

Makerspaces

Inland Empire/Desert Region (Riverside and San Bernardino counties)

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

Introduction

The makerspace movement is built upon the foundation of constructionism, or the philosophy of hands-on learning through the building of things (Kurti et al., 2014). According to the California Manufacturing Network, makerspaces or Maker Labs function much like traditional wood-, metal-, or auto shop classes but are oriented more toward technology, specifically focusing on STEM concepts (Science, Technology, Engineering, and Math) (CMTC, 2019). Makerspace equipment may range from laser cutters to LEGOs but often provides access to 3D printers, CNC Machines, soldering irons, and sewing machines (Makerspaces, 2021). The experiences makerspaces offer are only limited to the facility size, the resources available, and the student's imagination. These facilities "can act as a provocation for inquiry" into multiple career education fields (University of Redlands, 2021).

Makerspaces often serve as a first step in the career exploration journey, all while providing hands-on skills. While the skills learned and experiences gained in these spaces are invaluable to those who may not otherwise have access to these resources, there is little evidence that participation in a makerspace will lead directly to employment. Students should transition to a focused career education program shortly after finding a career or skill interest. This report focuses on skills that may be gained by students in a well-equipped makerspace or Maker Lab.

Demand for General Makerspace/Maker Lab Skills and Experience

A search of online job advertisements (ads) did not reveal a desire for workers with general makerspace skills and experience. A regional keyword search of ads posted over the last 12 months (January 2020 to February 2021) yielded three (3) total results. The online job ads, posted by the Ontario City Library and Corona Public Library, sought candidates classified as library assistants, clerical (Standard Occupational Classification (SOC) 43-4121). These ads included descriptions of the facilities, which contain makerspaces but did not specify a desire for workers with general makerspace skills and experience.

The following sections display a search of online job ads for common resources available in a makerspace or maker labs. Please note that access to makerspace resources-alone is likely insufficient to secure

employment. Colleges should be prepared to guide students to a relevant educational program once they have selected a career path.

Demand for 3D Printer Skills

Over the last 12 months, there were 20 regional online job ads for positions requiring the skill "3D printing/additive manufacturing." Due to the low number of ads, there were only two occupations with more than one job advertisement, *commercial and industrial designers* (SOC 27-1021) and *production workers, all other* (SOC 51-9199). These occupations illuminate the distinction between 3D printer design-oriented occupations and operation-oriented occupations. Collectively, these occupations accounted for approximately one-third (35%) of regional online job ads and represented less than 1% of 2,390 statewide job ads for this skill. Statewide, the occupations with the most online job ads are *mechanical engineers* (SOC 17-2141), *engineers, all other* (SOC 17-2199), and *engineering technicians, except drafters, all other* (SOC 17-3029). Exhibit 1 displays current occupational employment, projected annual job opportunities, and hourly wage information for 3D printing occupations mentioned in online employer job ads. Please note that 3D printing experience-alone is likely insufficient to secure employment in these fields.

Exhibit 1: Five-year job projections and hourly earnings, 2019-2024

Occupations	2019 Jobs	Annual Openings (New + Replacement Jobs)	25 th Pct. Hourly Earnings	Median Hourly Earnings
Production Workers, All Other	3,833	402	\$12.62	\$14.63
Commercial and Industrial Designers	181	16	\$18.51	\$28.67
Total	4,013	418	-	-

Source: Emsi 2021.1

The two regional employers posting the most ads were Raytheon and KN Engineering Incorporated; both employers are located in Riverside. Approximately 38% of statewide employers requesting this skill are located in Los Angeles/Orange County region, indicating that there are more opportunities available to individuals willing to commute out of the region.

Exhibit 2 displays a sample of common specialized and employability skills employers seek in addition to 3D printing skills. Specialized skills are occupation-specific skills that employers request for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job postings may be utilized to guide

curriculum development. Please note that this section's skills information represents very few employer job ads and may not indicate in-demand skills across the state.

Exhibit 2: Sample of in-demand skills from employer online job ads

Occupations	Specialized Skills	Employability Skills
Commercial and Industrial Designers (n=4)	<ul style="list-style-type: none"> • Product Testing • Engineering Management • Computer-Aided Drafting/Design (CAD) • Mechanical Engineering 	<ul style="list-style-type: none"> • Computer Literacy • Written Communication • Research • Organizational Skills
Production Workers, All Other (n=3)	<ul style="list-style-type: none"> • Machine Operation • Lathes • Drill Presses • Pneumatic Tools 	<ul style="list-style-type: none"> • Computer Literacy • Work Area Maintenance • Detail-Oriented • Organizational Skills

Source: Burning Glass – Labor Insights

Three regional community colleges offer makerspaces with 3D printing capabilities, an additive manufacturing program offered at Chaffey College's InTech Center. The following list contains links to these makerspace resource websites.

- Chaffey College's InTech Center Additive Manufacturing: <https://intechcenter.org/student-services/training-programs/additive-manufacturing/>
- Mt. San Jacinto College's Eagle MakerSpace: <https://www.msjc.edu/makerspace/index.html>
- Moreno Valley College's iMake Innovation Center: <https://mvccte.com/imake/>
- San Bernardino Community College District's MakerSpace: <https://cccmaker.com/space/san-bernardino-valley-college/>

For more information regarding California Community College makerspaces, please visit the [CCC Maker](#) website (CCC Maker, 2021).

Demand for CNC Machine Skills

Over the last 12 months, there were 607 regional job ads posted for positions that included a desire for "Computer Numerical Control (CNC)," "CNC Mill," and "CNC Machine" skills. The occupations with the most ads in the region were *computer numerically controlled tool operators* (SOC 51-9161), *machinists* (SOC 51-4041), and *computer numerically controlled tool programmers* (SOC 51-9162). These occupations accounted for approximately half (51%) of regional online job ads for CNC machine skills. Exhibit 3 displays current occupational employment, projected annual job opportunities, and hourly wage information for CNC machining occupations. Please note, makerspace CNC machine experience-alone may not be sufficient to secure employment in this field.

Exhibit 3: Five-year job projections and hourly earnings, 2019-2024

Occupations	2019 Jobs	Annual Openings (New + Replacement Jobs)	25 th Pct. Hourly Earnings	Median Hourly Earnings
Machinists	3,475	347	\$14.08	\$18.36
Computer Numerically Controlled Tool Operators	944	82	\$15.15	\$18.39
Computer Numerically Controlled Tool Programmers	244	26	\$23.94	\$32.18
Total	4,664	455	-	-

Source: Emsi 2021.1

The three regional employers posting the most ads were Precision Castparts, located in Ontario; Allied Mechanical, located in Ontario; and Arms Precision, located in Corona. Employers located in Corona, Riverside, and Ontario accounted for 50% (301 ads) of the 607 total regional online job ads

Exhibit 4 displays a sample of specialized and employability skills from online job ads in combination with CNC machining skills. Specialized skills are occupation-specific skills that employers request for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job postings may be utilized to guide curriculum development.

Exhibit 4: Sample of in-demand skills from employer online job ads

Occupations	Specialized Skills	Employability Skills
Computer Numerically Controlled Tool Operators (n=182)	<ul style="list-style-type: none"> • Machining • Lathes • Calipers • Micrometers 	<ul style="list-style-type: none"> • Detail-Oriented • Physical Abilities • Communication Skills • Teamwork/Collaboration
Machinists (n=80)	<ul style="list-style-type: none"> • Lathes • Micrometers • Calipers • Grinders 	<ul style="list-style-type: none"> • Detail-Oriented • Organizational Skills • Physical Abilities • Troubleshooting
Computer Numerically Controlled Tool Programmers (n=45)	<ul style="list-style-type: none"> • Machining • Lathes • Mastercam • G-code 	<ul style="list-style-type: none"> • Communication Skills • Detail-Oriented • Editing • Troubleshooting

Source: Burning Glass – Labor Insights

Students interested in a CNC machining career may focus their training in the California Community College machining and machine tools (TOP 0956.30) program. This program prepares students for employment in the fabrication, assembly, and repair of parts and components or systems on machines, such as lathes, grinders, drill presses, milling machines, and shaping machines. These programs include Computer Numerical Control and tool design (Taxonomy of Programs, 2012). Exhibit 5 displays the annual average awards for regional machining and machine tools programs. These programs have collectively awarded an annual average of 17 associate degrees and certificates over the last three academic years.

Exhibit 5: 2016-19, Annual average community college awards for the machining and machine tools programs in the Inland Empire/Desert Region

0956.30 – Machining and Machine Tools	Associate degree	Certificate requiring 30 < 60 semester units	Certificate requiring 18 < 30 semester units	Certificate requiring 6 < 18 semester units	Total CC Annual Average Awards, Academic Years 2016-19
Norco	1	-	4	3	8
San Bernardino	1	0	3	5	9
Total	2	0	8	7	17

Source: MIS Data Mart

Please refer to this machining report for a labor market analysis of CNC machine occupations in the Inland Empire/Desert Region: <http://coeccc.net/reports/Machining>

Demand for Laser Cutter Skills

Over the last 12 months, there were 27 regional job ads for positions that require laser cutting skills. The occupations with the most regional online job ads were *computer numerically controlled tool operators* (SOC 51-9161) and *production workers, all other* (SOC 51-9199). These occupations accounted for more than half (55%) of regional online job ads and approximately 4% of the 612 statewide online job ads for this skill. Statewide, the occupation with the most job ads for laser cutting skill is *mechanical engineers* (SOC 17-2141), a four-year degree-level occupation. Exhibit 6 displays regional employment, projected annual job openings, and median hourly earnings for the laser cutting occupations mentioned in online employer job ads. Please note that laser cutting experience-alone is insufficient to secure employment in these fields.

Exhibit 6: Five-year job projections and hourly earnings, 2019-2024

Occupations	2019 Jobs	Annual Openings (New + Replacement Jobs)	25 th Pct. Hourly Earnings	Median Hourly Earnings
Computer Numerically Controlled Tool Operators	944	82	\$15.15	\$18.39
Production Workers, All Other	95	7	\$12.75	\$14.37
Total	4,872	491	\$12.62	\$14.63

Source: Emsi 2021.1

The three regional employers with the most online job ads were LaserTech, a precision manufacturer located in Riverside (NOTE: it's unclear if this employer is currently in business), Fireblast Global, a fire equipment manufacturer located in Corona, and California Super Trucks, a vehicle manufacturer located in Moreno Valley. Cities with at least three or more online job ads, Corona, Riverside, and Upland, accounted for 67% (18 ads) of regional online job ads.

Exhibit 7 displays a sample of specialized and employability skills employers seek in combination with laser cutting skills. Specialized skills are occupation-specific skills that employers request for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job postings may be utilized to guide curriculum development. Please note that the skills information included in this section represents very few employers' desires and may not indicate in-demand skills across the state.

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

Occupations	Specialized Skills	Employability Skills
Computer Numerically Controlled Tool Operators (n=5)	<ul style="list-style-type: none"> Machine Operation Equipment Cleaning Data Collection Quality Assurance and Control 	<ul style="list-style-type: none"> Teamwork/Collaboration Work Area Maintenance Problem Solving Detail-Oriented
Production Workers, All Other (n=4)	<ul style="list-style-type: none"> Machine Operation Hand Tools Machining Calipers 	<ul style="list-style-type: none"> English Preventative Maintenance Troubleshooting Time Management

Source: Burning Glass – Labor Insights

There appears to be two regional community college makerspaces with laser cutting capabilities. The following list contains links to the regional community college websites.

- Moreno Valley College's iMake Innovation Center: <https://mvccte.com/imake/>

- Mt. San Jacinto College's Eagle MakerSpace: <https://www.msjc.edu/makerspace/index.html>

For more information regarding California Community College makerspaces, please visit the [CCC Maker](#) website (CCC Maker, 2021).

The California Community College manufacturing and industrial technology (TOP 0956.00) programs provide the training associated with laser cutting positions. This program prepares students for employment through instruction related to the engineering principles and technical skills to manufacture products and related industrial processes. These programs include shaping and forming operations, materials handling, instrumentation and controls, and quality control. Additionally, these programs include computer-aided manufacturing and robotics. These programs also include optimization theory, industrial and manufacturing planning, and related management skills (Taxonomy of Programs, 2012).

Exhibit 8 displays the annual average awards for manufacturing and industrial technology (TOP 0956.00) programs in the Inland Empire/Desert Region. These programs have collectively awarded an annual average of 30 associate degrees and certificates over the last three academic years.

Exhibit 8: 2016-19, Annual average community college awards for the manufacturing and industrial technology programs in the Inland Empire/Desert Region

0956.00 – Manufacturing and Industrial Technology	Associate degree	Certificate requiring 30 < 60 semester units	Certificate requiring 18 < 30 semester units	Certificate requiring 6 < 18 semester units	Total CC Annual Average Awards, Academic Years 2016-19
Norco	4	0	20	4	29
San Bernardino	1	1	-	-	2
Total	5	1	20	4	30

Source: MIS Data Mart

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Appendix: Occupation definitions, sample job titles, five-year projections for makerspace occupations

Commercial and Industrial Designers (27-1021)

Design and develop manufactured products, such as cars, home appliances, and children's toys. Combine artistic talent with research on product use, marketing, and materials to create the most functional and appealing product design.

Sample job titles: Design Engineer, Designer, Industrial Designer, Mechanical Designer, Mold Designer, Product Design Engineer, Product Designer, Product Development Engineer, Sign Designer

Entry-Level Educational Requirement: Bachelor's degree

Training Requirement: None

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 17%

Machinists (51-4041)

Set up and operate a variety of machine tools to produce precision parts and instruments out of metal. 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: CNC Machinist (Computer Numeric Controlled Machinist), CNC Machinist (Computer Numerically Controlled Machinist), Gear Machinist, Machine Repair Person, Machinist, Maintenance Machinist, Manual Lathe Machinist, Production Machinist, Tool Room Machinist

Entry-Level Educational Requirement: High school diploma or equivalent

Training Requirement: More than twelve months on-the-job training

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 41%

Computer Numerically Controlled Tool Operators (51-9161)

Operate computer-controlled tools, machines, or robots to machine or process parts, tools, or other work pieces made of metal, plastic, wood, stone, or other materials. May also set up and maintain equipment.

Sample job titles: Brake Press Operator, Computer Numerical Control Lathe Operator (CNC Lathe Operator), Computer Numerical Control Machine Operator (CNC Machine Operator), Computer Numerical Control Machinist (CNC Machinist), Computer Numerical Control Mill Operator (CNC Mill Operator), Computer Numerical Control Operator (CNC Operator), Computer Numerical Control Set-Up and Operator (CNC Set-Up and Operator), Machine Operator, Machine Set-Up Operator, Machinist

Entry-Level Educational Requirement: High school diploma or equivalent

Training Requirement: Between one and twelve months on-the-job training

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 43%

Computer Numerically Controlled Tool Programmers (51-9162)

Develop programs to control machining or processing of materials by automatic machine tools, equipment, or systems. May also set up, operate, or maintain equipment.

Sample job titles: CAD CAM Programmer (Computer-Aided Design Computer-Aided Manufacturing Programmer), Computer Numerical Control Machinist (CNC Machinist), Computer Numerical Control Programmer (CNC Programmer), Programmer

Entry-Level Educational Requirement: Postsecondary nondegree award

Training Requirement: Between one and twelve months on-the-job training

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 43%

Production Workers, All Other (51-9199)

All production workers not listed separately.

Sample job titles: N/A

Entry-Level Educational Requirement: High school diploma or equivalent

Training Requirement: Between one and twelve months on-the-job training

Incumbent workers with a Community College Award or Some Postsecondary Coursework: 29%

Appendix: Program Completion and Outcome Methodology

Exhibits 5 and 8 display the average annual California Community College (CCC) awards conferred during the three academic years between 2016 and 2019, from the California Community Colleges Chancellor's Office Management Information Systems (MIS) Data Mart. Awards are the combined total of associate degrees and certificates issued during the timeframe, divided by three in this case to calculate an annual average. This is done to minimize the effect of atypical variation that might be present in a single year.

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

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

Occupation (SOC)	2019 Jobs	5-Yr Change	5-Yr % Change	Annual Openings (New + Replacement Jobs)	Entry-Experienced Hourly Wage Range (10 th to 90 th percentile)	Median Hourly Wage (50 th percentile)	Average Annual Earnings	Typical Entry-Level Education & On-The-Job Training Required	Work Experience Required
Production Workers, All Other (51-9199)	3,833	31	1%	402	\$12.00 to \$40.19	\$14.63	\$38,900	High school diploma or equivalent & 1-12 months	None
Machinists (51-4041)	3,475	73	2%	347	\$12.08 to \$31.50	\$18.36	\$42,400	High school diploma or equivalent & More than 12 months	None
Computer Numerically Controlled Tool Operators (51-9161)	944	(20)	(2%)	82	\$12.54 to \$28.09	\$18.39	\$40,300	High school diploma or equivalent & 1-12 months	None
Computer Numerically Controlled Tool Programmers (51-9162)	244	19	8%	26	\$20.24 to \$43.98	\$32.18	\$65,400	Postsecondary nondegree award & 1-12 months	None
Commercial and Industrial Designers (27-1021)	181	(1)	(1%)	16	\$15.49 to \$55.92	\$28.67	\$66,700	Bachelor's degree & None	None
Total	8,772	89	1%	880	-	-	-	-	-

Source: Emsi 2021.1