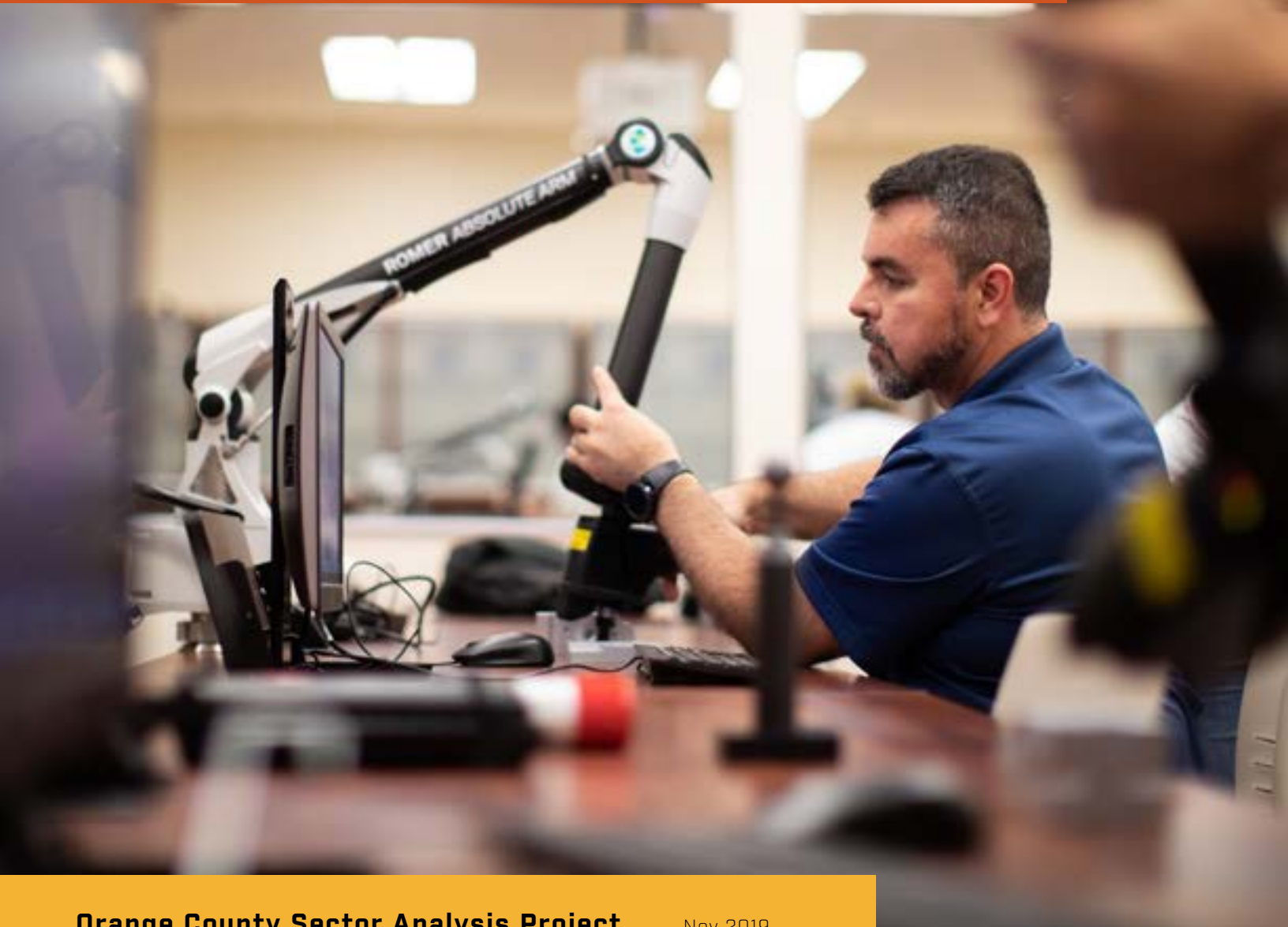


ADVANCED MANUFACTURING



Orange County Sector Analysis Project

Nov 2019

Prepared by:
Orange County Center of Excellence
for Labor Market Research

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Orange County Community Colleges

ADVANCED MANUFACTURING

Demand and Supply Analysis: Orange County

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Important Disclaimers

All representations included in this report have been produced from primary research and/or secondary review of publicly and/or privately available data and/or research reports. This study examines the most recent data available at the time of the analysis; however, data sets are updated regularly and may not be consistent with previous reports. Efforts have been made to qualify and validate the accuracy of the data and the report findings; however, neither the Centers of Excellence for Labor Market Research (COE), COE host college/district, nor California Community Colleges Chancellor's Office are responsible for the applications or decisions made by individuals and/or organizations based on this study or its recommendations.

INTRODUCTION

This sector brief is a product of the Orange County Sector Analysis Project. It provides information about the Advanced Manufacturing sector in Orange County, one of Orange County's two emerging sectors; it compares labor market demand with educational program supply for middle-skill jobs and provides qualitative information from experts in the field. Orange County community colleges could use the information in this report for strategic planning and discussions about program development, career pathways work, sector strategies, noncredit-to-credit pipelines, apprenticeship programs, and work-based learning opportunities.

All of the Orange County Sector Analysis Project briefs began with quantitative labor market demand and supply analysis; however, they also include qualitative information derived from the project's focus group discussions. Between July and August 2019, the Orange County Center of Excellence for Labor Market Research (COE) hosted a total of 12 sector-specific focus groups with regional stakeholders, including faculty and deans, as well as regional and state directors for employer engagement. One of these focus groups was specific to the Advanced Manufacturing sector. The objectives of the focus groups were to identify labor market supply gaps (supply gaps) in middle-skill jobs; understand where programs exist or do not exist to fill in the supply gaps; and discuss how Orange County's community colleges could close the supply gaps. Focus group participants reviewed the demand and supply analysis prior to meeting and provided intelligence regarding how they are working to close supply gaps as well as the challenges they encounter in their programs; this valuable information could not be captured via traditional labor market research methods. The COE recorded then analyzed these discussions which resulted in the "Focus Group Insights" sections throughout this brief, supplementing traditional, quantitative labor market data with important, qualitative information.

Middle-Skill Jobs and Living Wage Introduction

In this brief, middle-skill jobs include: all occupations that require an educational requirement of some college, associate degree or apprenticeship; all occupations that require a bachelor's degree, but also have more than one-third of their existing labor force with an educational attainment of some college or associate degree; or all occupations that require a high school diploma or equivalent or no formal education, but also require short- to long-term on-the-job training.

In this brief, top middle-skill jobs are defined as jobs that have both the most labor market demand (annual job openings) and entry-level wages at or above the California Family Needs Calculator¹ (commonly known as a "living wage"). The living wage is the hourly wage that a single adult needs to earn in order to meet basic needs in Orange County, and is currently \$17.39 per hour. The living wage is defined by the California Family Needs Calculator, which calculates the income necessary to cover costs including housing, food, transportation, health care, and other basic necessities.

Entry-level wage is defined as the 25th percentile hourly wage, which means that 25% of all workers in that occupation earn equal to or below this amount. Percentile wages represent the distribution of wages for each occupation. Generally, workers with minimal education and experience can expect to earn wages near the 10th percentile. With the additional education and training students receive in community college programs, they are more likely to earn wages at the 25th percentile, rather than the 10th percentile. Generally, with even more education and experience, students could expect to progress and earn the median wage, which is defined as the 50th percentile hourly wage.

Demand Introduction

For the purpose of this report, labor market demand is determined by the number of annual job openings employers expect to fill due to job growth and employee turnover between 2018 and 2023. Job growth is when an employer experiences increased demand for products and hires new employees to increase production, while employee turnover is when an employer hires replacement workers for employees who leave the workforce or change occupations.

Supply Introduction

Supply is determined by the average annual-number of related awards (e.g., certificates, degrees) generated between 2015 and 2017 by the region's community colleges and other educational institutions (e.g., private providers) for the purpose of this

¹ <https://insightccd.org/2018-family-needs-calculator/>

report. However, it should be noted that a student may earn more than one award; therefore, supply may be overestimated for certain occupations.

Whether or not there is a supply gap is determined by the difference between the demand and supply. The methodology regarding how these numbers are calculated is described in Appendix A.

FOCUS GROUP INSIGHTS

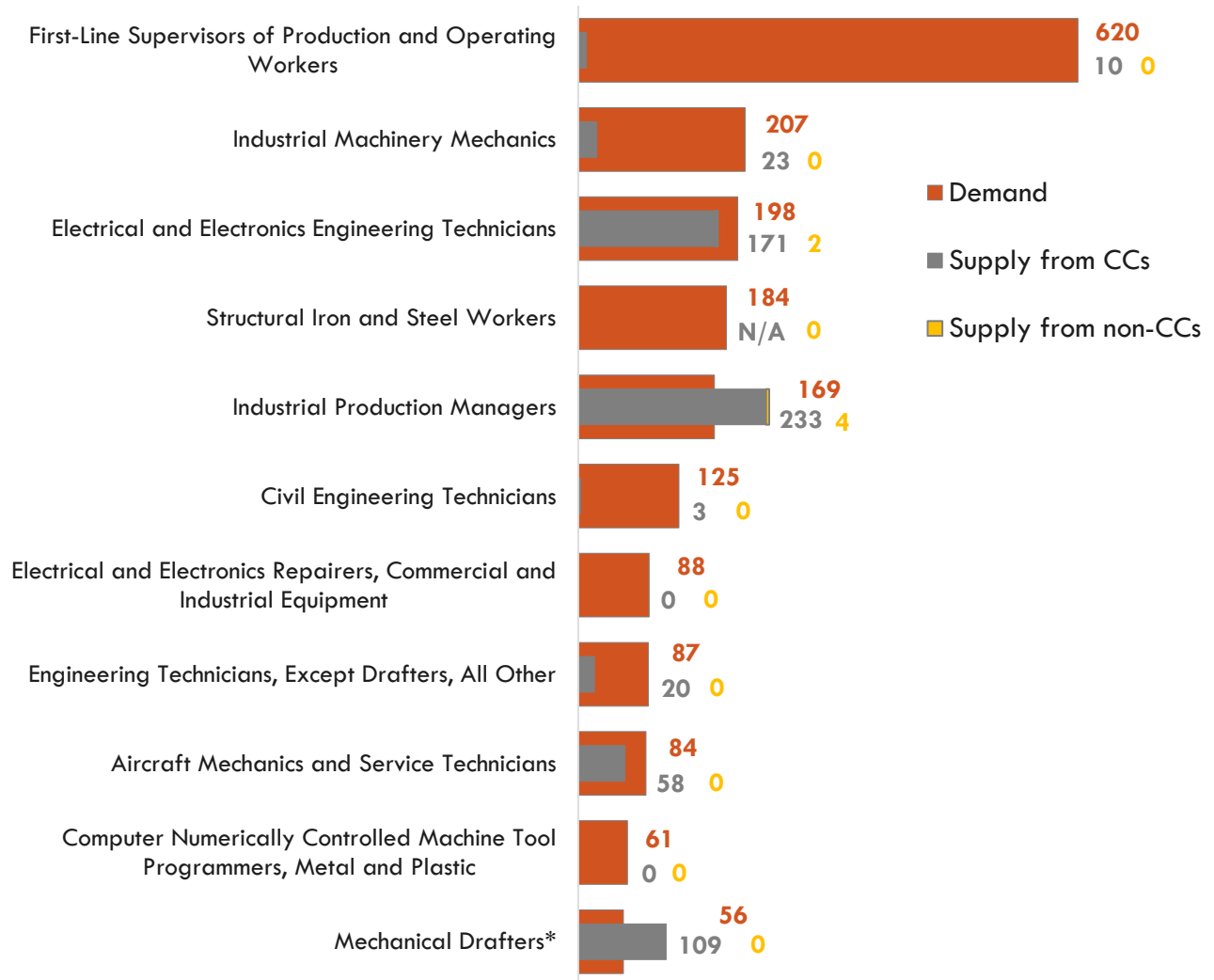
The Advanced Manufacturing sector focus group included three faculty members and four administrators from five of the seven institutions – six community colleges and one noncredit school – that offered Advanced Manufacturing programs in Orange County between 2015 and 2017. The regional director for employer engagement also attended the focus group.

Focus group participants identified several data limitations, challenges in expanding programs, and other issues that were common across multiple sectors. The cross-sector, common themes are expanded on and explained in further detail in the standalone Orange County Sector Analysis Project Executive Summary report. Focus group participants also reported on limitations and challenges that were unique to the Advanced Manufacturing sector. This sector-specific information is highlighted throughout this report in the Focus Group Insights and the Focus Group Insights – The Big Picture sections.

ADVANCED MANUFACTURING TOP MIDDLE-SKILL JOBS

This section compares Orange County's labor market demand for the top middle-skill jobs in Advanced Manufacturing with program supply from the region's community colleges and non-community college providers (Exhibit 1). As seen in Exhibit 2, the entry-level wages² for these top middle-skill jobs are higher than the \$17.39 per hour living wage. Descriptions for each occupational title can be found in Appendix B. Detailed supply and demand data analyzed for each occupation, including supply numbers by institutions is included in Appendix C.

**Exhibit 1. Advanced Manufacturing Top Middle-Skill Jobs in Orange County:
Labor Market Demand vs. Program Supply**



(Please note: * indicates that the occupation has an oversupply of labor, and N/A indicates that no community college program reported awards for this occupation or no community college program is available for this occupation.)

² In this report, entry-level wage is defined as the 25th percentile hourly wage, which means that 25% of all workers in the field earn equal to or below this amount. Generally, workers with less experience earn lower wages.

FOCUS GROUP INSIGHTS

Local Low-Unit Certificates

The Advanced Manufacturing sector focus group participants felt that supply data from traditional labor market information is limited; it does not capture locally issued low-unit certificates that are not reported to, or approved by, the California Community Colleges Chancellor's Office (CCCCO). According to focus group participants, Advanced Manufacturing programs attract industry professionals who are interested in upskilling or learning new skills for their current jobs. However, the supply data does not capture students that take a small number of courses to gain additional skills if colleges do not report data for low-unit certificate programs. This could result in an under-reporting of the supply number.

Challenges in Identifying Supply for Management Positions

This brief analyzes labor market demand and supply data for the Advanced Manufacturing sector, using occupational codes from the Standard Occupational Classification (SOC) system for demand data and program codes from the Taxonomy of Programs (TOP) and Classification of Instructional Programs (CIP) systems for supply data (see Appendix A for more information). However, matching SOC codes to TOP and CIP codes has its limitations, particularly for management positions. Focus group participants pointed out that the TOP codes associated with the Industrial Production Managers occupation train for various managerial occupations, not just Industrial Production Managers. For this reason, the program supply numbers for Industrial Production Managers is likely overstated.

Low Completion Numbers

Focus group participants indicated that supply numbers for programs that actually report awards to the CCCCCO are lower than expected. Manufacturing courses in Orange County tend to have high retention and success rates (91% and 82%, respectively, for all colleges, according to the CCCCCO's dashboard tool, LaunchBoard³); however, completion numbers for certificates and degrees appear low. Focus group participants said that students may take one or two courses and exit the community college system without actually receiving a certificate or degree. Focus group participants agreed that it is very common for students to be hired before they complete a program. These explanations suggest that some programs may be overdesigned, meaning that programs require more courses than necessary for students to gain the necessary skills to obtain employment. An Orange Coast College administrator acknowledged that programs could be overdesigned, but pointed out that the Student Centered Funding Formula (SCFF)⁴ incentivizes awards by weighing the number of points for degrees and certificates higher than other metrics, such as the completion of nine or more CTE units or attainment of the regional living wage. Colleges could still re-work overdesigned programs or consider moving these programs to enhanced noncredit, where the dollar per career development/college preparatory (CDCP) FTES has increased and is now the same as it is for credit. Additionally, noncredit certificates are included in the Strong Workforce Program metrics, Student Success Metrics, and Vision for Success.

"We know these programs are overdesigned, but it takes a long time to undo what already exists."
— Orange Coast College Administrator

³ <https://www.calpassplus.org/LaunchBoard/Community-College-Pipeline.aspx>

⁴ <https://www.cccco.edu/About-Us/Chancellors-Office/Divisions/College-Finance-and-Facilities-Planning/Student-Centered-Funding-Formula>

Exhibit 2. Advanced Manufacturing Top Middle-Skill Jobs in Orange County: Entry-Level and Median Wages

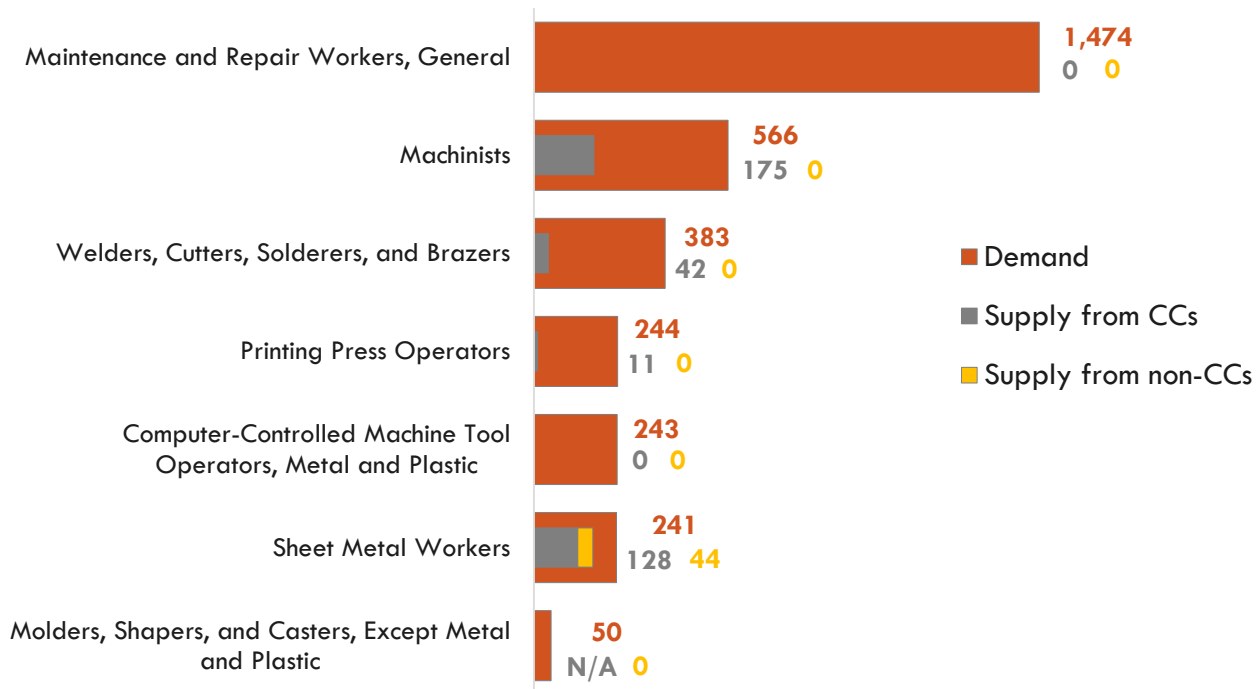
SOC Code	SOC (Occupational) Title	Demand (Annual Openings)	Entry-Level Wage (25 th Percentile)	Median Wage
49-9071	First-Line Supervisors of Production and Operating Workers	620	\$19.57	\$26.77
51-4041	Industrial Machinery Mechanics	207	\$19.18	\$24.48
51-4121	Electrical and Electronics Engineering Technicians	198	\$18.92	\$26.08
51-5112	Structural Iron and Steel Workers	184	\$25.22	\$35.91
51-4011	Industrial Production Managers	169	\$34.19	\$46.47
47-2211	Civil Engineering Technicians	125	\$24.28	\$31.56
51-9195	Electrical and Electronics Repairers, Commercial and Industrial Equipment	88	\$21.22	\$25.36
17-3029	Engineering Technicians, Except Drafters, All Other	87	\$21.64	\$28.24
49-3011	Aircraft Mechanics and Service Technicians	84	\$24.22	\$29.94
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	61	\$20.34	\$26.75
17-3013	Mechanical Drafters	56	\$22.58	\$27.61

ADVANCED MANUFACTURING MIDDLE-SKILL JOBS WITH ENTRY-LEVEL WAGES BELOW CALIFORNIA FAMILY NEEDS CALCULATOR

While it is important to understand which top middle-skill jobs have opportunities for increased program supply, it is also important to consider middle-skill occupations that have entry-level wages below the regional living wage but median wages near or above it. Since wages generally increase from entry-level to median earnings with additional experience and training, students could potentially earn self-sustaining wages with additional apprenticeship or work-based learning opportunities.

As seen in Exhibit 3, middle-skill Advanced Manufacturing jobs with entry-level wages below the regional living wage have a significant number of annual job openings (labor market demand).

**Exhibit 3. Advanced Manufacturing Middle-Skill Jobs with Entry-Level Wages Below the California Family Needs Calculator in Orange County:
Labor Market Demand vs. Program Supply**



(Please note: N/A indicates that no community college program reported awards for this occupation or no community college program is available for this occupation.)

While these occupations have entry-level wages below the California Family Needs Calculator of \$17.39 per hour, occupations such as Maintenance and Repair Workers, General; Machinists; Computer-Controlled Machine Tool Operators, Metal and Plastic; and Sheet Metal Workers have median wages higher than the regional living wage as denoted via the gray shading in Exhibit 4.

Exhibit 4. Advanced Manufacturing Middle-Skill Jobs with Entry-Level Earnings Below the California Family Needs Calculator in Orange County: Entry-Level and Median Wages

SOC Code	SOC (Occupational) Title	Demand (Annual Openings)	Entry-Level Wage (25 th Percentile)	Median Wage
49-9071	Maintenance and Repair Workers, General	1,474	\$15.51	\$19.18
51-4041	Machinists	566	\$16.30	\$21.17
51-4121	Welders, Cutters, Solderers, and Brazers	383	\$13.87	\$16.80
51-5112	Printing Press Operators	244	\$12.41	\$16.17
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	243	\$13.74	\$17.43
47-2211	Sheet Metal Workers	241	\$15.70	\$21.21
51-9195	Molders, Shapers, and Casters, Except Metal and Plastic	50	\$12.57	\$17.27

FOCUS GROUP INSIGHTS – THE BIG PICTURE

Focus group participants addressed other issues and challenges that cannot be captured by traditional labor market information and provided insight on the tactics colleges and employers are currently using to address supply gaps in the Advanced Manufacturing sector.

How Employers are Filling Supply Gaps

Focus group participants across all sectors reported that employers recruit heavily at four-year colleges for potential workers, even if a position does not require a bachelor's degree. In the Advanced Manufacturing focus group, participants noted that there is anecdotal evidence that students taking community college courses tend to know how to work machines better than their four-year college counterparts who tend to be more theory-based.

Faculty and administrators also shared that employers utilize staffing agencies in order to meet their workforce needs because they pre-screen candidates and provide a low-risk, fast-moving, pipeline of workers for companies. Additionally, companies such as Oakley take current employees and re-train them. One faculty member said that, in some cases, employers engage in re-training by giving employees a two-year time period to gain necessary skills by completing community college training programs.

"Employers go to Adecco or another staffing agency and say 'send us everybody.' [The employer] would send them through a training program. Those who didn't like it would leave and those that stayed would have opportunities down the road...that's how they build supply."

— Fullerton College Faculty Member

Skills and Certifications

According to the focus group participants, many skills taught in community college Advanced Manufacturing programs are transferable and are not exclusive to a single/particular job. For example, the community colleges in the region are developing new programs around robotics, conversational programming, and maintenance that are not specific to the Advanced Manufacturing sector and are valuable to other sectors such as Energy, Construction, and Utilities.

In order to close labor market supply gaps in the sector, focus group participants said that companies tend to hire students before they complete their programs as long as students have the foundational skills needed for the job. Once on board, companies could provide training specific to the companies' products and processes. One focus group participant indicated that manufacturing firms tend to be small—some with fewer than 20 employees. Small manufacturers prefer workers with skills specific to their business and have developed in-house training to meet those specialized needs. Therefore, it may not be necessary for students to complete an entire program in order to be "job ready" for these types of manufacturers.

Certifications are another way to demonstrate skill attainment according to focus group participants. Faculty and administrators identified a number of certifications for which Orange County community college programs train. These certifications include Siemens Programmable Logic Controller (PLC), Level One Mechatronics, SOLIDWORKS, AutoCAD, Revit, and Additive Manufacturing.

Challenges in Expanding Programs

Focus group participants identified several challenges to expanding programs in the Advanced Manufacturing sector. Many of these challenges, including the lack of dedicated lab space, difficulty hiring faculty and staff, and high costs for equipment, cut across all sectors. However, a unique challenge for the Advanced Manufacturing sector is that Orange County's community colleges offer several Advanced Manufacturing courses—many of which have similar training goals or learning outcomes. However, each college has a different approach and curriculum, which can be confusing for students to navigate, should they desire to complete their education across multiple institutions. This fragmentation may cause students to take longer to actually complete programs, especially if courses do not articulate from one institution to another.

KEY FINDINGS: ADVANCED MANUFACTURING

Based on the demand and supply data, as well as the focus group insights analyzed in this brief, the COE identified the following key research findings and recommendations:

Demand and Supply Key Findings

5,080 annual job openings (labor market demand)	1,033 average annual program awards (labor market supply)	4,047 supply gap (number of awards needed to close the gap)
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Focus Group Key Findings and Recommendations

Key Finding	Recommendation
1. Retention and success rates are high for Advanced Manufacturing courses, but program completion numbers are low: Community colleges in Orange County are undersupplying for middle-skill Advanced Manufacturing jobs. Nearly 9% of all students enrolled in Advanced Manufacturing programs completed a degree or certificate in the 2016-2017 academic year. Students often take one or two courses to gain additional skills, then exit the community college system or they find a job before completing their program. These explanations suggest that some programs may be overdesigned, meaning that they require more courses than necessary for students to gain the needed skills to obtain employment.	1. To increase completion rates of students in Advanced Manufacturing programs, colleges could re-work overdesigned programs or consider moving these programs to enhanced noncredit. Noncredit certificates are included in the Strong Workforce Program (SWP) metrics, Student Success metrics, and the Vision for Success. Enhanced noncredit programs could be a way to satisfy student needs for short-term programs and still benefit colleges. Additionally, college faculty, deans, and the Regional Director for Employer Engagement for this sector should review program and course data to determine the specific barriers that prevent students from successfully completing a program (e.g., challenging introductory courses and differing pre-requisites across colleges for higher level courses). Strong Workforce Program (SWP) funds could be invested at the college level to address students' specific barriers to course/program retention and completion.
2. Advanced Manufacturing skills and certifications are transferable and not necessarily exclusive to a particular occupation: Orange County community colleges are developing new programs around robotics, conversational programming, and maintenance that are not solely specific to the Advanced Manufacturing Sector and provide valuable skills that can be used in other sectors such as Energy, Construction, and Utilities.	2. Employers tend to hire students before they complete their programs, as long as students have foundational skills needed for the job. Industry-recognized certifications are another way to demonstrate skill attainment. Colleges could explore offering courses that will allow students to obtain certifications such as Siemens Programmable Logic Controller (PLC), Level One Mechatronics, and SOLIDWORKS, all of which can be applied in both the Advanced Manufacturing and Energy, Construction, and Utilities sectors.

Key Finding	Recommendation
<p>3. Advanced Manufacturing programs across Orange County community colleges are fragmented: Orange County community colleges offer several Advanced Manufacturing courses and programs—many of which have similar training goals or learning outcomes. However, each college has a different approach and curriculum, which can be confusing for students to navigate, should they desire to complete their education across multiple institutions. This fragmentation may cause students to take longer to actually complete programs, especially if courses do not articulate from one institution to another.</p> <p>4. Knowledge, Skills, and Abilities (KSAs) for the sector have not been validated by employers: The OC Sector Analysis Project examines job gaps but does not explore the specific KSAs taught at the colleges and compare them to the labor market’s demand for Advanced Manufacturing KSAs.</p>	<p>3. To address the fragmentation of Advanced Manufacturing programs, the Regional Director for Employer Engagement could convene administrators, faculty, and counselors to discuss articulation agreements for courses and programs that have similar goals or learning outcomes. This could create a more seamless pipeline for students thereby increasing their opportunity for completing an Advanced Manufacturing program.</p> <p>4. To determine if the region’s community colleges are training for the right KSAs, the Advanced Manufacturing Regional Director for Employer Engagement should convene employers in a “regional advisory group” where employers can review program KSAs, provide feedback, and validate the KSAs’ current relevance and demand in the labor market</p>

APPENDIX A: METHODOLOGY AND ADVANCED MANUFACTURING DATA DEFINITIONS

The Centers of Excellence for Labor Market Research (COE) prepared this report by analyzing data from occupations and education programs. Occupational data is derived from Emsi, a software program that consolidates data from the California Employment Development Department (EDD), U.S. Bureau of Labor Statistics (BLS) and other government agencies. Program supply data is drawn from two systems: Taxonomy of Programs (TOP) and Classification of Instructional Programs (CIP).

The California Community Colleges (CCC) define “sectors” by TOP codes. To determine what occupations should be analyzed in this brief, the COE first reviewed the TOP codes associated with the sector and then matched them with the SOC codes. According to the CCC, the following six-digit TOP codes define the Advanced Manufacturing sector:

TOP6 Program Name	TOP6 Code
Aeronautical and Aviation Technology	0950.00
Aircraft Electronics (Avionics)	0950.40
Aircraft Fabrication	0950.50
Appliance Repair	0935.10
Computer Electronics	0934.10
Electrical, Electronic, and Electro-Mechanical Drafting	0953.30
Electronics and Electric Technology	0934.00
Engineering Technology, General	0924.00
Fashion Production	1303.30
Industrial and Occupational Safety and Health	0956.70
Industrial Electronics	0934.20
Industrial Quality Control	0956.80
Industrial Systems Technology and Maintenance	0945.00
Instrumentation Technology	0943.30
Laser and Optical Technology	0934.80
Machining and Machine Tools	0956.30
Manufacturing and Industrial Technology	0956.00
Mechanical Drafting	0953.40
Ocean Technology	1920.00
Optics	0961.00
Petroleum Technology	0954.30
Plastics and Composites	0954.20
Printing and Lithography	0963.00
Surveying	0957.30
Technical Illustration	0953.60
Vacuum Technology	0943.30
Welding Technology	0956.50

Using a TOP-SOC crosswalk, the COE then identified middle-skill jobs for which programs within these TOP codes train. The COE examined more than 850 occupational codes from the Standard Occupational Classification (SOC)⁵ system and identified approximately 300 occupational codes as middle-skill jobs.

⁵ SOC is a federal statistical standard used by EDD, BLS and other federal agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data.

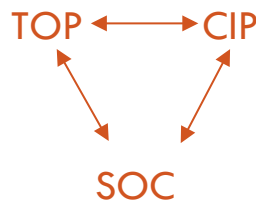
Middle-skill jobs include:

- All occupations that require an educational requirement of some college, associate degree or apprenticeship;
- All occupations that require a bachelor's degree, but also have more than one-third of their existing labor force with an educational attainment of some college or associate degree; or
- All occupations that require a high school diploma or equivalent or no formal education, but also require short- to long-term on-the-job training where multiple community colleges have existing programs.

For this study, the COE analyzed occupations with a labor market demand of at least 50 annual job openings. (For comparison, the average and median demand for an occupation in Orange County is 307 and 63 annual job openings, respectively.)⁶ The number of annual job openings estimates employment change and turnover for an occupation each year between 2018 and 2023. Annual job openings include:

- Job Growth: An employer experiences increased demand for products and hires new employees to increase production. If job growth is zero or negative, then any and all openings are due to replacement needs.
- Replacement Needs: An employer hires replacement workers for employees who leave the workforce or change occupations. Replacement rates are derived from national 10-year, occupation-specific percentages published by the U.S. BLS's Employment Projections program.

The COE then cross-referenced the SOC codes with CIP and TOP codes to compare labor market demand with program supply. The following diagram illustrates this process:



The COE determined labor market supply for an occupation or SOC code by analyzing the number of program completers or awards in a related TOP or CIP code. The COE developed a “supply table” with this information, which is the source of the program supply data for this report. 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), also known as IPEDS. TOP is a system of numerical codes used at the state level to collect and report information on California community college programs and courses throughout the state that have similar outcomes. CIP codes are a taxonomy of academic disciplines at institutions of higher education in the United States and Canada. Institutions outside of the California community college system do not use TOP codes in their reporting systems.

Because a TOP/CIP code may train for more than one occupation, simply aggregating all supply from all related codes may overestimate supply for an occupation. Therefore, the COE de-duplicated TOP codes that trained for more than one occupation to avoid counting the program supply more than once. Doing so provides a more accurate representation of the supply gaps in the region by occupation. This information can be seen in the demand and supply tables in Appendix C of this study.

Qualitative Methodology

An integral aspect of the Orange County Sector Analysis Project was the qualitative data collected during the project’s focus groups. In May 2019, the COE created an advisory group comprised of the Orange County Regional Consortium Director as well as five CTE deans and directors that represented the four community college districts in Orange County. The advisory group created a process and timeline for inviting faculty and administrators to participate in focus groups to better understand where

⁶ Emsi. Data set 2019.2. QCEW Employees + Non-QCEW + Self-Employed. 2018-2023.

programs exist or do not exist to fill supply gaps and discuss how Orange County's community colleges could close the supply gaps for the county's eight priority and emerging sectors.

To create the invite list of faculty and administrators, Regional Directors for Employer Engagement and career education deans at each college were asked to identify faculty and administrators that could represent their respective colleges in the sector-specific focus groups. Once this list was compiled, the career education deans invited faculty and administrators to express their interest in participating in a focus group via email. The email introduced the COE, provided an overview of the Orange County Sector Analysis Project, described the goals of the focus groups, and informed faculty that they would be compensated for their participation, and that lunch would be provided for all participants. All those that stated their interest were then connected with the COE who managed the focus groups scheduling and details.

In order to be as inclusive as possible, 12 focus groups were scheduled for the eight sectors – four sectors had one focus group each and four sectors had two focus groups each, during a three-week period from July to August 2019. All focus groups participants received a confirmation email before the event that included the focus group agenda, their sector-specific draft brief, and a pre-assignment with questions based off of the information contained in the draft sector briefs. Focus group participants were instructed to complete and bring the pre-assignment to the convening so that they were prepared to discuss the data, the challenges they face in their programs, and strategies to close supply gaps. Each focus groups was recorded, with permission of the participants, by the COE solely for transcription purposes.

The COE conducted no more than two focus group sessions per day. During the focus groups the Orange County Sector Analysis Project was explained and then the information contained in the draft sector briefs was presented in detail. Participants were encouraged to ask questions and engage in dialogue throughout the entire focus group session. The COE took notes of each discussion as well as recorded the sessions, with permission of the participants and solely for transcription purposes.

Following the conclusion of the focus groups, the COE compiled the audio files, transcripts, notes, and pre-assignments to conduct a qualitative analysis of the themes for each focus group and to identify commonalities across multiple focus groups. The findings from this analysis have been highlighted throughout this report in the "Focus Group Insight" sections.

APPENDIX B: DEFINITIONS FOR ADVANCED MANUFACTURING MIDDLE-SKILL JOBS

Aircraft Mechanics and Service Technicians (SOC 49-3011): Diagnose, adjust, repair, or overhaul aircraft engines and assemblies, such as hydraulic and pneumatic systems. Includes helicopter and aircraft engine specialists. Sample job titles include:

- Airframe and Powerplant Mechanic
- Helicopter Mechanic
- Aircraft Maintenance Technician
- Aircraft Technician
- Aircraft Mechanic
- Aircraft Restorer

Civil Engineering Technicians (SOC 17-3022): Apply theory and principles of civil engineering in planning, designing, and overseeing construction and maintenance of structures and facilities under the direction of engineering staff or physical scientists. Sample job titles include:

- Civil Engineering Technician
- Engineering Specialist
- Engineering Assistant
- Engineer Technician
- Design Technician
- Civil Engineering Designer

Computer-Controlled Machine Tool Operators, Metal and Plastic (SOC 51-4011): Operate computer-controlled machines or robots to perform one or more machine functions on metal or plastic work pieces. Sample job titles include:

- Computer Numerical Control Technician
- Computer Numerical Control Machine Operator
- Computer Numerical Control Set-Up and Operator
- Machinist
- Computer Numerical Control Machinist

Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic (SOC 51-4012): Develop programs to control machining or processing of metal or plastic parts by automatic machine tools, equipment, or systems. Sample job titles include:

- Computer Numerical Control Programmer
- Computer Numerical Control Machinist
- Programmer
- Process Engineer
- Machine Operator
- Computer Numerical Control Machining Center Operator

Electrical and Electronics Engineering Technicians (SOC 17-3023): Apply electrical and electronic theory and related knowledge, usually under the direction of engineering staff, to design, build, repair, calibrate, and modify electrical components, circuitry, controls, and machinery for subsequent evaluation and use by engineering staff in making engineering design decisions. Sample job titles include:

- Digital Tech
- Calibration Technician
- Test Technician
- Electrical Technician
- Equipment Specialist
- Results Technician

Electrical and Electronics Repairers, Commercial and Industrial Equipment (SOC 49-2094): Repair, test, adjust, or install electronic equipment, such as industrial controls, transmitters, and antennas. Sample job titles include:

- Field Service Technician
- Technical Support Specialist
- Maintenance Technician
- Repair Technician
- Instrument and Control Technician
- Scale Technician

Engineering Technicians, Except Drafters, All Other (17-3029): All engineering technicians, except drafters, not listed separately. Sample job titles include:

- Electrical Engineering Technologists (17-3029.02): Assist electrical engineers in such activities as process control, electrical power distribution, or instrumentation design. May prepare layouts of electrical transmission or distribution systems, supervise the flow of work, estimate project costs, or participate in research studies.
- Industrial Engineering Technologists (17-3029.05): Assist industrial engineers in such activities as quality control, inventory control, or material flow methods. May conduct statistical studies or analyze production costs.
- Manufacturing Engineering Technologists (17-3029.06): Develop tools, implement designs, or integrate machinery, equipment, or computer technologies to ensure effective manufacturing processes.
- Photonics Technicians (17-3029.08): Build, install, test, or maintain optical or fiber optic equipment, such as lasers, lenses, or mirrors, using spectrometers, interferometers, or related equipment.

First-Line Supervisors of Production and Operating Workers (SOC 51-1011): Directly supervise and coordinate the activities of production and operating workers, such as inspectors, precision workers, machine setters and operators, assemblers, fabricators, and plant and system operators. Sample job titles include:

- Production Supervisor
- Paper Machine Supervisor
- Operations Supervisor
- Paper Products Supervisor
- Molding Supervisor
- Sawmill Supervisor

Industrial Machinery Mechanics (SOC 49-9041): Repair, install, adjust, or maintain industrial production and processing machinery or refinery and pipeline distribution systems. Sample job titles include:

- Overhauler
- Machine Adjuster
- Industrial Mechanic
- Loom Technician
- Master Mechanic
- Maintenance Technician

Industrial Production Managers (SOC 11-3051): Plan, direct, or coordinate the work activities and resources necessary for manufacturing products in accordance with cost, quality, and quantity specifications. Sample job titles include:

- Production Manager
- Quality Control Supervisor
- Site Manager
- Biofuels Production Manager
- Production Support Supervisor
- Power Project Manager

Machinists (SOC 51-4041): Set up and operate a variety of machine tools to produce precision parts and instruments. Includes precision instrument makers who fabricate, modify, or repair mechanical instruments. May also fabricate and modify parts to make or repair machine tools or maintain industrial machines, applying knowledge of mechanics, mathematics, metal properties, layout, and machining procedures. Sample job titles include:

- Tool Room Machinist
- Production Machinist
- Gear Machinist
- Utility Operator
- Senior Maintenance Machinist
- Manual Lathe Machinist

Maintenance and Repair Workers, General (SOC 49-9071): Perform work involving the skills of two or more maintenance or craft occupations to keep machines, mechanical equipment, or the structure of an establishment in repair. Duties may involve pipe fitting; boiler making; insulating; welding; machining; carpentry; repairing electrical or mechanical equipment; installing, aligning, and balancing new equipment; and repairing buildings, floors, or stairs. Sample job titles include:

- Plant Maintenance Technician
- Facilities Engineer
- Building Engineer
- Stationary Engineer
- Process Technician

Mechanical Drafters (SOC 17-3013): Prepare detailed working diagrams of machinery and mechanical devices, including dimensions, fastening methods, and other engineering information. Sample job titles include:

- Design Drafter
- Tool Design Drafter
- Piping Designer
- Drafting Technician
- Product Designer
- Installation Drafter

Molders, Shapers, and Casters, Except Metal and Plastic (SOC 51-9195): Mold, shape, form, cast, or carve products such as food products, figurines, tile, pipes, and candles consisting of clay, glass, plaster, concrete, stone, or combinations of materials. Sample job titles include:

- Granite Cutter
- Neon Tube Bender
- Mold Maker
- Fabricator
- Neon Glass Blower
- Caster

Printing Press Operators (SOC 51-5112): Set up and operate digital, letterpress, lithographic, flexographic, gravure, or other printing machines. Includes short-run offset printing presses. Sample job titles include:

- Digital Press Operator
- Flexographic Press Operator
- Lithographic Press Operator
- Offset Press Operator
- Web Offset Press Feeder
- Web Pressman

Sheet Metal Workers (SOC 47-2211): Fabricate, assemble, install, and repair sheet metal products and equipment, such as ducts, control boxes, drainpipes, and furnace casings. Work may involve any of the following: setting up and operating fabricating machines to cut, bend, and straighten sheet metal; shaping metal over anvils, blocks, or forms using hammer; operating soldering and welding equipment to join sheet metal parts; or inspecting, assembling, and smoothing seams and joints of burred surfaces. Includes sheet metal duct installers who install prefabricated sheet metal ducts used for heating, air conditioning, or other purposes. Sample job titles include:

- Sheet Metal Mechanic
- Sheet Metal Layout Mechanic
- Sheet Metal Apprentice
- Sheet Metal Installer
- Heating, Ventilation, and Air Conditioning Sheet Metal Installer
- Sheet Metal Fabricator

Structural Iron and Steel Workers (SOC 47-2221): Raise, place, and unite iron or steel girders, columns, and other structural members to form completed structures or structural frameworks. May erect metal storage tanks and assemble prefabricated metal buildings. Sample job titles include:

- Structural Steel Erector
- Tower Hand
- Iron Worker
- Fitter
- Rigger
- Steel Fabricator

Welders, Cutters, Solderers, and Brazers (SOC 51-4121): Use hand-welding, flame-cutting, hand soldering, or brazing equipment to weld or join metal components or to fill holes, indentations, or seams of fabricated metal products. Sample job titles include:

- Maintenance Welder
- Wirer
- Refrigeration Brazer/Solderer
- Aluminum Welder
- Solderer
- Production Welder

APPENDIX C: ADVANCED MANUFACTURING DEMAND AND SUPPLY DATA

The following tables compare labor market demand and program supply by occupation, and are the underlying information for the exhibits in this brief. Because a TOP/CIP code may train for more than one occupation, simply aggregating all supply from all related codes may overestimate supply for that occupation. Therefore, the COE de-duplicated TOP codes that train for more than one occupation to avoid counting program supply more than once. This de-duplication process is denoted by the “Already Accounted For” statements in the tables on the following pages.

Additionally, the COE reviewed program data from the LaunchBoard⁷ and the statewide COE Supply Table⁸ and identified conflicting information. For certain occupations, LaunchBoard indicates that a college has a program for that occupation, but the COE Supply Table does not show program data for that college, and vice versa. These discrepancies are marked with the following:

+The COE Supply Table indicates that this college supplies awards for this TOP code, but this college is not listed in the LaunchBoard

*LaunchBoard indicates that this college/school supplies awards for this TOP code, but this college is not listed in COE Supply Table

The COE provided these markings for the community colleges in the region to review potential miscoded programs at their respective colleges.

The demand and supply tables in the following pages have three categories:

1. **Supply Gap** – If Average Annual Openings exceed Average Annual Awards by more than 25 percent, then the cell is shaded in green.
2. **Supply Met** – If Average Annual Openings is within 25 percent +/- of Average Annual Awards, then the cell is shaded in blue.
3. **Oversupply** – If Average Annual Awards exceed the Average Annual Openings by more than 25 percent, then the cell is shaded in red.

⁷ calpassplus.org/LaunchBoard/Home.aspx

⁸ coeccc.net/COE/media/SupplyandDemandPageDocuments/Supply-2014-17_Feb-2018.xlsm

DEMAND AND SUPPLY DATA FOR TOP ADVANCED MANUFACTURING MIDDLE-SKILL JOBS IN ORANGE COUNTY

+The COE Supply Table indicates that this college/school supplies awards for this TOP code, but this college is not listed in the LaunchBoard

*LaunchBoard indicates that this college/school supplies awards for this TOP code, but this college is not listed in COE Supply Table

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2018-23)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2015-17)	TOP6 TITLE	TOP6 OR CIP	COLLEGE	COLLEGE SUPPLY (3-YR AVG)
First-Line Supervisors of Production and Operating Workers	620	Supply Gap	10	Industrial Systems Technology and Maintenance	0945.00	Fullerton+	2
						Santiago Canyon	8
Industrial Machinery Mechanics	207	Supply Gap	23	Industrial Systems Technology and Maintenance	0945.00	Already Accounted For	0
				Manufacturing and Industrial Technology	0956.00	Fullerton	6
						Irvine	8
						Saddleback	6
						Santa Ana	3
						Orange Coast*	0
Electrical and Electronics Engineering Technicians	198	Supply Met	173	Electronics and Electric Technology	0934.00	Coastline+	117
						Irvine	20
						Orange Coast	7
						Saddleback	17
						Santa Ana	10
						North Orange Adult*	0
					CIP 15.0399	Southern California Institute of Technology	2
Structural Iron and Steel Workers	184	Supply Gap	0	Sheet Metal and Structural Metal	0956.40	No Programs	0
Industrial Production Managers	169	Oversupply	237	Management Development and Supervision	0506.30	Coastline	207
						Irvine+	1
						Saddleback	25
						Golden West*	0
						Cypress*	0
						Orange Coast*	0
					CIP 52.0204	Allied American University	4

ADVANCED MANUFACTURING
Demand and Supply Analysis: Orange County

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2018-23)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2015-17)	TOP6 TITLE	TOP6 OR CIP	COLLEGE	COLLEGE SUPPLY (3-YR AVG)
Civil Engineering Technicians	125	Supply Gap	3	Engineering Technology, General	0924.00	Santa Ana	3
						Irvine*	0
						Fullerton*	0
Electrical and Electronics Repairers, Commercial and Industrial Equipment	88	Supply Gap	0	Electronics and Electric Technology	0934.00	Already Accounted For	0
					CIP 15.0399	Already Accounted For	0
				Industrial Electronics	0934.20	No Programs	0
Engineering Technicians, Except Drafters, All Other	87	Supply Gap	20	Engineering Technology, General	0924.00	Already Accounted For	0
				Industrial Electronics	0934.20	No Programs	0
				Plastics and Composites	0954.20	No Programs	0
				Other Engineering and Related Industrial Technologies	0999.00	Coastline	20
						Santa Ana*	0
Aircraft Mechanics and Service Technicians	84	Supply Gap	58	Aeronautical and Aviation Technology	0950.00	Orange Coast	29
				Aviation Airframe Mechanics	0950.10	Orange Coast	15
				Aviation Powerplant Mechanics	0950.20	Orange Coast	14
				Aircraft Fabrication	0950.50	Orange Coats*	0
Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	61	Supply Gap	0	Manufacturing and Industrial Technology	0956.00	Already Accounted For	0
Mechanical Drafters	56	Oversupply	109	Architecture and Architectural Technology	0201.00	Fullerton	8
						Orange Coast	45
						Saddleback	8
				Drafting Technology	0953.00	Fullerton	7
						Golden West	17
						Irvine	3
						Saddleback	1
						Santa Ana	19
				Mechanical Drafting	0953.40	Irvine+	1

DEMAND AND SUPPLY DATA FOR ADVANCED MANUFACTURING MIDDLE-SKILL JOBS WITH ENTRY-LEVEL WAGES BELOW CALIFORNIA FAMILY NEEDS CALCULATOR IN ORANGE COUNTY

+The COE Supply Table indicates that this college/school supplies awards for this TOP code, but this college is not listed in the LaunchBoard

*LaunchBoard indicates that this college/school supplies awards for this TOP code, but this college is not listed in COE Supply Table

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2018-23)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2015-17)	TOP6 TITLE	TOP6 OR CIP	COLLEGE	COLLEGE SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	1,474	Supply Gap	0	Industrial Systems Technology and Maintenance	0945.00	Already Accounted For	0
Machinists	566	Supply Gap	175	Manufacturing and Industrial Technology	0956.00	Already Accounted For	0
				Machining and Machine Tools	0956.30	Fullerton	4
						Orange Coast	64
						Santa Ana	84
Welders, Cutters, Solderers, and Brazers	383	Supply Gap	42	Welding Technology	0956.50	Fullerton	14
						Orange Coast	8
						Santa Ana	20
Printing Press Operators	244	Supply Gap	11	Printing and Lithography	0936.00	Fullerton	11
						Saddleback*	0
Computer-Controlled Machine Tool Operators, Metal and Plastic	243	Supply Gap	0	Manufacturing and Industrial Technology	0956.00	Already Accounted For	0
				Machining and Machine Tools	0956.30	Already Accounted For	0
Sheet Metal Workers	241	Supply Gap	172	Environmental Control Technology	0946.00	Cypress	87
					CIP 47.0201	Orange Coast	41
						Brownson Technical School	13
						InterCoast Colleges-Anaheim	26
				Sheet Metal and Structural Metal	0956.40	InterCoast Colleges-Roseville	5
Molders, Shapers, and Casters, Except Metal and Plastic	50	Supply Gap	0	N/A	N/A	No Programs	0