

DRONE TECHNOLOGY

July 2022



Prepared by the
Orange County
Center of Excellence



C·O·E

CENTERS OF EXCELLENCE
FOR LABOR MARKET RESEARCH

Table of Contents

Introduction	4
Note Regarding Drone Labor Market Information	5
Summary Analysis	6
Key Findings	6
Drones Demand	7
Job Postings	7
Time Series Analysis of Online Job Postings	7
Online Job Postings Analysis, Last 12 Months	8
Drones Top Five Job Families.....	8
Educational Requirements in Online Job Postings.....	9
Wages in Online Job Postings	9
Skills in Online Job Postings by Group.....	10
Supply	15
California Community College Drone Programs.....	15
California Community College Supply	17
California Community College Drone Courses.....	18
Conclusion	22
Appendix A: Keywords used in Burning Glass Search	23
Appendix B: Burning Glass Market Salary Explanation	23
Appendix C: Sources	24
Appendix D: Acknowledgements.....	24

List of Exhibits

Exhibit 1: Drone-Related Online Job Postings in Los Angeles and Orange Counties.....	7
Exhibit 2: Number of Job Postings by Job Family in Los Angeles and Orange Counties Over the Past 12 Months	9
Exhibit 3: Minimum Requested Level of Education by Job Family (n=229)	9
Exhibit 4: Advertised Wages in Online Job Postings	10
Exhibit 5: Top Ten Skills in Online Job Postings for All Job Families (n=860).....	11
Exhibit 6: Top Ten Skills in Online Job Postings for Computer and Mathematical Job Family (n=161).....	12
Exhibit 7: Top Ten Skills in Online Job Postings for Arts, Design, Entertainment, and Media Job Family (n=145).....	12
Exhibit 8: Top Ten Skills in Online Job Postings for Architecture and Engineering Job Family (n=106).....	13
Exhibit 9: Top Ten Skills in Online Job Postings for Transportation and Material Moving Job Family (n=81)	14
Exhibit 10: Top Ten Skills in Online Job Postings for Management Job Family (n=63).....	14
Exhibit 11: Drone Technology-Related Associate Degree and Certificate Programs in California	15
Exhibit 12: Drone Technology-Related Community College Awards (Certificates and Degrees) in California, 2017-2020	18
Exhibit 13: Drone Technology-Related Community College Courses Throughout California	19

Introduction

The Orange County Center of Excellence for Labor Market Research (OC COE) prepared this report to provide updated Los Angeles/Orange County regional labor market supply and demand data related to unmanned aerial vehicles (UAV), more commonly known as drones. Previous research from the OC COE showed that online job postings related to drone technology often require base knowledge in a traditional field, such as software development, engineering, and photography, plus experience with drones as an additional skill or qualification.¹ Based on these findings, Orange County community colleges have continued to develop drone piloting and technology programs that incorporate drones into a wide variety of traditional occupations. In January 2022, the County of Orange, in collaboration with Fullerton College and the Orange County Workforce Development Board (OCWDB), launched the Drone Piloting Program for Orange County youth.² The following month, Fullerton College's proposed Drone Pilot Apprenticeship program received an intent to award of nearly \$500,000 from the Workforce and Economic Development Division of the California Community Colleges Chancellor's Office.³

While drones were originally developed for military application, the Federal Aviation Administration (FAA) issued its first commercial drone permit in 2006, opening the door for private companies, government agencies, and individuals to use drones for a wide variety of activities. Law enforcement agencies have used drones to chase suspects, assist with crime scene investigation, and conduct search and rescue missions.⁴ Geographic Information Systems (GIS) specialists use drones to provide more detailed and timely aerial images for quicker analysis when compared to satellite imagery.⁵ Photojournalists have used drones to show the effects of climate change by capturing images of lakes that have dried up and to show how Greenland's ice sheet is melting.⁶ Governments in Indonesia, India, Mexico, and Turkey have recently used drones to conduct mass disinfections to combat the spread of the coronavirus disease.⁷

Notable applications of drone technology within California include drone deployments by police and fire departments. The Chula Vista Police Department (CVPD) has used drones to respond to 911 calls and other emergencies since 2018 under its Drones as a First Responder (DFR) program. CVPD has increased its ability to operate its drones throughout the city, obtaining FAA permission to launch from anywhere in the city and to launch more than one drone from a single launch site.⁸ Additionally, NASA researchers based in Silicon Valley monitored the use of drones to fight wildfires in Northern California in 2021.⁹

¹ <https://coeccc.net/orange-county/2020/06/drone-technology-2020-report-2/>

² <https://news.fullcoll.edu/county-of-orange-partners-with-fullerton-college-to-launch-drone-piloting-program-for-youth/>

³ <https://www.cccco.edu/-/media/CCCCO-Website/Files/Workforce-and-Economic-Development/WEDD-Memo/CAI-FY2122Intent-to-Award-Memo2222022a11y.pdf?la=en&hash=37E5DF85A97D9308395FCD6FC080F3912B718AAF>

⁴ <https://www.forbes.com/sites/stephenrice1/2019/10/07/10-ways-that-police-use-drones-to-protect-and-serve/#443e668f6580>

⁵ <https://www.esri.com/about/newsroom/arcuser/uav-and-gis-an-emerging-dynamic-duo/>

⁶ "Taking Visual Journalism into the Sky with Drones," *The New York Times*, last modified May 2, 2018, accessed April 3, 2020, <https://www.nytimes.com/2018/05/02/technology/personaltech/visual-journalism-drones.html>.

⁷ <https://www.reuters.com/article/us-health-coronavirus-disinfection/mass-disinfections-to-combat-coronavirus-pose-another-health-hazard-idUSKBN211PB>

⁸ [UAS Drone Program | City of Chula Vista \(chulavistaca.gov\)](https://www.chulavistaca.gov/office-of-public-works/uas-drone-program)

⁹ <https://www.nasa.gov/feature/at-california-blazes-nasa-team-observes-how-drones-fight-wildfire/>

Within Orange County, the Irvine Police Department and Orange County Sheriff's Department launched drone programs in 2018 and 2019, respectively. These programs include civilian and uniformed drone pilots who use drones to assist with ongoing police and fire operations.^{10 11} To control the local mosquito population and lower the risk of West Nile Virus, the Orange County Mosquito and Vector Control District used drones to drop larvicide at several locations throughout the county in 2021.¹² The Disneyland Resort – the largest employer in the county – is exploring how to incorporate drones into “nighttime spectaculars” as they did in Paris earlier this year; the potential use of drones is in the “blue sky” phase of development, meaning the very early stages of exploration.¹³

As of December 2015, the FAA began requiring all commercial UAV pilots to have a Remote Pilot Certificate in accordance with the FAA's Small UAS Rule (Part 107), commonly referred to as a “Part 107 license”. A Remote Pilot Certificate license costs \$175 and applicants must pass an aeronautical knowledge exam. Alternatively, pilots that hold a pilot certificate issued under FAA 14 CFR Part 61 and completed a flight review within the last 24 months are eligible to obtain a Remote Pilot Certificate after completing an online training course. Once the Remote Pilot Certificate is obtained, pilots are required to complete an online recurrent training course every 24 months.¹⁴ In addition to a Part 107 license, all UAVs, with the exception of those that weigh 0.55 pounds or less, must be registered with the FAA.¹⁵ According to FAA data, there are 24,376 Part 107 pilots in the region – Los Angeles County has 17,574 and Orange County has 6,793.

Note Regarding Drone Labor Market Information

Currently, there is no Standard Occupational Classification (SOC) code in the Bureau of Labor Statistics (BLS) coding system for jobs related to drone technology (i.e., drone pilots, drone technicians, or drone photographers); therefore, traditional occupational demand data for drone technology roles is limited. To better understand the current need for drone knowledge, skills, and abilities (KSAs), and to expand on previous research from the OC COE, this report primarily focuses on an analysis of online job postings in Los Angeles and Orange counties for job titles related to drones.

In addition to analyzing online job postings, this report also provides an overview of drone programs and courses offered at community colleges throughout California. The supply figures in this report were obtained using the Chancellor's Office Curriculum Inventory (COCI) to identify programs and courses with a drone emphasis. In this report, supply is defined as the three-year average of awards conferred by community colleges in programs related to drone technology. This data is collected using the California Community Colleges Chancellor's Office (CCCCO) data tool, the Management Information Systems (MIS) Data Mart. By focusing on these programs, the supply numbers in this report capture the most accurate data available from community colleges. While four-year and other non-community college institutions may offer drone programs and

¹⁰ <https://www.latimes.com/socal/daily-pilot/news/tn-wknd-et-drones-orange-county-sheriff-department-20190412-story.html>

¹¹ <https://voiceofoc.org/2018/10/irvine-police-department-begins-drone-program/>

¹² <https://www.latimes.com/socal/daily-pilot/news/story/2021-09-09/o-c-vector-control-launches-air-strike-against-mosquitoes-dropping-larvicide-via-drone>

¹³ <https://www.ocregister.com/2022/06/10/disneyland-explores-ways-to-use-aerial-drones-in-nighttime-spectaculars/>

¹⁴ https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot

¹⁵ https://www.faa.gov/uas/getting_started/register_drone

courses, there is not a comprehensive and methodologically sound way to collect detailed course and program data for these institutions. For that reason, this report focuses on data available from community colleges.

Summary Analysis

Based on the available data, demand for applied drone skills in the workforce has increased in recent years. While demand is typically defined as the number of annual job openings for a set of occupations, drone skills can be applied to a variety of occupations. However, not all positions within those occupations may require drone skills, so traditional demand data will be overstated for drone positions. For this reason, and because drone skills can be applied to numerous occupations, this analysis is primarily based on online job postings. While online job postings are useful for understanding knowledge, skills, and abilities (KSAs), education requirements, and other employer hiring preferences, the number of job postings does not provide an accurate count of job openings. For example, employers may list jobs that they do not end up filling or may use a single posting to hire several people. Therefore, the number of online job postings is not comparable to nor indicative of the number of annual openings for any given occupation. Following is an overview of this report's key findings:

Key Findings:

- Over the past 12 months, there were **860 online job postings related to drones in Los Angeles and Orange counties**. The highest number of job postings were for drivers, senior software engineers, and senior test pilots.
 - While job postings decreased in 2020 in tandem with an economy-wide downturn in hiring associated with the COVID-19 pandemic, **total postings over the past 12 months exceed yearly totals during the last pre-pandemic period.**
 - Within those job postings, **55% (475) included a requested and/or minimum level of education.**
 - Of the job postings listing a minimum education requirement, **42% (201) requested a high school diploma, vocational training, or an associate degree.**
- Advertised entry-level wages in these postings are **\$19.74, which is lower than the California Family Needs Calculator living wage** for one adult in Orange County, which is \$20.63 (the living wage in Los Angeles County is \$18.10). However, there is significant variation across job types.
- Nearly **65% of all job postings fall into five “Job Families”**: Computer and Mathematical; Arts, Design, Entertainment, Sports and Media; Architecture and Engineering; Transportation and Materials Moving; and Management.
 - **The skills requested in each Job Family vary greatly due to the vastly different tasks typically required by each, many of which do not include piloting.**
- There are **11 community colleges** throughout California that have drone-related programs, conferring an average of **15 awards annually** between 2017 and 2020.

- However, **all of these programs were approved in 2017 or later, so several programs were not active during this time period and only recently began to confer awards.**
- There are **32 community colleges** throughout California that offer drone-related courses **listed under 26 different TOP codes** ranging from Piloting (3020.20) to Journalism (0602.00) and Electro-Mechanical Technology (0935.00).

Drones Demand

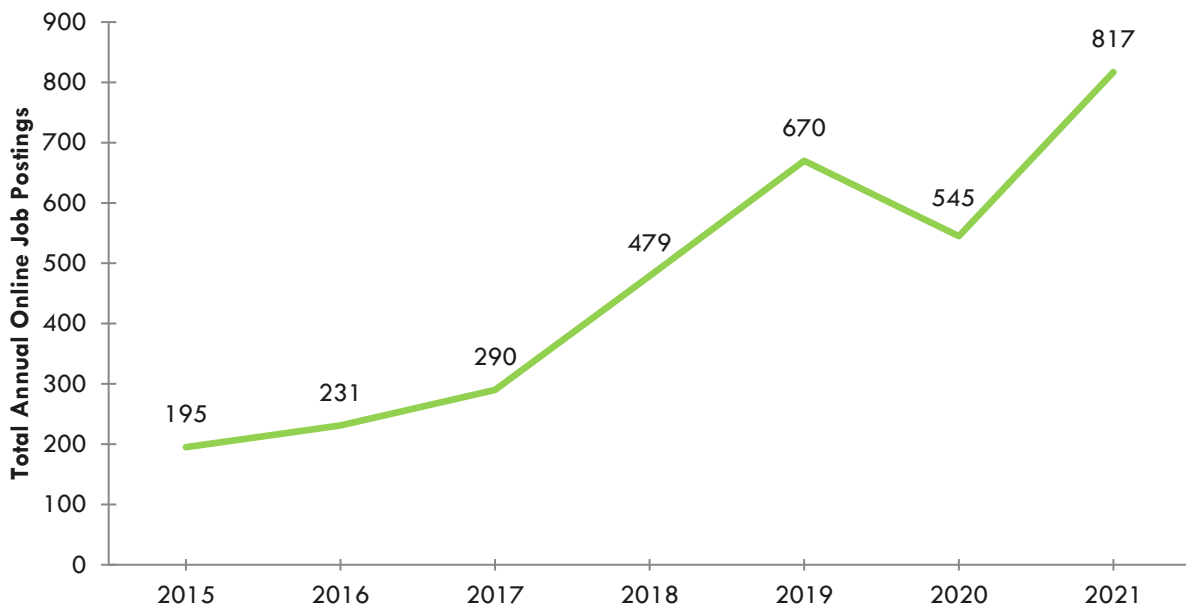
Job Postings

To identify online job postings most closely related to drones, 27 keywords were used as search parameters in Burning Glass, a software tool that aggregates and deduplicates online job postings from thousands of sources. The full list of keywords is listed in Appendix A.

Time Series Analysis of Online Job Postings

To understand how demand for drone skills has changed over time, Exhibit 1 shows the total number of job postings related to drones in each year from 2015 to 2021 in Los Angeles and Orange counties. During this period, total annual online job postings grew from 195 to 817 at an average rate of 53% per year. Drone-related online job postings steadily increased from 2015 to 2017 then significantly increased from 2017 to 2019. There was year-to-year growth in job postings in every year except for 2020, when drone-related online job postings declined by 19% (125), most likely because of the economic impacts from the COVID-19 pandemic. However, from 2020 to 2021 there was significant recovery as job postings increased 50% (277).

Exhibit 1: Drone-Related Online Job Postings in Los Angeles and Orange Counties



Source: EMSI/Burning Glass (March 2022)

Online Job Postings Analysis, Last 12 Months

Over the past 12 months, there were 860 online job postings related to drones in Los Angeles and Orange counties. Compared to the same time period from 2019 to 2020, there was an increase of 320 online job postings. While there was a decrease in postings during 2020 due to an economy-wide hiring downturn associated with the COVID-19 pandemic, annual job posting totals exceed annual posting totals for the last pre-pandemic period.

These postings were spread across numerous industries and occupations since drones can be used in a variety of roles. To better understand the skills most requested, online job postings were grouped into Job Families then the top five, which account for 65% of all postings, were analyzed. These Job Families are classifications from O*NET, a U.S. Department of Labor program that provides occupational data and information, which defines a Job Family as a group of “occupations based upon work performed, skills, education, training, and credentials.”¹⁶ .

Drones Top Five Job Families

The Computer and Mathematical Job Family includes occupations primarily related to information technology, computer programming, and software development. This Job Family also includes geographic information systems (GIS) technicians and other related geospatial occupations.

The Arts, Design, Entertainment, Sports, and Media Job Family includes a wide variety of media occupations, ranging from coaches and scouts to floral designers and photographers. This Job Family also includes directors, video editors, and videographers.

The Architecture and Engineering Job Family covers a wide variety of occupations, including aerospace engineering, electrical and electronics, manufacturing, and product safety occupations. Though most GIS positions are in the Computer and Mathematical Job Family, surveyors and mapping technicians are included in the Architecture and Engineering Job Family

The Transportation and Material Moving Job Family includes pilots, air traffic controllers, and airfield operations specialists. This Job Family also includes occupations related to other forms of transportation, such as ship engineers, rain workers, and inspectors for all forms of transportation.

The Management Job Family includes a variety of managerial and supervisory occupations that cut across industries. Occupations in this family include general and operations managers, architectural and engineering managers, marketing managers, and sales managers.

Exhibit 2, below, shows the top five Job Families by number of job postings in Los Angeles and Orange counties.

¹⁶ <https://www.onetonline.org/find/family>

Exhibit 2: Number of Job Postings by Job Family in Los Angeles and Orange Counties Over the Past 12 Months

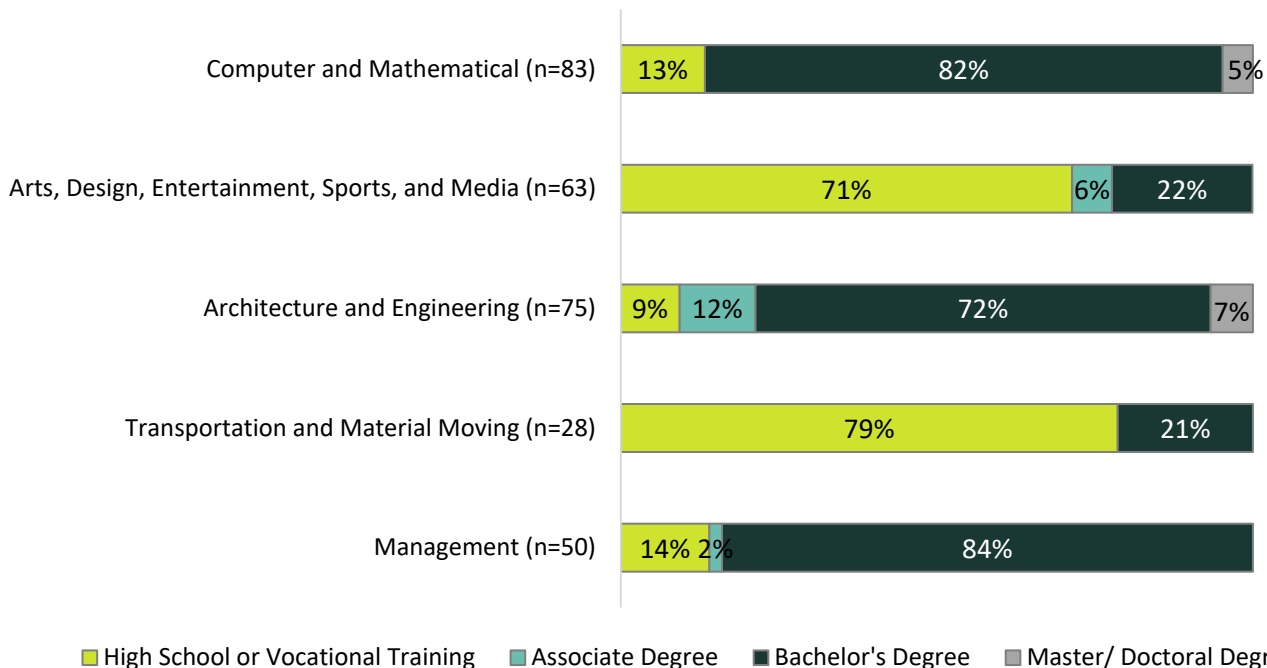
Job Family	# of Postings
Computer and Mathematical	161
Arts, Design, Entertainment, Sports, and Media	145
Architecture and Engineering	106
Transportation and Material Moving	81
Management	63

Source: EMSI/Burning Glass (March 2022)

Educational Requirements in Online Job Postings

Of the 566 job postings that fall into the five Job Families, 54% (299) included a minimum level of education. Exhibit 3 shows the distribution of minimum level of education by Job Family. Across all Job Families, a bachelor’s degree was requested most frequently. The Job Families with the highest percentage of job postings requesting a high school diploma, vocational training, or an associate degree were Transportation and Material Moving (79%) and Arts, Design, Entertainment, Sports, and Media (77%). Two Job Families did not have any postings that requested an associate degree: Computer and Mathematical and Transportation and Material Moving.

Exhibit 3: Minimum Requested Level of Education by Job Family (n=229)



Source: EMSI/Burning Glass (March 2022)

Wages in Online Job Postings

Exhibit 4, on the following page, shows the estimated hourly wages from online job postings for all five Job Families. These figures were calculated using Burning Glass’s Market Salary tool, which provides an estimate of the average salary for online job postings based on a variety of

factors including location, education, skills, and experience. Burning Glass’s full definition and methodology is listed in Appendix B.

These “market salary” estimates suggest that hourly wages range for all job postings range from \$19.74 (25th percentile or entry-level) to \$44.17 (75th percentile or experienced). However, there is variance in wages across Job Families. Typical entry-level hourly wages for the Transportation and Material Moving and Arts, Design, Entertainment, Sports, and Media Job Families are below the living wage estimates for Orange County (\$20.63) but above the living wage estimate for Los Angeles County (\$18.10). However, typical median hourly wages for these Job Families range between \$24.47 and \$29.82, which are above the living wage estimate for both Orange and Los Angeles counties. Typical entry-level wage for the Computer and Mathematical, Architecture and Engineering, and Management Job Families are higher than the living estimate for both Los Angeles and Orange counties.

It is important to note that these figures are based on a machine learning model developed by Burning Glass and actual compensation will vary based on individual employer salary practices, education, and experience.

Exhibit 4: Advertised Wages in Online Job Postings¹⁷

Job Family	Advertised Entry-Level Hourly Wages (25 th Percentile)	Advertised Median Hourly Wages	Advertised Experienced Hourly Wages (75 th Percentile)
Computer and Mathematical	\$37.76	\$50.90	\$60.36
Arts, Design, Entertainment, Sports, and Media	\$18.96	\$24.74	\$32.99
Architecture and Engineering	\$25.69	\$38.27	\$49.73
Transportation and Material Moving	\$18.78	\$29.82	\$39.28
Management	\$28.41	\$39.76	\$58.26

Source: EMSI/Burning Glass March 2022

Skills in Online Job Postings by Group

Drone Skills Requested in Online Job Postings— To understand the skills required for drone-related jobs, a list of the top 10 technical skills across all Job Families was compiled. While this list represents the most frequently requested skills for drone-related jobs, the diversity of employers and drone applications associated with these job postings means that individual skills were requested at relatively low frequencies. In the more than 800 online job postings used in this analysis, the most frequently mentioned skill is only listed in less than 200 postings and the last of the top 10 is listed in just over 70. Exhibit 5, on the following page, shows the top 10 skills requested across all Job Families. The top 10 skills were: photography, software engineering, Python, videography, customer service, C++, project management, repair, scheduling, and software development. This list has changed from the previous Drone Technology Report which listed FAA Regulations at the most requested skill. In this report it is not even included in the

¹⁷ The figures presented in Exhibit 3 are based on a machine learning model developed by Burning Glass. Actual compensation will vary based on individual employer salary practices, education, and experience.

current top 10 skills. Other skills that dropped off the top 10 list include: simulation, teaching, and flight safety.

While understanding the top skills across all Job Families provides valuable information, the top skills could be misleading because they are not requested in postings for all Job Families. For example, skills such as C++ and software development are overrepresented because the Computer and Mathematical Job Family had the highest number of job postings. These skills are primarily requested for postings in that Job Family but are not requested in other Job Families such as Arts, Design, Entertainment, Sports, and Media. The following sections disaggregate skills data by Job Family to better understand these variations.

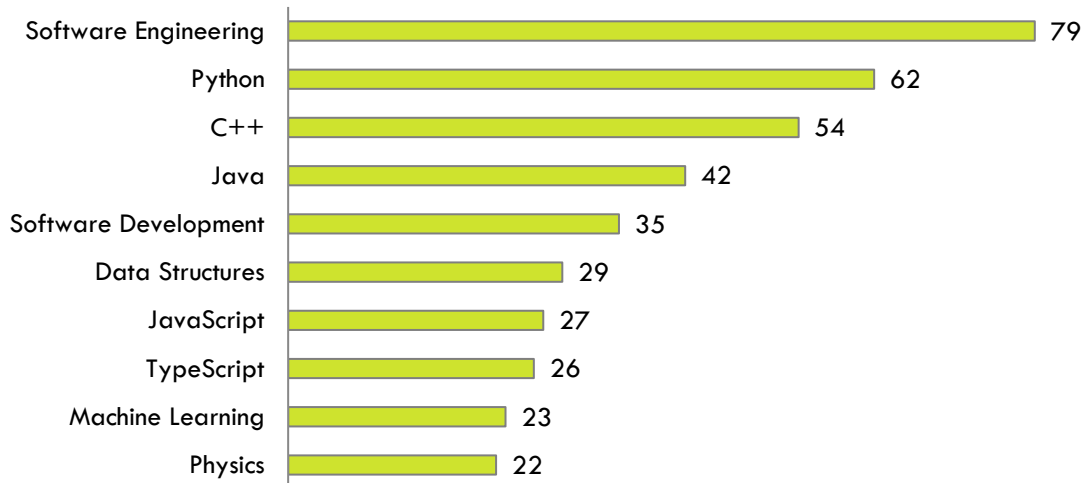
**Exhibit 5: Top Ten Skills in Online Job Postings for All Job Families
(n=860)**



Source: EMSI/Burning Glass (March 2022)

Computer and Mathematical Skills Requested in Online Job Postings—Exhibit 6, on the following page, shows the top 10 skills requested in online job postings for the Computer and Mathematical Job Family. The top skills were software engineering, Python, C++, Java, software development, data structures, JavaScript, TypeScript, machine learning, and physics. Each of these skills was requested in at least 14% of Computer and Mathematical postings. Unmanned Aerial Systems (UAS) was requested in 4% (7) of Computer and Mathematical postings. Knowledge of FAA Regulations was not requested in any postings in this Job Family. A review of the job descriptions from these postings shows that, while knowledge of drones or possession of a Part 107 license is sometimes a desired qualification, it is not always required. These jobs do not primarily involve flying or piloting drones. Instead, postings in this area focus on software development for drones, analyzing drone images for GIS and mapping purposes, and development of control systems.

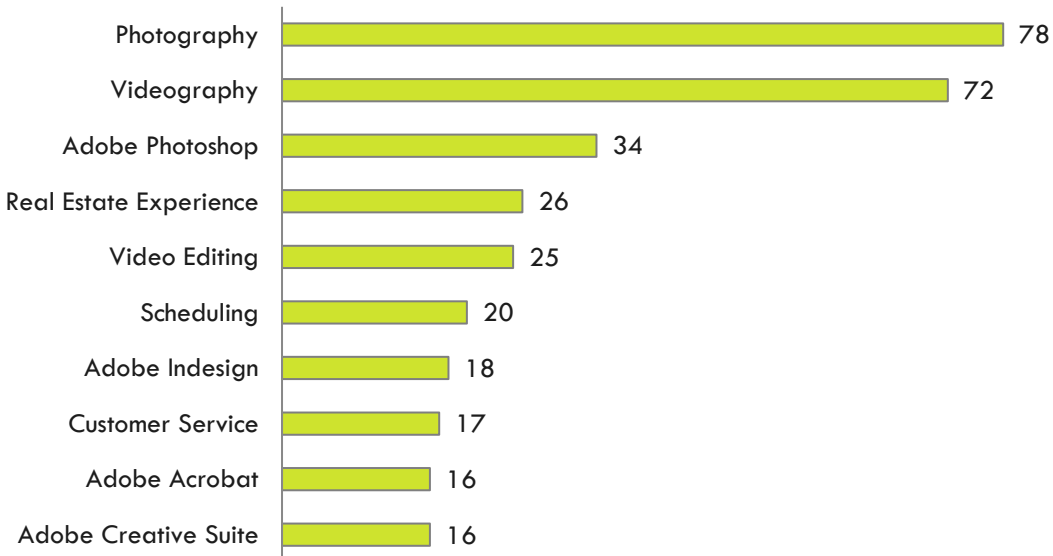
Exhibit 6: Top Ten Skills in Online Job Postings for Computer and Mathematical Job Family (n=161)



Source: EMSI/Burning Glass (March 2022)

Arts, Design, Entertainment, and Media Skills Requested in Online Job Postings—Exhibit 7 shows the top 10 skills requested for the Arts, Design, Entertainment, Sports, and Media Job Family. The top skills were photography, videography, Adobe Photoshop, real estate experience, video editing, scheduling, Adobe InDesign, customer service, Adobe Acrobat, and Adobe Creative Suite. Each of these skills was requested in at least 11% of job postings in this Job Family. Photography was required in nearly 50% of postings. These positions are primarily related to photography and video editing and include drones as either a required or highly desired qualification. About 20% of these postings request real estate experience.

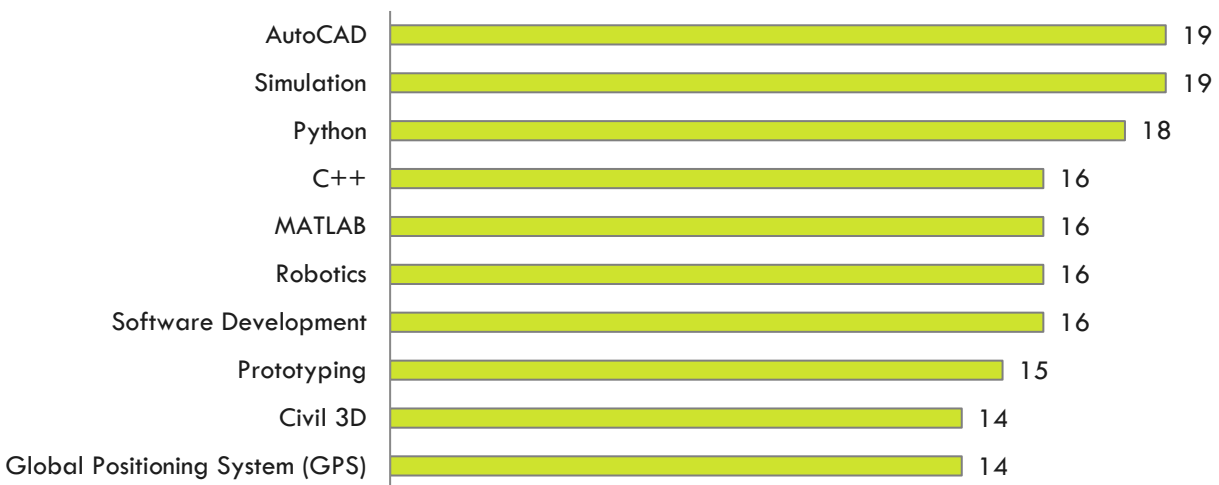
Exhibit 7: Top Ten Skills in Online Job Postings for Arts, Design, Entertainment, and Media Job Family (n=145)



Source: EMSI/Burning Glass (March 2022)

Architecture and Engineering Skills Requested in Online Job Postings—Exhibit 8 shows the top 10 skills requested for the Architecture and Engineering Job Family. The top skills were: AutoCAD, Simulation, Python, C++, MATLAB, robotics, software development, prototyping, civil 3D, and global positioning system (GPS). Each of these skills was requested in at least 13% of Architecture and Engineering postings. UAS was requested in 3 job postings and avionics was requested in 8 postings. Similar to postings in the Computer and Mathematical Job Family, these positions do not primarily involve flying or piloting drones. These positions focus on drone repair, preventative maintenance of ground and airborne electronic equipment to ensure flight safety, and assembly of electronic components.

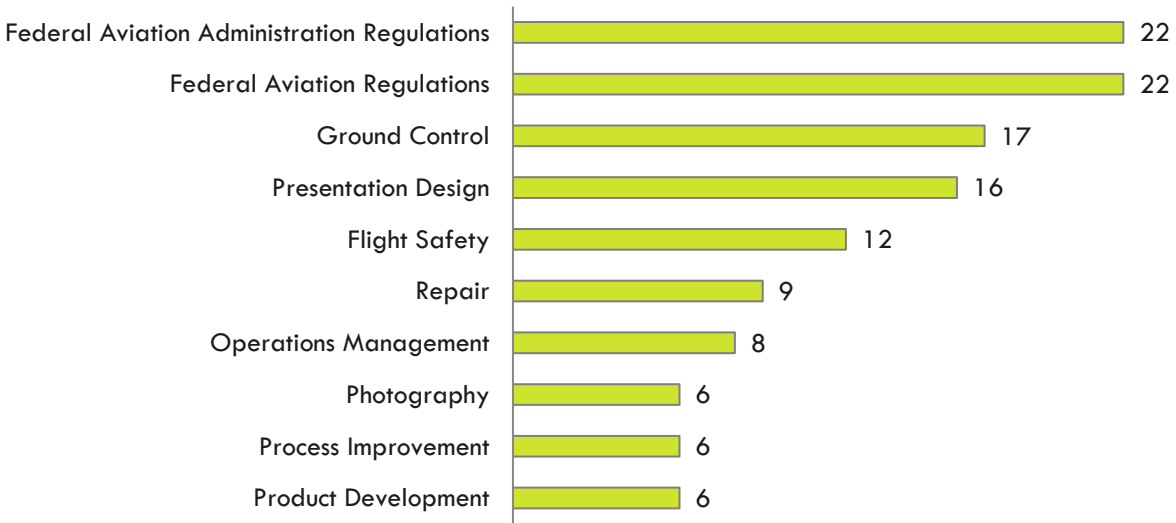
Exhibit 8: Top Ten Skills in Online Job Postings for Architecture and Engineering Job Family (n=106)



Source: EMSI/Burning Glass (March 2022)

Transportation and Material Moving Skills Requested in Online Job Postings—Exhibit 9 shows the top 10 skills requested for the Transportation and Material Moving Job Family. The top skills were Federal Aviation Administration regulations, federal aviation regulations, ground control, presentation design, flight safety, repair, operations management, photography, process improvement, and product development. Postings in this Job Family primarily involve drone piloting and the majority of postings require or highly desire a Part 107 license. Detailed information about these postings is difficult to find in job postings because many of them are posted by government contractors and therefore require security clearances. However, these postings typically include a requirement for knowledge of mission planning and mission execution.

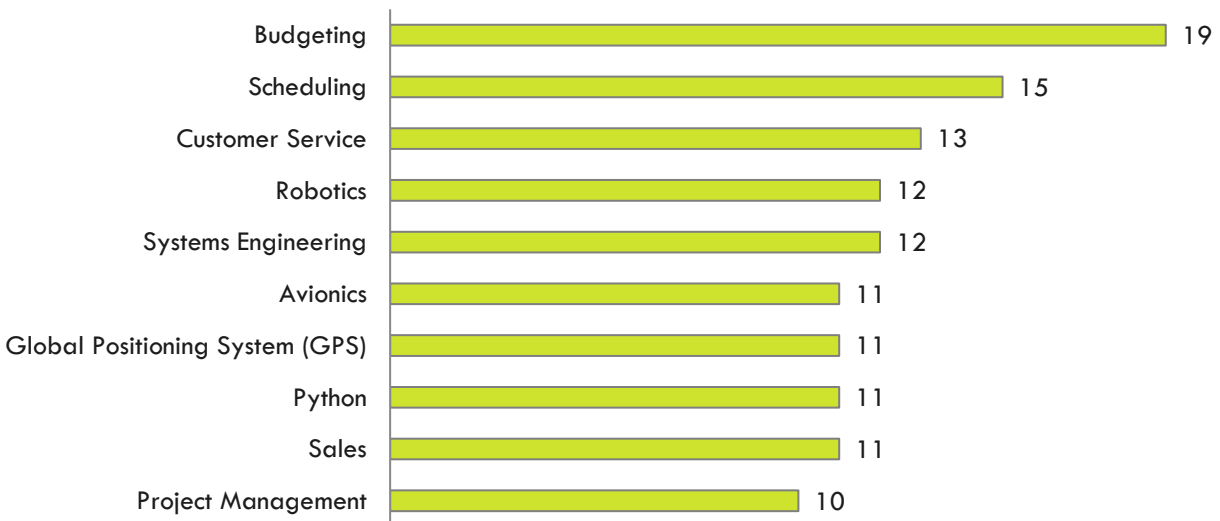
Exhibit 9: Top Ten Skills in Online Job Postings for Transportation and Material Moving Job Family (n=81)



Source: EMSI/Burning Glass (March 2022)

Management Skills Requested in Online Job Postings—Exhibit 10 shows the top 10 skills requested for the Management Job Family. The top skills were budgeting, scheduling, customer service, robotics, systems engineering, avionics, global positioning system (GPS), Python, sales, and project management. Postings in this Job Family primarily involve providing professional, technical, and managerial services related to drones. UAS was requested in 4 job postings.

Exhibit 10: Top Ten Skills in Online Job Postings for Management Job Family (n=63)



Source: EMSI/Burning Glass (March 2022)

Supply

This section will summarize the supply of skilled drone workers coming from California community colleges and will include award totals as well as a lists of existing community college programs and courses related to drones. Note that the development and implementation of drone programs is recent and continues to develop, making this report subject to temporal constraints on data collections and reporting. Additionally, because drone programs are often classified under the same Taxonomy of Programs (TOP) codes as other programs, such as GIS, digital media, or piloting, it is often difficult to obtain annual award totals.

Furthermore, the California Community College Chancellor’s Office (CCCCO) revised the unit thresholds for Certificates of Achievement in Spring 2019, which changed the award types that are collected and reported in the MIS Data Mart. Due to these changes, the unit requirements for a Certificate of Achievement were reduced to 16 units (from 18 units). Colleges that offered certificates ranging from 16 to less than 18 units that were not approved by the Chancellor’s Office, commonly known as local certificates, were required to submit those certificates for approval as a Certificate of Achievement.¹⁸

Because of these changes, it is difficult – and in some cases not possible - to quantify supply from drone programs that had to modify their unit requirements in order to comply with the new Certificate of Achievement unit thresholds, particularly at colleges that had existing Certificates of Achievement with the same TOP code that were unrelated to drones. All information presented in this report is current as of Spring 2022.

California Community College Drone Programs

According to the Chancellor’s Office Curriculum Inventory (COCI), an inventory provided by the CCCCCO, there are 11 community colleges that currently offer drone technology-related associate degree or certificate programs throughout the state. Cypress College, in Orange County, and Palomar College, in San Diego, offer the most programs (four each). Regionally, Orange County has the most programs (ten) followed by San Diego/Imperial (six) and the Bay Area and Los Angeles (three each). Exhibit 11 lists each drone technology-related program and the award type students earn upon successful completion of the program.

Since the last Drone Technology report was released in 2020, two drone programs at Gavilan listed under TOP Code 0950.00/Aeronautical and Aviation Technology have become inactive. These programs are associated with eight drone courses that are no longer offered at Gavilan.

Exhibit 11: Drone Technology-Related Associate Degree and Certificate Programs in California

TOP Code/Title	Local Program Name	College	Region	Award Type	CCCCO Approval Date
0302.00/ Environmental Studies	Drone Technology and Applications	Southwestern	SD/Imperial	Noncredit program	2/19/2021
0602.00/Journalism	Drone Journalism	Fullerton	Orange County	Certificate	7/23/2021

¹⁸ https://www.cccco.edu/-/media/CCCCO-Website/About-Us/Divisions/Educational-Services-and-Support/Academic-Affairs/What-we-do/Curriculum-and-Instruction-Unit/Files/Requirement_Changes_to_Certificates_of_Achievements_pdf.pdf?la=en&hash=26B42086BB875E974289C9A2E979D3670A74D0C4

TOP Code/Title	Local Program Name	College	Region	Award Type	CCCCO Approval Date
0612.20/Film Production	Drone Videography	Orange Coast	Orange County	Certificate	2/17/2021
	Drone Operator I	Palomar	SD/Imperial	Certificate	7/14/2021
0614.00/Digital Media	Drone Applications and Technologies	Palomar	SD/Imperial	A.S. Degree	6/20/2018
	Basic Drone Imaging Skills	Orange Coast	Orange County	Certificate	4/7/2021
0702.00/ Computer Information Systems	Drone Media	Merced	Central	Certificate	6/10/2021
0799.00/Other Information Technology	Drone Technology	Santa Ana	Orange County	Certificate	1/27/2021
0950.00/Aeronautical and Aviation Technology	Basic Drone Piloting	Los Medanos	Bay	Noncredit Program	3/3/2021
	Unmanned Aircraft System Technology	West Valley	Bay	Certificate	2/6/2017
1012.00/Applied Photography	UAV/UAS Drone Photography and Video	Cypress	Orange County	Certificate	1/17/2017
	Drone Camera Operator	Mt. San Antonio	Los Angeles	A.S. Degree	8/31/2018
	Drone Photography	Orange Coast	Orange County	Certificate	2/17/2021
2206.10/Geographic Information Systems	Drone Operations	Palomar	SD/Imperial	Certificate	1/26/2018
	Drone Technology	Diablo Valley	Bay	Certificate	6/29/2020
	Getting Started with Drone Careers and Safety	Palomar	SD/Imperial	Nondegree Program	5/24/2021
3020.00/Aviation and Airport Management and Services	Unmanned Aircraft Systems	Orange Coast	Orange County	Certificate	6/21/2019
3020.20/Piloting	UAS Drone Basic	Cypress	Orange County	Certificate	1/17/2017
	UAS Drone Advanced	Cypress	Orange County	Certificate	1/17/2017
	UAS Drone	Cypress	Orange County	A.S. Degree	1/29/2017
	Unmanned Aircraft System	Mt. San Antonio	Los Angeles	A.S. Degree	3/10/2020
	Unmanned Aircraft Systems	Mt. San Antonio	Los Angeles	Certificate	4/20/2020
	Drone Technology and Applications	Southwestern	SD/Imperial	Certificate	4/12/2019
4930.13/Academic Guidance	Drone Technology	Merced	Central	Certificate	1/9/2020

Source: Chancellor's Office Curriculum Inventory (COCI 2.0)

California Community College Supply

Exhibit 12, on the following page, shows the three-year average number of awards conferred by community colleges in drone technology-related programs which constitutes the “supply”. Because awards data is collected and organized by TOP code and colleges can list multiple programs under the same TOP code, awards conferred under these TOP codes may not be specifically related to drone technology.

However, by utilizing CCCCCO tools to compare MIS Data Mart and COCI data, awards listed under the same TOP Code can be disaggregated based on the number of units the certificate requires. For example, Cypress College has five programs listed under the Applied Photography TOP Code (1012.00). Only one of these program, UAV/UAS Drone Photography and Video, requires “greater than 8 and less than 16 semester units.” Therefore, all awards for this TOP code that list a unit requirement in this range must therefore have been conferred for UAV/UAS Drone Photography and Video.

Though this method is more accurate than listing the number of awards for all programs in a given TOP code, there are still limitations. For example, Cypress offers two AS Degree programs, UAV/UAS and Commercial Pilot under the 3020.20 TOP code. Since these programs have the same number of required units for the associate degree, it is not possible to disaggregate the number of awards conferred in each program with Data Mart data.

Additionally, as noted above, the CCCCCO reduced the unit requirements for a Certificate of Achievement to 16 units (from 18 units). Colleges that offered certificates ranging from 16 to less than 18 units that were not approved by the Chancellor’s Office were required to submit those certificates for approval as a Certificate of Achievement. Due to these changes, it is not possible to quantify supply from drone programs that had to modify their unit requirements, particularly at colleges that had existing Certificates of Achievement that were unrelated to drones within the same TOP code.

For example, West Valley was included in the supply in previous versions of this report because it offered one drone-related program that required 12 to 18 units under TOP code 0950.00 (Aeronautical and Aviation Technology). However, that certificate was converted to a Certificate of Achievement and the OC COE is no longer able to identify the supply from the drone program because there is another program under that TOP code that is not related to drones. For that reason, the supply in this report differs from previous versions.

It is also important to consider that all of these programs were approved in 2017 or later. Several programs, such as Drone Photography at Orange Coast and Drone Technology at Santa Ana, were approved after awards were earned in the 2019-2020 academic year as shown previously in Exhibit 11 and therefore had not yet begun to be offered. Based on the approval dates, no awards for these programs could have been awarded during the three years used to calculate supply. Since awards were not conferred for these programs, those colleges and programs are not included in Exhibit 12.

**Exhibit 12: Drone Technology-Related Community College Awards
(Certificates and Degrees) in California, 2017-2020**

TOP Code	Program	College	2017-2018 Awards	2018-2019 Awards	2019-2020 Awards	3-Year Award Average
3020.20	Piloting	Southwestern	-	-	2	1
Supply Subtotal/Average			-	-	2	1
1012.00	Applied Photography	Cypress	-	2	1	1
		Mt. San Antonio	3	5	10	6
Supply Subtotal/Average			3	7	11	7
2206.10	Geographic Information Systems	Diablo Valley	9	6	7	7
Supply Subtotal/Average			9	6	7	7
Supply Total/Average			12	13	20	15

Source: MIS Data Mart

California Community College Drone Courses

While there are seven community colleges that offer drone certificate and degree programs, there are a total of 32 community colleges that offer 80 drone-related courses throughout California, according to COCI. These courses are listed under 26 different TOP codes, ranging from Piloting (3020.20) to Journalism (0602.00) and Electro-Mechanical Technology (0935.00). While the number of students and enrollments in these courses are not considered part of traditional supply data, they demonstrate drones’ diverse applications across a number of areas.

Because drone job postings typically require or request knowledge in a traditional field, a student with a background in another area, such as photography, programming, or surveying could complete a drone course to add drone skills and become eligible for those jobs. While these students may not complete a drone program, they could be considered part of the supply of qualified workers. However, individual course data is not available in Data Mart, so the OC COE cannot quantify the number of students enrolled in these courses.

Additionally, these courses may be reflective of interdisciplinary partnerships across departments and highlight the importance of base knowledge in a traditional field to compliment drone skills. Exhibit 13, on the following page, lists all drone-related courses throughout the state.

It is important to note that these courses do not include not-for-credit-courses, which are also commonly referred to as community education or community service courses. Additionally, these courses include only those that are listed in COCI. The OC COE was able to identify at least one other college, Grossmont, that offers noncredit drone piloting courses that are not listed in COCI.¹⁹

It is worth noting that there are eight drone-related courses at Gavilan college that have become inactive since the previous Drone Technology report was released in 2020. These programs are

¹⁹ <https://www.govtech.com/education/San-Diego-College-Offers-Free-Training-in-Drone-Piloting.html>

associated with two drone programs offered by Gavilan, a certificate of achievement and an associate degree, that are now also classified as inactive in COCI.

Exhibit 13: Drone Technology-Related Community College Courses Throughout California

TOP Code/Title	College	Local Course Name	Region	CTE
0602.00/Journalism	Fullerton	Federal Aviation Administration Drone Pilot Test Preparation	Orange County	CTE
		UAV/Drone Reporting		
0604.20/Television (including combined TV/Film/Video)	Santa Ana	Drone Cinematography & Editing	Orange County	CTE
		Drone Pilot License Test Prep		
		Drone Pilot Training		
0614.00/Digital Media	Coastline	Drone Imaging 1	Orange County	CTE
		Drone Imaging 2		
0614.10/Multimedia	Butte	Drone Video and Photography	North Far North	CTE
		Introduction to Drone Management and Operations		
	Ohlone	Commercial Drone Imaging	Bay Area	
	Orange Coast	Drone Imaging for Immersive Media	Orange County	
0614.60/Computer Graphics and Digital Imagery	Santa Rosa	Applied Drone Projects	Bay Area	CTE
		Drone Piloting and Imaging		
0699.00/Other Media and Communications	Palomar	Digital Imaging with Drones	SD/Imperial	CTE
0701.00/Information Technology, General	Mission	Introduction to Drones and Unmanned Aerial Vehicles	Bay Area	CTE
0702.00/Computer Information Systems	Siskiyou	The Drone Academy	North Far North	CTE
	Merced	Drone Media I	Central/Mother Lode	
		Drone Media II		
		Federal Aviation Administration Drone Pilot Test		
		Introduction to Drones		
0707.10/Computer Programming	Merced	Drone Technology I	Central/Mother Lode	CTE
		Drone Technology II		
0799.00/Other Information Technology	Santa Ana	Introduction to Drones	Orange County	CTE
0901.00/Engineering, General (requires Calculus) (Transfer)	San Mateo	Introduction to Drone-based Science and Engineering	Bay Area	Not CTE

TOP Code/Title	College	Local Course Name	Region	CTE
0934.00/Electronics and Electric Technology	Fullerton	Basic Drone Piloting	Orange County	CTE
0935.00/Electro-Mechanical Technology	Santa Ana	Introduction to Autonomous Control and Drones	Orange County	CTE
		Payload and Sensors for the Manufacturing of Autonomous Drones		
		Repair and Troubleshooting of Autonomous Drones		
0950.00/Aeronautical and Aviation Technology	Fullerton	Counter Drone Operations	Orange County	CTE
	Los Medanos	Applied Drone Piloting	Bay Area	
		Basic Drone Piloting		
	Palomar	Digital Imaging with Drones	SD/Imperial	
West Valley	Drone Videography and Photography	Bay Area		
0953.00/Drafting Technology	American River	Introduction to Applied Drone Technology	North/Far North	CTE
		Survey of Applied Drone Technology in Design		
0953.30/Electrical, Electronic, and Electro-Mechanical Drafting	Cerritos	Introduction to Drone Technology	Los Angeles	N/A
0956.00/Manufacturing and Industrial Technology	San Diego City	STEM Drone Building	SD/Imperial	CTE
0999.00/Other Engineering and Related Industrial Technologies	Fullerton	Applied Drone Lab	Orange County	CTE
		Applied Drone Piloting		
	Solano	Basics of Drone Operations	Bay Area	
		Drone Photography and Video		
Introduction to Drones				
1012.00/Applied Photography	Cypress	Drone Photography and Video	Orange County	CTE
		UAV Flight Lab - Photography		
	Glendale	Drone Photography and Video	Los Angeles	
	Mt. San Antonio	Drone Advanced Still and Motion Camera Operator	Los Angeles	
		Drone Basic Still and Motion Camera Operator		
		Drone Inspection and Thermal Imaging		
		Drone Photogrammetry and Mapping		
San Francisco City	Beginning Drone Piloting and Imaging	Bay Area		

TOP Code/Title	College	Local Course Name	Region	CTE
	Santa Ana	Drones for Mapping	Orange County	
	Sierra	Drone Photography and Videography	North/Far North	
	Southwestern	Drone Aerial Photography and Cinematography	SD/Imperial	
1509.00/Philosophy	Cabrillo	Clones, Drones, the 99% and Other Moral Conundrums for the 21st Century	Bay Area	Not CTE
1902.00/Physics, General	Napa Valley	Theory and Experimentation with Drones and Rockets	Bay Area	Not CTE
	San Mateo	Introduction to Drone-based Science and Engineering	Bay Area	
2105.00/Administration of Justice	Santa Ana	Introduction to Drone Laws	Orange County	CTE
2105.50/Police Academy	Santa Ana	Building a Public Safety Drone Program	Orange County	CTE
		Drones for First Responders		
2206.10/Geographic Information Systems	Columbia	UAV/Drone Mapping	Central/Mother Lode	CTE
	Diablo Valley	Drone Operations and Piloting	Bay Area	
		Drone Remote Sensing and Mapping		
	Palomar	Careers in the Drone Industry	SD/Imperial	
		Introduction to Drone Safety and Applications		
		Introduction to Remote Sensing and Drone		
	Redwoods	Drone Academy	North Far North	
Southwestern	Introduction to Drone Safety and Applications	SD/Imperial		
3020.20/Piloting	Cypress	UAV/UAS Advanced	Orange County	CTE
		UAV/UAS Advanced Flight		
		UAV/UAS Advanced Simulator		
		UAV/UAS Basic		
		UAV/UAS Basic Flight		
		UAV/UAS Basic Simulator		
	Fullerton	Advanced Drone Piloting Skills	Orange County	
	Reedley	Remote Pilot Ground School for small Unmanned Aircraft Systems (sUAS)	Central/Mother Lode	
	Southwestern	Introduction to Drone Technology and Applications	SD/Imperial	

TOP Code/Title	College	Local Course Name	Region	CTE
3099.00/Other Commercial Services	Citrus	Commercial Drone Applications and Flight Training	Los Angeles	CTE
		Drone Mapping		
		Drone Pilot License		

Source: Chancellor's Office Curriculum Inventory (COCI 2.0)

Conclusion

This report on Drone Technology in the California workforce builds on the findings of the OC COE's previous reports on drone technology published in 2019 and 2020. The application of drone technology in the workforce continues to be based on demand for drone skills to supplement base knowledge in a given field and other industry-specific skills rather than demand for workers in drone-specific occupations. Demand for drone-related skills is growing across a broad cross-section of industries. While drone-related job postings fell during 2020, over the past 12 months, job postings have increased and recovered beyond their pre-pandemic levels. Typical entry-level (25th percentile) wages for all drone-related job listings are below the living wage and entry-level wages vary widely between Job Families. The types of skills that are being sought out are often industry-specific and vary across Job Families. Employment in positions that require drone skills are accessible to students with a high school or community college education. Over 40% of drone-related job postings requested less than a bachelor's degree. However, educational credential requirements differ across Job Families.

California community colleges have rapidly responded to demand for drone skills by designing and implementing programs and courses that allow students to gain applicable drone skills. As of Spring 2022, there are 20 active drone programs and 80 active drone-related community college courses at community colleges throughout the state. All drone programs have been developed after 2017, with nearly half (9) of them being approved during 2021. Drone-related courses are listed under 26 TOP codes, demonstrating that community colleges are bringing drone skills into the classroom in a wide variety of industrial and occupational contexts. While award data is sparse in 2022, the quantity of available data and award totals are likely to increase as recently created drone programs mature. However, due to the changes in unit thresholds for Certificates of Achievement, and because of the numerous different TOP codes for drone programs, it will continue to be difficult – and in some cases not possible – to quantify the number of awards specifically for drone programs. Due to the ever-evolving nature of emerging technologies like drones– as well as changes to Remote Pilot Certificate requirements - collecting and reporting demand and supply data will continue to be a challenge. However, the OC COE will stay abreast of these changes to inform community colleges of opportunities within this emerging area.

Appendix A: Keywords used in Burning Glass Search

- UAV operator
- UAS Operator
- UAV pilot
- UAS pilot
- unmanned aircraft system operator
- unmanned aircraft system pilot
- unmanned aerial vehicle operator
- unmanned aerial vehicle pilot
- drone operator
- drone pilot
- unmanned aerial system operator
- unmanned aerial system pilot
- unmanned aircraft vehicle operator
- unmanned aircraft vehicle pilot
- autonomous pilot
- drone technician
- drone operations
- drone photography
- aerial cinematography
- UAS technician
- sUAS
- part 107 pilot
- UAV technician
- UAV mechanic
- UAS mechanic
- drone
- drone videographer

Appendix B: Burning Glass Market Salary Explanation

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

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

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

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

Appendix C: Sources

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

Appendix D: Acknowledgements

The OC COE would like to thank Nickolas Emilio, COE Statewide Professional Expert, for his work on this report.

For more information, please contact:

Jesse Crete, Ed.D., Director
Center of Excellence, Orange County
crete_jesse@rscdd.edu

Jacob Poore, Research Analyst
Center of Excellence, Orange County
poore_jacob@rscdd.edu

July 2022