

SECTOR PROFILE

Advanced Manufacturing Pathways & Occupations



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Prepared by:
San Francisco Bay Center of Excellence for Labor Market Research



Introduction

To support the planning and development of career education (CE) programs and to inform information about different sector pathways within the Bay Area, the San Francisco Bay Center of Excellence (COE) for Labor Market Research developed a series of sector profiles highlighting trends in the labor market and postsecondary education and training programs that fall within each sector. These profiles highlight jobs that fall below, within, and above middle skill jobs. Middle skill jobs are those that typically require training beyond a high school diploma, but less than a bachelor's degree. These occupations are a critical component of the labor workforce and support the economic vitality of the Bay Area.

The Advanced Manufacturing profile summarizes key findings on current and projected workforce demand, hourly wages for occupations within the sector by career pathway, and program information from community colleges in the region that offer training programs in Advanced Manufacturing.

What Pathways Make Up the Advanced Manufacturing Sector?

This profile provides a snapshot of the labor market for Advanced Manufacturing and focuses on three career pathways within the sector. The labor market data presented in this profile includes in-demand occupations by each pathway that have related education and training programs offered at community colleges across the Bay Area.

The three Advanced Manufacturing career pathways below offer a range of opportunities for employment and advancement across skill levels.

ADVANCED MANUFACTURING CAREER PATHWAYS

- 1 Maintenance

- 2 Production

- 3 Quality Assurance

Quick Facts About Bay Area Advanced Manufacturing

Quick facts related to the Advanced Manufacturing sector below feature labor market projections between 2021-2026 in the Bay Area, and community college program information for program years 2018-19 to 2020-21.

The Advanced Manufacturing sector accounted for over 220,000 jobs in the Bay Region in 2021. Between 2021 and 2026, these jobs are projected to grow by 11% with 28,813 projected annual job openings.

Advanced Manufacturing programs are offered at 23 community colleges in the Bay Area. More than 7,000 students enrolled in Advanced Manufacturing programs each year at a Bay Region community college during program years 2018-19 to 2020-21, and 616 students completed a degree or certificate, on average. As for demographics, approximately 26% of students who enrolled between program years 2018-19 to 2020-21 were 20 to 24 years old. Males were predominantly represented among students who enrolled in Advanced Manufacturing programs (85%), as well as students who identify as White (34%) or Hispanic (33%).

Bay Area Advanced Manufacturing Quick Facts



223,774

Number of Jobs
in 2021



11%

5-year
Projected Job Growth



28,813

5-year
Projected Annual Openings



23

Community Colleges (CC)
Offering Advanced Manufacturing
Programs



7,049

Students Enrolled in
CC Advanced Manufacturing
Programs
(2018-19 to 2020-21)



616

CC Degrees/Certificates Awarded on
Average in Advanced Manufacturing
(2018-19 to 2020-21)

Local Employers



- Joby Aviation
- Bloom Energy
- Tesla
- Bio-Rad
- Apple
- Lucid Motors
- Plastikon
- LeeMAH Electronics
- Sanmina
- Jabil

Projected Employment for the Advanced Manufacturing Sector

Industry Employment Demand for Advanced Manufacturing

The Advanced Manufacturing sector includes sub-sectors and industries grouped under North American Industry Classification System (NAICS) codes 31, 32, and 33, which is used to organize and categorize industries in the job market for the sector. A single two-digit NAICS code, for example, may represent several sub-sector and industry groups within the sector.

Overall, employment demand in the Advanced Manufacturing sector is projected to grow in the Bay Region over the next several years (2021-2026) by 9% (Table 1). Approximately 327,052 workers in the Bay Region were employed in Advanced Manufacturing industries in 2021, and this number is projected to increase to 356,143 workers by 2026.

Table 1: Projected Industry Demand for Advanced Manufacturing

2021 JOBS	2026 JOBS	JOB CHANGE	% CHANGE
327,052	356,143	29,091	9%

Source: Lightcast, Projected Demand for Advanced Manufacturing, 2021-2026 [2023.1].

Occupational Demand for Advanced Manufacturing by Career Pathway

Examining demand for Advanced Manufacturing by career pathway, Table 2 summarizes the number of workers employed in each pathway in 2021 and the total number of openings projected between 2021-2026. The Production career pathway had the most jobs in 2021 with 154,510 workers, and it's also projected to have the most job openings between 2021-2026, with 100,253.

Table 2: Number of Jobs and Total Openings for Advanced Manufacturing by Career Pathway (2021-2026)

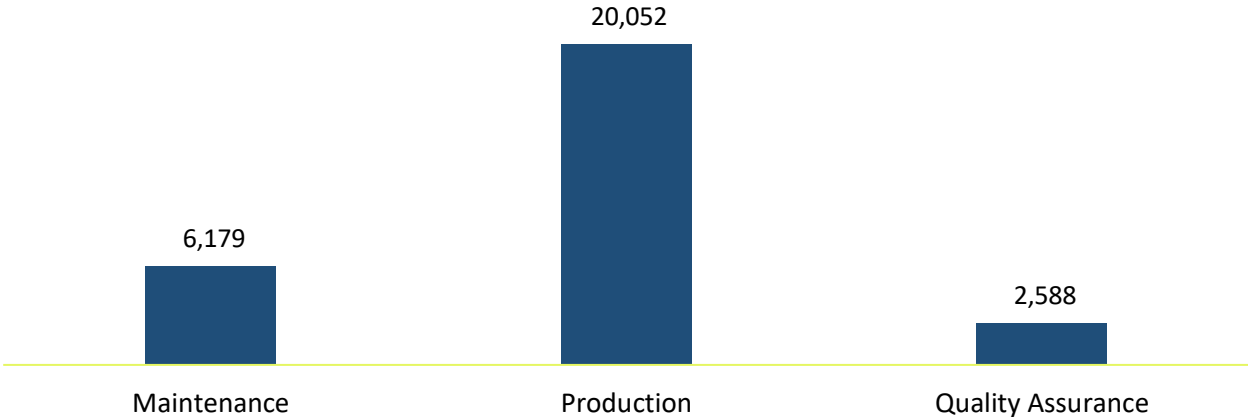
PATHWAY	2021 JOBS	2021 - 2026 OPENINGS*
Maintenance	50,498	30,864
Production	154,510	100,253
Quality Assurance	18,766	12,926

Source: Lightcast, Projected Number of Jobs and Total Openings for Advanced Manufacturing, 2021-2026 [2023.1].

*2021-2026 Openings are new job openings and replacement job openings. Replacement openings are created as workers switch jobs, retire or leave for other reasons.

In terms of annual openings, Figure 1 presents projected average annual openings for each career pathway in Advanced Manufacturing. More than 20,000 annual openings are projected for occupations in the Production pathway between 2021 and 2026, followed by over 6,000 projected annual openings in the Maintenance pathway.

Figure 1: Annual Job Openings for Advanced Manufacturing by Career Pathway (2021-2026)



Source: Lightcast, Projected Demand for Advanced Manufacturing, 2021-2026 [2023.1].



Advanced Manufacturing Occupations and Skill Level by Career Pathway

When examining specific occupations in the Advanced Manufacturing sector, Table 3 below presents data on employment and projected demand by occupation, grouped by career pathway and skill level. The Production pathway is the largest with 18 occupations, followed by the Maintenance pathway with eight occupations. Please note that the figures in Table 3 are calculated across regional data and totals may be subject to rounding error.

SKILL LEVEL LEGEND

• = Below Middle Skill • • = Middle Skill • • • = Above Middle Skill

Table 3: Projected Demand for Advanced Manufacturing Occupations by Career Pathway (2021-2026)

Skill Level	Occupation	Annual Openings	2021 Jobs	5-Yr Change	5-Yr % Change	5-Yr Replacement Jobs	Replacements as % of Openings
MAINTENANCE PATHWAY							
•	Maintenance and Repair Workers, General	4,114	33,832	3,285	10%	17,279	83%
•	Installation, Maintenance, and Repair Workers, All Other	614	5,520	178	4%	2,866	92%
•	Helpers--Installation, Maintenance, and Repair Workers	246	1,754	132	8%	1,093	89%
• •	Industrial Machinery Mechanics	646	4,855	929	19%	2,303	72%
• •	Computer, Automated Teller, and Office Machine Repairers	257	2,240	-2	-2%	1,201	94%
• •	Electrical and Electronics Repairers, Commercial and Industrial Equipment	112	937	98	10%	453	82%
• •	Maintenance Workers, Machinery	108	805	92	13%	450	82%
• •	Millwrights	76	555	113	17%	265	73%
	Maintenance Total	6,173	50,498	4,825	10%	25,910	83%
PRODUCTION PATHWAY							
•	Miscellaneous Assemblers and Fabricators	5,362	31,209	6,747	15%	20,022	81%
•	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	2,805	20,600	1,727	10%	12,290	86%
•	Packaging and Filling Machine Operators and Tenders	1,454	10,958	679	6%	6,436	89%

SKILL LEVEL LEGEND

• = Below Middle Skill •• = Middle Skill ••• = Above Middle Skill

	Annual Openings	2021 Jobs	5-Yr Change	5-Yr % Change	5-Yr Replacement Jobs	Replacements as % of Openings
• Production Workers, All Other	790	6,020	397	8%	3,540	88%
• Helpers--Production Workers	691	4,244	109	3%	3,309	96%
•• First-Line Supervisors of Production and Operating Workers	1,553	11,675	1,378	12%	6,377	82%
•• Machinists	965	7,261	771	12%	4,045	83%
•• Electrical and Electronic Engineering Technologists and Technicians	880	7,454	256	5%	4,069	90%
•• Welders, Cutters, Solderers, and Brazers	864	5,685	941	14%	3,364	81%
•• Engineering Technologists and Technicians, Except Drafters, All Other	410	3,463	283	8%	1,760	86%
•• Semiconductor Processing Technicians	367	2,973	55	17%	1,722	80%
•• Computer Numerically Controlled Tool Operators	343	2,878	162	9%	1,543	86%
•• Industrial Engineering Technologists and Technicians	153	984	227	23%	538	71%
••• Computer Hardware Engineers	968	11,738	995	10%	3,842	77%
••• Electrical Engineers	846	10,153	942	11%	3,293	75%
••• Mechanical Engineers	788	9,086	1,063	15%	2,877	69%
••• Industrial Engineers	735	7,166	1,303	24%	2,372	60%
••• Materials Engineers	78	963	43	15%	318	82%
Production Total	20,052	154,510	18,078	12%	81,717	81%

QUALITY ASSURANCE PATHWAY

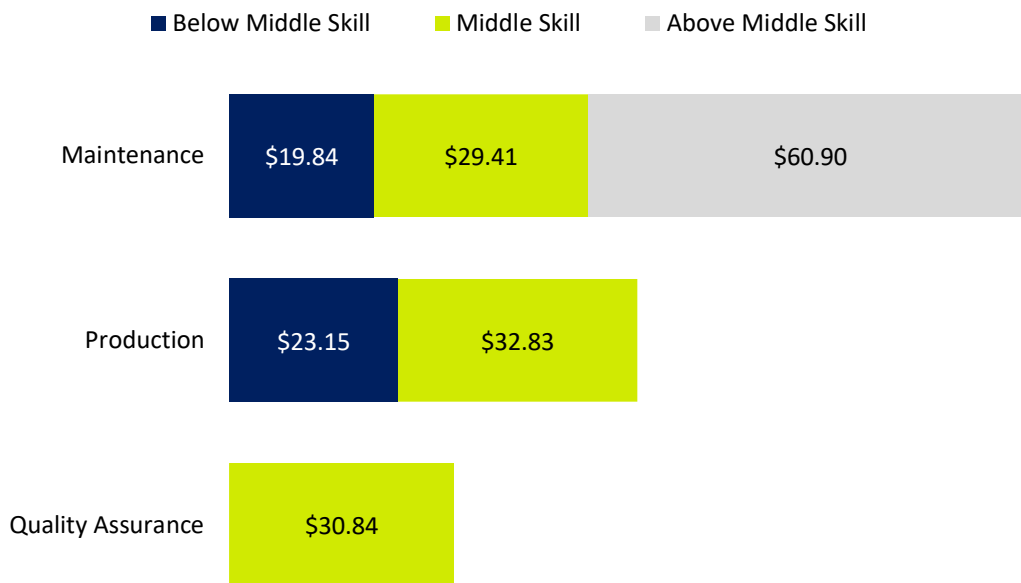
•• Inspectors, Testers, Sorters, Samplers, and Weighers	2,093	14,783	1,023	9%	9,416	88%
•• Occupational Health and Safety Specialists	300	2,396	210	8%	1,284	86%
•• Weighers, Measurers, Checkers, and Samplers, Recordkeeping	171	1,411	17	1%	811	95%
•• Calibration Technologists and Technicians	24	176	20	13%	82	77%
Quality Assurance Total	2,588	18,766	1,270	8%	11,593	87%
ADVANCED MANUFACTURING TOTAL	28,813	223,774	24,173	11%	119,220	83%

Source: Lightcast, Projected Demand for Advanced Manufacturing Occupations, 2021-2026 [2023.1].

Advanced Manufacturing Occupational Wages by Career Pathway

In terms of wages, Figure 2 below presents the median averages for below middle skill, middle skill, and above middle skill jobs by career pathway. Table 4 summarizes wages by the 25th percentile, median and 75th percentile hourly earnings for each occupation in the Bay Region. The 25th percentile wage is used here as a proxy for entry-level earnings, while the 75th percentile represents estimated earnings for a more experienced worker in the occupation.

Figure 2: Average Median Hourly Earnings for Career Pathways (2021-2026)



Source: Lightcast, Projected Demand for Advanced Manufacturing, 2021-2026 [2023.1].

Table 4: Hourly Earnings for Advanced Manufacturing Occupations by Career Pathway (2021-2026)

SKILL LEVEL LEGEND		
•	= Below Middle Skill	• • • = Above Middle Skill
• •	= Middle Skill	

Skill Level	Occupation	25 th Pct. Hourly Earnings	Median Hourly Earnings	75 th Pct. Hourly Earnings
MAINTENANCE PATHWAY				
•	Maintenance and Repair Workers, General	\$20.09	\$25.56	\$33.11
•	Installation, Maintenance, and Repair Workers, All Other	\$19.54	\$22.52	\$28.41
•	Helpers--Installation, Maintenance, and Repair Workers	\$17.41	\$21.37	\$25.22
• •	Industrial Machinery Mechanics	\$27.21	\$34.66	\$43.65

SKILL LEVEL LEGEND

• = Below Middle Skill • • = Middle Skill • • • = Above Middle Skill

Skill Level	Occupation	25 th Pct. Hourly Earnings	Median Hourly Earnings	75 th Pct. Hourly Earnings
• •	Computer, Automated Teller, and Office Machine Repairers	\$19.75	\$24.13	\$27.81
• •	Electrical and Electronics Repairers, Commercial and Industrial Equipment	\$26.84	\$35.91	\$46.52
• •	Maintenance Workers, Machinery	\$24.73	\$32.36	\$36.36
• •	Millwrights	\$28.38	\$37.08	\$42.40
Maintenance Total Averages		\$22.99	\$29.20	\$35.44

PRODUCTION PATHWAY

•	Miscellaneous Assemblers and Fabricators	\$17.22	\$20.95	\$22.76
•	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	\$17.34	\$21.37	\$26.56
•	Packaging and Filling Machine Operators and Tenders	\$16.96	\$19.55	\$23.67
•	Production Workers, All Other	\$16.88	\$19.94	\$22.84
•	Helpers--Production Workers	\$16.05	\$17.40	\$20.54
• •	First-Line Supervisors of Production and Operating Workers	\$27.52	\$35.82	\$45.35
• •	Machinists	\$21.05	\$26.50	\$33.61
• •	Electrical and Electronic Engineering Technologists and Technicians	\$28.91	\$36.24	\$44.27
• •	Welders, Cutters, Solderers, and Brazers	\$21.86	\$26.90	\$33.09
• •	Engineering Technologists and Technicians, Except Drafters, All Other	\$23.74	\$29.40	\$40.89
• •	Semiconductor Processing Technicians	\$18.49	\$22.20	\$27.42
• •	Computer Numerically Controlled Tool Operators	\$21.51	\$25.20	\$29.77
• •	Industrial Engineering Technologists and Technicians	\$27.15	\$32.99	\$39.76
• • •	Computer Hardware Engineers	\$64.23	\$80.54	\$99.66
• • •	Electrical Engineers	\$46.94	\$62.37	\$75.70
• • •	Mechanical Engineers	\$44.22	\$56.01	\$71.38
• • •	Industrial Engineers	\$43.67	\$54.42	\$64.70
• • •	Materials Engineers	\$40.84	\$51.17	\$67.01
Production Total Averages		\$28.59	\$35.50	\$43.83

SKILL LEVEL LEGEND

• = Below Middle Skill • • = Middle Skill • • • = Above Middle Skill

Skill Level	Occupation	25 th Pct. Hourly Earnings	Median Hourly Earnings	75 th Pct. Hourly Earnings
QUALITY ASSURANCE PATHWAY				
• •	Inspectors, Testers, Sorters, Samplers, and Weighers	\$18.27	\$22.41	\$28.92
• •	Occupational Health and Safety Specialists	\$38.30	\$47.74	\$58.72
• •	Weighers, Measurers, Checkers, and Samplers, Recordkeeping	\$17.32	\$20.28	\$24.32
• •	Calibration Technologists and Technicians	\$26.82	\$33.43	\$39.05
Quality Assurance Total Averages		\$33.40	\$40.09	\$47.42
ADVANCED MANUFACTURING TOTAL		\$26.64	\$33.21	\$40.78

Source: Lightcast, 25th pct., Median, and 75th pct. Hourly Earnings for Advanced Manufacturing Occupations, 2021-2026 [2023.1].



Emerging Occupations and Trends in the Advanced Manufacturing Sector

Table 5 summarizes emerging trends that will impact the Advanced Manufacturing sector over the next decade. The impact on careers will likely be less that it creates new career pathways, and more that it shifts the numbers of jobs among various careers. For instance, fewer welders may be needed as welding automation increases, but the region may need more Computer-Aided Manufacturing (CAM) programmers and maintenance technicians to program and fix the automation equipment. These trends will likely significantly increase the number of industrial maintenance jobs (which include automation and robotics). These trends will also drive the need for more people to have the (currently taught) skillsets of Programmable Logic Controllers (PLCs), sensors, and Computer-Aided Design (CAD).

Table 5: Emerging Trends and Definitions in the Advanced Manufacturing Sector

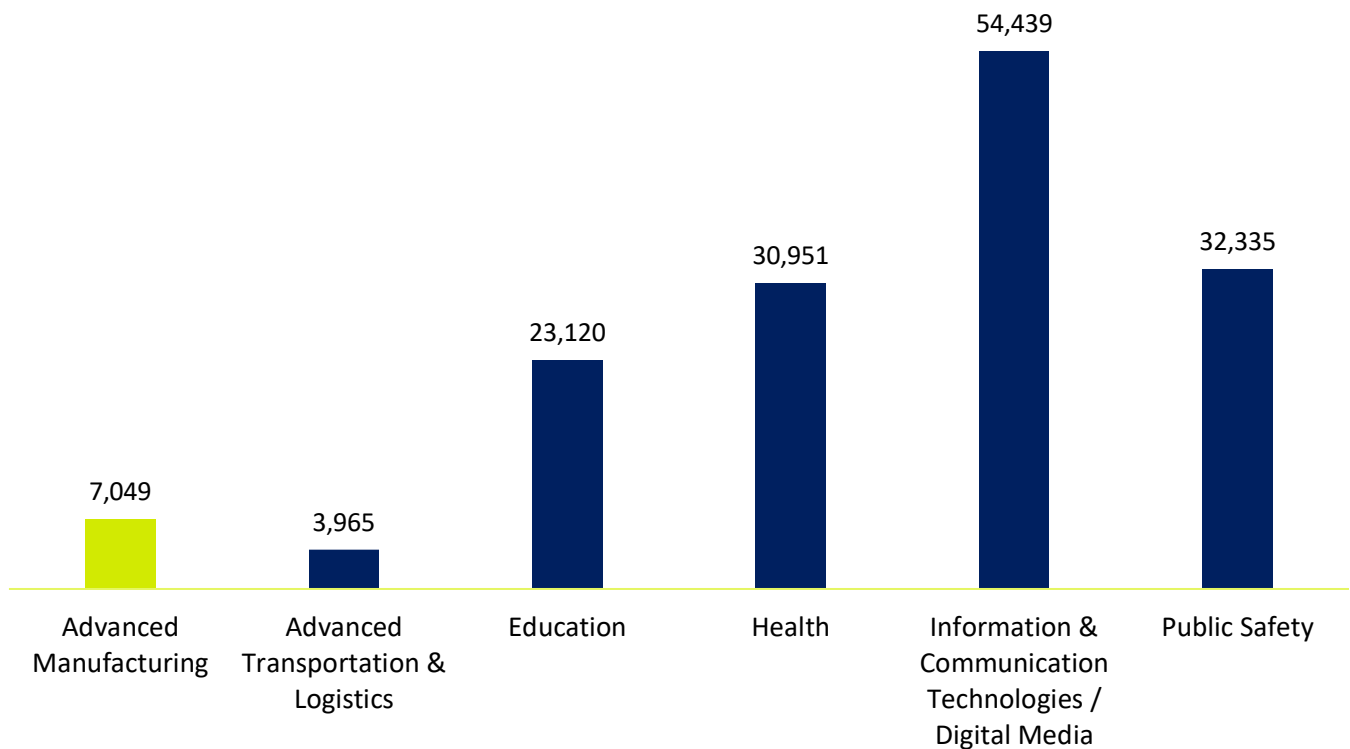
Trend	Definition
Internet of Things (IOT)	Devices with sensors , processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.
Predictive Maintenance	Techniques and technologies used to help determine the condition of equipment in order to estimate when maintenance should be performed.
Lights Out Manufacturing (Dark Factories)	Fully automating the production of goods at factories and other industrial facilities, such as to require no human presence on-site.
Digital Twins	Computer models of manufacturing products and systems.
Robots	Collaborative robots. A robot intended for direct human-robot interaction within a shared space, or where humans and robots are in close proximity.
3D Printing	3D printing or additive manufacturing is the construction of a three-dimensional object from a CAD model or a digital 3D model . It can be done in a variety of processes in which material is deposited, joined or solidified under computer control .
Augmented Reality (AR)	An interactive experience that combines the real world and computer-generated content.
Sustainable Products	Sustainable products are those products that provide environmental, social and economic benefits while protecting public health and environment over their whole life cycle, from the extraction of raw materials until the final disposal.
Electric Vehicles (EV)	A vehicle that uses one or more electric motors for propulsion .
Battery Powered Products	A battery is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices.

Advanced Manufacturing Community College Programs

California community colleges offer a variety of programs in Advanced Manufacturing, training students for career pathways in Maintenance, Production, and Quality Assurance. Colleges combine classroom instruction on campus, online, and/or as external work experiences. Of the 28 community colleges in the Bay region, 23 colleges offer a program related to the Advanced Manufacturing sector.

Figure 3 shows community college pipeline students by each of the Bay region's six priority sectors. During program years (PY) 2018-19 to 2020-21, more than 7,000 students enrolled in Advanced Manufacturing courses each year, on average. These numbers represent an unduplicated count of students who took any single credit course or had positive attendance hours in any noncredit course in a TOP code related to Advanced Manufacturing (Table 6).

Figure 3: Community College Pipeline Students* by Sector (3-YR Average, PY 2018-19 to PY 2020-21)



Source: Cal-PASS Plus LaunchBoard. Program Years 2018-19 to 2020-21, Bay Area Community Colleges.

*Community College Pipeline Students: Unduplicated count of "All students who took at least .5 units in any single credit course or who had at least 12 positive attendance hours in any noncredit course(s) on the selected TOP code in the selected year.

Twenty-eight (28) Taxonomy of Program (TOP) codes related to Advanced Manufacturing are presented in Table 6, along with the number of colleges in the region that awarded degrees and certificates in program years 2018-19 to 2020-21. Note that only data on programs are presented below, and may not include the number of students in courses offered that could be related to Advanced Manufacturing.

Table 6: Advanced Manufacturing Programs at Community Colleges in the Bay Area (PY 2018-19 to 2020-21)

TOP6	TOP6 Program Title	# Colleges w/Programs
093400	Electronics and Electric Technology	10
095300	Drafting Technology	10
095650	Welding Technology	10
095630	Machining and Machine Tools	8
095600	Manufacturing and Industrial Technology	6
094500	Industrial Systems Technology and Maintenance	5
092400	Engineering Technology, General	4
095000	Aeronautical and Aviation Technology	3
095670	Industrial and Occupational Safety and Health	2
130330	Fashion Production	2
093420	Industrial Electronics	1
093480	Laser and Optical Technology	1
093510	Appliance Repair	1
093600	Printing and Lithography	1
095040	Aircraft Electronics (Avionics)	1
095330	Electrical, Electronic, and Electro-Mechanical Drafting	1
095340	Mechanical Drafting	1
095730	Surveying	1
093410	Computer Electronics	0
094300	Instrumentation Technology	0
094330	Vacuum Technology	0
095050	Aircraft Fabrication	0

TOP6	TOP6 Program Title	# Colleges w/Programs
095360	Technical Illustration	0
095420	Plastics and Composites	0
095430	Petroleum Technology	0
095680	Industrial Quality Control	0
096100	Optics	0
192000	Ocean Technology	0

Source: CCCC Datamart. Program Years 2018-19 to 2020-21 by TOP6 Code, Bay Area Community Colleges.



Table 7 and 8 summarize educational supply by analyzing the number of degrees awarded in related TOP and Classification of Instructional Programs (CIP) codes. According to TOP data, 616 degrees or certificates were awarded, on average, in a Bay Area community college between program years 2018-19 to 2020-21. The average number of degrees and certificates awarded in programs may include students who earned multiple degrees or certificates. According to CIP data (Table 8), non-community college institutions supply the Bay Area with 620 awards, on average, each year. Total awards for a TOP or CIP Program Title, which is the sum of all award types, may be subject to rounding error.

Table 7: Awards for Community College Programs in the Bay Area (PY 2018-19 to 2020-21)

TOP6	TOP6 Title	Associate Degree/ Associate for Transfer	Certificate	Other Award	Total Awards
092400	Engineering Technology, General (requires Trigonometry)	15	15	0	30
093400	Electronics and Electric Technology	35	116	0	151
093420	Industrial Electronics	7	7	0	14
093480	Laser and Optical Technology	2	13	0	15
093510	Appliance Repair	2	16	0	18
093600	Printing and Lithography	2	0	0	2
094500	Industrial Systems Technology and Maintenance	15	25	0	40
095000	Aeronautical and Aviation Technology	5	18	0	23
095040	Aircraft Electronics (Avionics)	5	0	0	5
095300	Drafting Technology	14	30	2	46
095330	Electrical, Electronic, and Electro-Mechanical Drafting	0	0	0	0
095340	Mechanical Drafting	0	0	0	0
095600	Manufacturing and Industrial Technology	7	7	0	14
095630	Machining and Machine Tools	34	102	15	151
095650	Welding Technology	26	42	0	68
095670	Industrial and Occupational Safety and Health	1	8	1	10
095730	Surveying	9	11	0	20
130330	Fashion Production	7	2	0	9
Total Awards		186	412	18	616

Source: CCCCO Datamart. Program Years 2018-19 to 2020-21 Annual Awards, by TOP6 Code, Bay Area Community Colleges.

Table 8: Awards for Non-Community College Programs in the Bay Area (PY 2017-18 to 2019-20)

CIP - CIP Program Title	Associate Degree	Bachelor's Degree	Other Award	Total Awards
47.0607 - Airframe Mechanics and Aircraft Maintenance Technology/Technician	0	0	86	86
49.0101 - Aeronautics/Aviation/Aerospace Science and Technology, General	0	43	0	43
19.0902 - Apparel and Textile Manufacture	1	8	0	9
30.3201 - Marine Sciences	0	56	0	56
15.1301 - Drafting and Design Technology/Technician, General	9	61	0	70
15.1302 - CAD/CADD Drafting and/or Design Technology/Technician	2	38	0	40
50.0404 - Industrial and Product Design	0	104	0	104
15.0612 - Industrial Technology/Technician	0	97	0	97
50.0410 - Illustration	12	93	0	105
48.0508 - Welding Technology/Welder	0	0	10	10
Total Awards	24	500	96	620

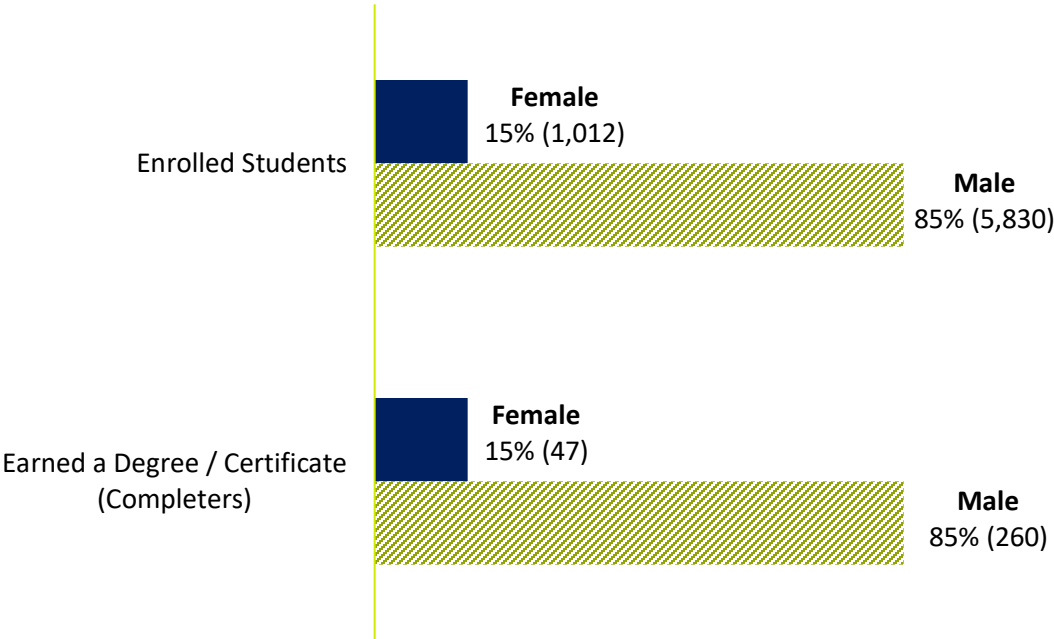
Source: Integrated Postsecondary Education Data System (IPEDS). Program Years 2017-18 to 2019-20 Annual Awards, by CIP Code, Bay Area Institutions.

Demographic Profile of Students in Advanced Manufacturing Programs

This sector profile also summarizes the demographics of students who enroll and complete a degree or certificate in Advanced Manufacturing programs. Figures 4 through 6 below present data on students by gender, race and ethnicity, and age.

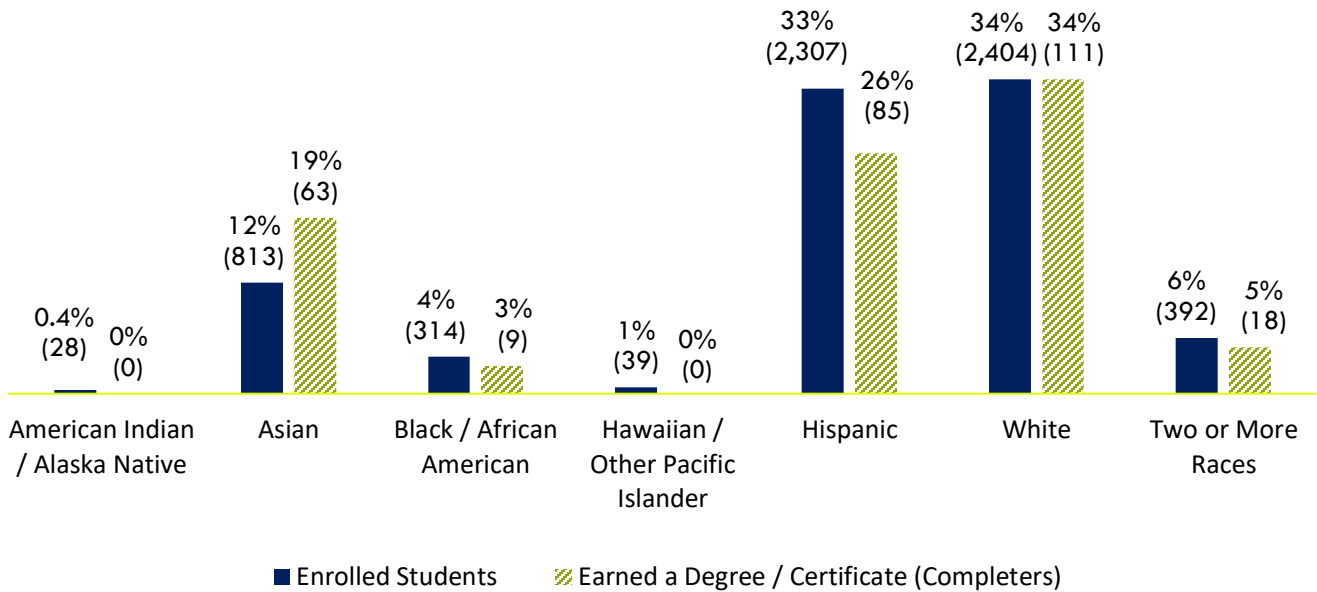
On average, more male students enroll (85%) and earn awards (85%) in Advanced Manufacturing programs, compared to female students (15% and 15% respectively). Students who identify as White (34%) and Hispanic (33%) comprise the two largest groups by race and ethnicity among enrolled students, while students 20 to 24 years old are the most represented age group among those who enroll and complete a program. The figures below provide greater detail on the demographic profiles of students who enrolled and earned degrees or certificates in Advanced Manufacturing programs in the Bay Area.

Figure 4: Gender of Students in Advanced Manufacturing Programs in the Bay Area (PY 2018-19 to 2020-21)



Note: May not total 100 percent due to non-respondent/non-binary.
Source: Cal-PASS Plus LaunchBoard. Program Years 2018-19 to 2020-21 Programs, Bay Area Community Colleges

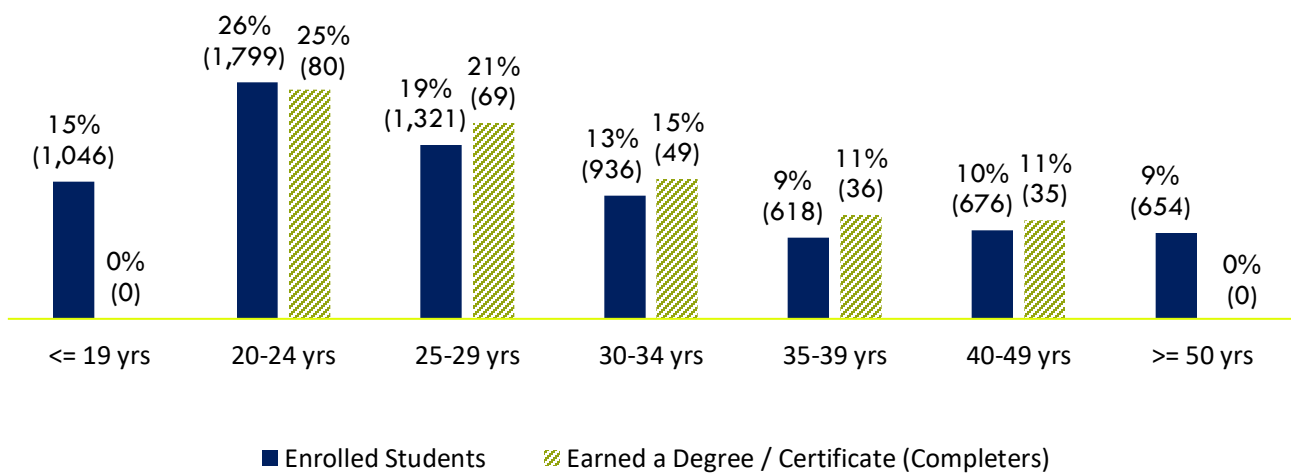
Figure 5: Race/Ethnicity of Students in Advanced Manufacturing Programs in the Bay Area (PY 2018-19 to 2020-21)



Note: May not total 100 percent due to non-respondent/unknown.

Source: Cal-PASS Plus LaunchBoard. Program Years 2018-19 to 2020-21 Programs, Bay Area Community Colleges

Figure 6: Ages of Students in Advanced Manufacturing Programs in the Bay Area (PY 2018-19 to 2020-21)



Note: May not total 100 percent due to non-respondent/unknown.

Source: Cal-PASS Plus LaunchBoard. Program Years 2018-19 to 2020-21 Programs, Bay Area Community Colleges

Methodology

Occupations for this report were identified by use of job descriptions and skills listed in O*Net. Labor demand data is sourced from Lightcast occupation and job postings data. Educational supply and student outcomes data is retrieved from multiple sources, including CCCCO Data Mart and CTE LaunchBoard.

Sources

O*Net Online

Lightcast

CTE LaunchBoard www.calpassplus.org

LaunchBoard

Statewide CTE Outcomes Survey

Employment Development Department Unemployment Insurance Dataset

Living Insight Center for Community Economic Development

Chancellor's Office MIS system

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