. General Dynamics	25. Amazon
13. ServiceNow	

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[25] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

Based on the 2018 statewide report job titles (see Exhibit 1), Exhibit 14b lists the top employers who posted online job postings between January 1, 2016 and December 31, 2020.

Exhibit 14b: Top Employers for *Cybersecurity Occupations* in San Diego County

(Online Job Postings for Statewide Report Job Titles, Jan 2016 – Dec 2020)[26]

Top Employers in Online Job Postings	
1. General Atomics	14. General Dynamics
2. CACI	15. San Diego Gas Electric
3. Qualcomm	16. Scientific Research Corporation
4. Leidos	17. Willis Towers Watson
5. Northrop Grumman	18. Accenture
6. Booz Allen Hamilton Inc.	19. Scripps Health
7. University of California San Diego	20. Tactical Engineering & Analysis, Inc.
8. BAE Systems	21. Viasat
9. Costar Group	22. Tactical Engineering & Analysis Inc.
10. SAIC	23. HealthStream
11. Epsilon Systems Solutions Incorporated	24. Fiserv
12. Via Technical	25. Corelation Inc.
13. Costar Realty Information	

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[26] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

Appendix A: Most Commonly Used Job Titles

Using the SOC occupational titles in this updated report and the 2018 statewide study's job titles (see Exhibit 8), the San Diego-Imperial COE examined online job postings to determine which occupational titles were most commonly used by employers. Between January 1, 2016 and December 31, 2020, there were 1,959,932 job postings in San Diego County that most frequently related to the SOC occupational category of "Software Developers and Software Quality Assurance Analysts and Testers." The most frequent job title cited was "Software Developer" (Exhibit A).[27]

Exhibit A: Occupational Titles and Job Titles for *Cybersecurity Occupations* by Number of Online Job Postings in San Diego County (Jan 2016 - Dec 2020)

SOC Occupational Title	#	Job Title	#
Computer Network Support Specialists	1,644	Cyber Defense Analyst	6
Computer User Support Specialists	19,104	Cyber Defense Forensic Analyst	0
Information Security Analysts	10,823	Cyber Defense Infrastructure Support Specialist	0
Network and Computer Systems Administrators	10,665	Cyber / Information Security Engineer / Analyst	10
Software Developers and Software Quality Assurance Analysts and Testers	80,338	Network Operations Specialist	59
		Software Developer	6,416
		System Administrator	0
		Systems Security Analyst	181
		Technical Support Specialist	821
		Vulnerability Assessment Analyst	1

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[27] Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool." Jan 1, 2016-Dec 31, 2020.

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