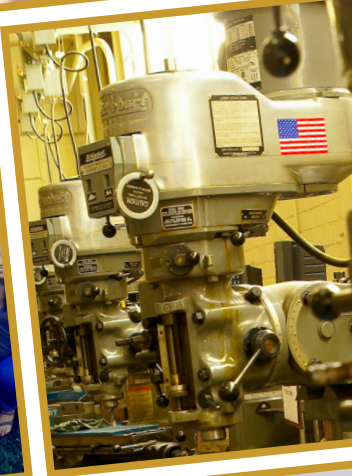


VENTURA COUNTY COMMUNITY COLLEGE DISTRICT

ECONOMIC DEVELOPMENT DIVISION



MANUFACTURING SECTOR – OCCUPATIONAL ANALYSIS

PHASE I VENTURA COUNTY

EXECUTIVE SUMMARY

The health of the manufacturing sector in Ventura County has direct implications on business retention, expansion, attraction, and start-up, all of which are fundamental elements of a regional economy. The manufacturing sector in Ventura County provides the region with the largest return on exports per year, totaling \$14.47 billion in 2016. In the same year, the sector employed over 33,000 workers in the county. This was a 2.7% growth in manufacturing jobs for the county over a five year period.

The top 12 occupations in assembly, production, drafting, and inspection earn a median wage of \$20.47 per hour, this is above the national median earnings for these occupations which sits at \$18.94 per hour. There are 8,672 jobs in these top 12 occupations in 2017, also above the national average for employment in these occupations by 1.8%. There has been an average of 288 job postings per month for these top production and design occupations over the past year, with an average of 330 hires per month in the same period.

Input gathered from industry articulates the need for greater technical proficiency levels and increased aptitude in communication and critical thinking abilities from entry-level workers. In order to address these requirements accurately, education and training models may include strategies that seek to increase proficiencies through repetition and problem-based learning layered with reading, writing, and arithmetic. Recruitment into education and training programs can be increased by accommodating various types of learners through scheduling. Offerings that focus on scheduling for two target markets, the full-time student population and the full-time worker population, may increase the local labor pool and provide venues for continuing education in the form of registered apprenticeships. An Increased Proficiency Platform for educational services can be applied that satisfies the needs of the entry-level assembler to the middle-level technician to high-level specificity of top manufacturing occupations.

Most meaningful to the discussion offered in this analysis is the need for consistent industry engagement in order to create a symbiotic and effective relationship between academia and industry. This variable arose at multiple points throughout the investigation, lending to its importance in future strategies for growth in education and training for the sector.

BACKGROUND

A 2015 report by Deloitte, sponsored by the Manufacturing Institute, analyzes the current and potential skills gap in the U.S. manufacturing sector, stating that in 2014 there was a talent shortage of 54% in the skilled production worker category. This is expected to increase to 63% by 2020. In economic terms, this can mean costly substitutes for manufacturing firms. A survey included in the study itemizes the additional costs incurred due to a lack of skilled talent, be these direct costs for overtime, or indirect costs reflected in increased cycle time and down time. More than 70% of respondents reported at least a 5% increase in overtime expenditures, with 32% of those reporting an increased overtime cost of 10%. Over 60% of companies reported an increase in down time of greater than 5%, and over 65% reported an increase of greater than 5% in their cycle time.

In a separate survey, 82% of employers felt that there is moderate to severe impact experienced in maintaining or increasing production levels to meet consumer demand under a talent shortage. Additionally, 41% of firms responded that there is a high impact on the ability to implement new technologies with a talent shortage. Research and design is also impacted by a lack of skilled talent, with 62% of firms stating that they have a moderate to severe impact in new product design and innovation.

These increased costs have a direct impact on the local economy in Ventura County in terms of quantity of exports, taxes, and local income, the last of which carries ripple effects through household expenditures and further sales tax collected. These revenue

streams contribute to the maintenance of public goods throughout the county including infrastructure, sanitation, parks, other public spaces and events.

The lack of skilled labor combined with a volatile global economic climate, has created a new opportunity for community colleges to participate in regional economies. More importantly, the skills and degrees earned through the community college system have become quintessential elements of any healthy economy in the 21st century, and thus are the foundation for healthy communities in this era.

A 2016 report out of the Brookings Institute highlights the positive return on investment for vocational certificates earned through community colleges. The study finds that attending a non-degree seeking program (or certificate program) at a community college increases earnings 8-10% more for returning adults (non-traditional students) than it does for continuing students. Another paper from Stevens et al. published in 2015 found that there were statistically significant returns to most credentials earned in health, business, engineering and industrial technology, family and consumer science, and protective services at the community college system in California.

In terms of regional economies, the manufacturing sector also contributes to local economic vitality by providing opportunities for entrepreneurship and technology development. The manufacturing sector in Ventura County is supported by over 987 unique subsectors from which raw materials and supply chain purchases are obtained. In 2016 there were over \$7 billion in in-region supply chain purchases by firms operating in the county. In the manufacturing sector, approximately 70.9% of supply chain goods are imported into the region. This totals a little over \$8.9 billion in local dollars that could remain in the county if the local resources for supply chains were enhanced and expanded. The large supply chain for the manufacturing sector has created an opportunity for small business development to replace imported supply chain goods for local manufacturers. Ventura County could contribute to increased economic vitality through import replacement and economic gardening by adding capacity in entrepreneurial resources at the post-secondary level including technical assistance for start-up and expansion, incubator space for design and production, and a dedicated resource for capital formation.

WORKFORCE DEVELOPMENT PARTNERS

The Ventura region is replete with organizations and resources that contribute to workforce development. Leveraging these resources is essential to the success of a greater workforce system. The Ventura County Workforce Development Board (WDB) Business Plan identifies advanced manufacturing as a top industry sector of focus. The WDB Manufacturing Committee 2-Year Plan (draft) prioritizes analyzing labor market data on an annual basis and further identifying gaps between education preparedness and manufacturing workforce needs.

The South Central Coast Regional Consortium (SCCRC) 3-Year Strategic Plan identifies the need to align college programs with regional and industry needs and provide support for Career and Technical Education programs as one of their top five goals. Another goal for the SCCRC articulates the need to reinforce regional leadership and operational partnerships among community college, industry, labor, and other workforce and economic development entities. The legislative foundation of SCCRC funding is to “increase the number of quality CTE courses, programs, and pathways that lead to successful workforce outcomes, or invest in new or emerging CTE courses, programs and pathways that may become operative in subsequent years and are likely to lead to successful workforce outcomes.”

The Ventura County Workforce Education Coalition seeks to improve education and industry relations to better serve industry needs. Roundtables in the form of Guild X are facilitated by the Coalition to bring business and academia to the same table.

The Ventura County P-20 Council is a group of key decision makers from education, business, parent organizations, government and community agencies who bring together partners throughout the region to promote and to support the strengthening of educational and career pathways from pre-school (P) through college and post-secondary/career (20). One of their top goals is to facilitate the education/ business connection throughout the County.

METHODOLOGY

The work completed in this research is dedicated to delivering a meaningful contribution to the goals of these workforce development partner organizations. Providing a platform for discussion built on comprehensive labor market analysis will assist these groups in the efficient interpretation of local labor demands for the region, and facilitate the development of effective initiatives for workforce development. A primary strategy for producing this type of research is maintaining consistent industry engagement to qualify traditional labor market information and real-time labor market data.

The following analysis contains quantitative information derived from multiple sources including the Bureau of Labor Statistics, Quarterly Census on Employment and Wages, California Employment Development Division, EMSI Economic Modeling Inc., and VCCCD Institutional Research. Research also included a series of informational interviews with manufacturing firms in the region, and discussions with the Workforce Development Board Manufacturing Committee and the Workforce Education Coalition Manufacturing Guild X to discover the contextual meaning of the skills needs in the county for this sector. Skills needs were correlated with current academic programming offered through the Ventura County Community College system to identify areas for update and enhancement.

The purpose of the analysis presented in Phase I is to identify gaps, challenges, and opportunities for community college programs and services in the field of manufacturing technologies in Ventura County. Phase II will include investigation into emerging occupations such as robotics technician and occupations closely aligned with small business development such as metal fabricators and drafters. Using a series of industry roundtables, strong partner initiatives for training and recruitment will be developed, problem-based learning projects for existing programs will be identified, a pre-apprenticeship short-term training program will be addressed, and any curricula updates needed for industry requirements will be further analyzed. Phase II will also include a financial analysis of potential programs to determine fiscal sustainability.

As a result of labor market data collection and informational interviews with employers, twelve top occupations were identified as having immediate demand in the regional economy. The following report provides statistical information pertaining to the demand for these positions and discussion of potential education and training alignment.

¹Major, C. and Palmer B. (2001). *Assessing the Effectiveness of Problem Based Learning in Higher Education: Lessons from the Literature*. *Academic Quarterly Exchange*, Vol5, Issue1.

²Soliz, Adela (2016). *Preparing America's labor force: Workforce development programs in public community colleges*. *Brookings Institute*.

³Stevens, A.H., Kurlaender, M., & Grosz, M. (2015). *Career and technical education and labor market outcomes: Evidence from*

⁴*California community colleges (NBER Working Paper No.21137)*. Cambridge, MA: National Bureau of Economic Research.

The Ventura County Workforce Development Board oversees federal Department of Labor funding available to Ventura County residents for workforce training and placement activities under the 2014 Workforce Innovation and Opportunity Act.

⁵*The South Central Coast Regional Consortium oversees allocations for Strong Workforce Program funding out of the California Community Colleges Chancellor's Office. This funding is intended to be used to derive industry-driven workforce programming.*

⁶As 88824(5) states, districts must certify that the use of Strong Workforce Program funds meet the following requirements:

- A) Increase the number of students in quality CTE courses, programs, and pathways that will achieve successful workforce outcomes.
- B) Increase the number of quality CTE courses, programs, and pathways that lead to successful workforce outcomes, or invest in new or emerging CTE courses, programs and pathways that may become operative in subsequent years and are likely to lead to successful workforce outcomes.

- C) Address recommendations from the Strong Workforce Task Force, including the recommended provision of student services related to career exploration, job readiness and job placement, and work-based learning.

The statute 88824 (e) specifically says "Funds appropriated to community college districts for the program shall supplement, and NOT SUPPLANT, existing funding of community college career technical education programs."

VENTURA COUNTY OCCUPATIONAL DATA

Largest Occupations Employed In the Manufacturing Sector

Description	Employed in Industry (2016)	% of Tot Jobs Industry (2016)
Team Assemblers	1,387	4.2
Machinists	1,011	3.1
Inspectors, Testers, Sorters, Samplers, and Weighers	901	2.7
First-Line Supervisors of Production and Operating Workers	884	2.7
Electrical and Electronic Equipment Assemblers	843	2.5

Manufacturing Industry Age Breakdown

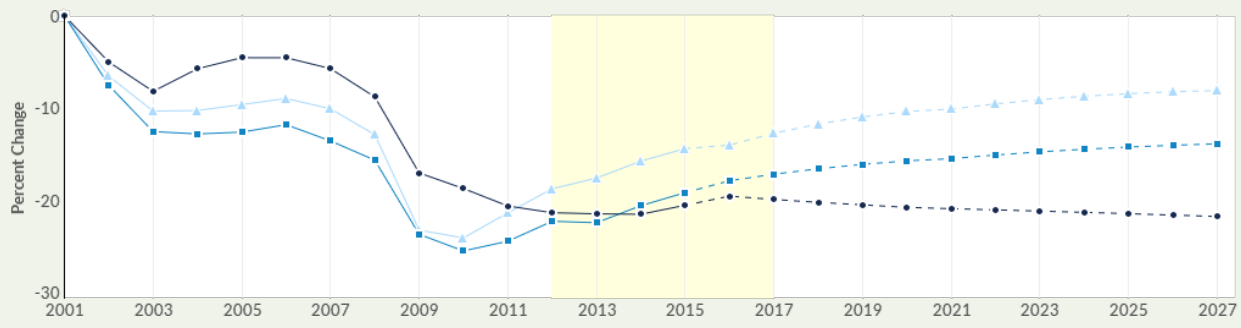
Age	2016 Jobs	2016 Percent
14-18	106	0.3%
19-24	1,552	4.7%
25-34	5,650	17.1%
35-44	7,833	23.7%
45-54	9,266	28.0%
55-64	6,648	20.1%
65+	2,061	6.2%

Manufacturing Industry Gender Breakdown

Gender	2016 Jobs	2016 Percent
Males	21,654	65.4%
Females	11,462	34.6%

Regional Job Trends for Top 12 Production Occupations

17-3013	Mechanical Drafters
17-3023	Electrical and Electronics Engineering Technicians
17-3024	Electro-Mechanical Technicians
51-1011	First-Line Supervisors of Production and Operating Workers
51-2022	Electrical and Electronic Equipment Assemblers
51-2023	Electromechanical Equipment Assemblers
51-2092	Team Assemblers
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic
51-4041	Machinists
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers
17-3029	Engineering Technicians, Except Drafters, All Other (Manufacturing Production Technicians)

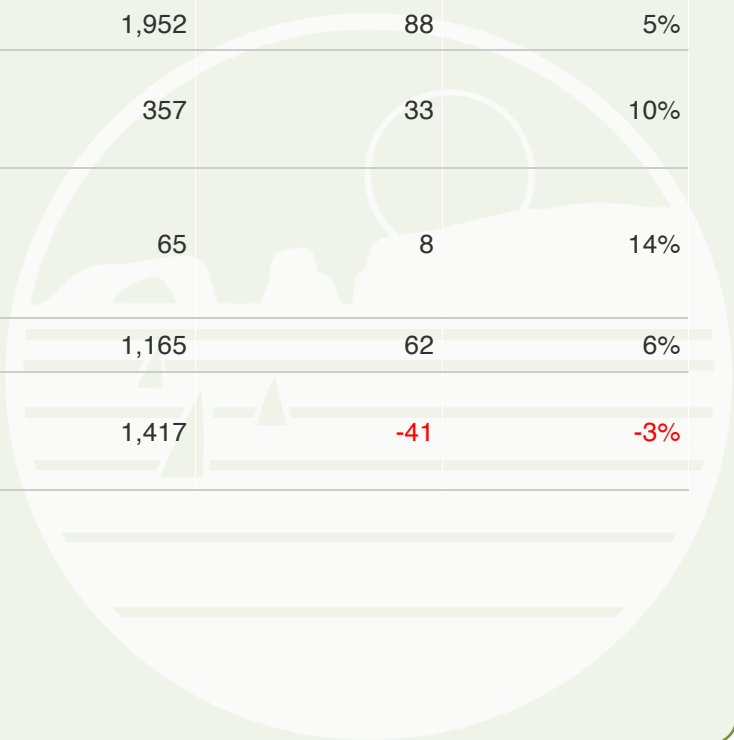


	Region	2012 Jobs	2017 Jobs	Change	% Change
●	Region	8,516	8,672	156	1.8%
●	California	330,438	352,174	21,736	6.6%
●	United States	3,322,582	3,569,339	246,757	7.4%

Sub-regional Job Quantity	2017 Jobs
Oxnard, CA 93030 (in Ventura County)	1,362
Camarillo, CA 93012 (in Ventura County)	1,079
Newbury Park, CA 91320 (in Ventura County)	943
Ventura, CA 93003 (in Ventura County)	855
Simi Valley, CA 93065 (in Ventura County)	656

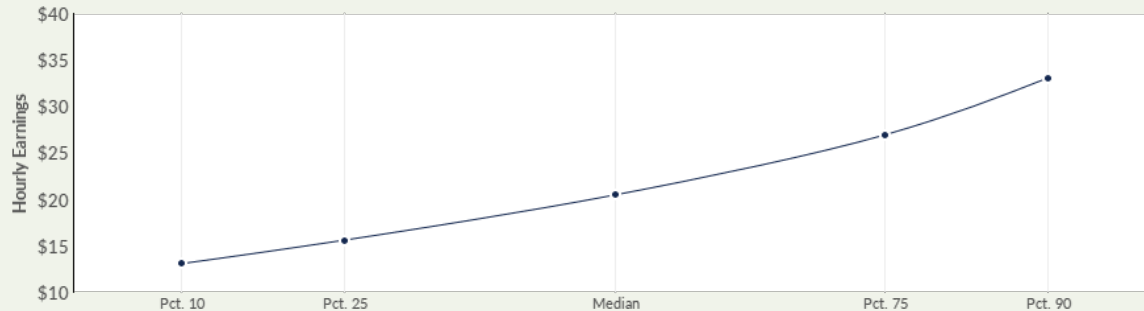
Five Year Growth in Top 12 Production Occupations

8,516	8,672	156	1.8%	
2012 Jobs	2017 Jobs	Change (2012-2017)	% Change (2012-2017)	
Occupation	2012 Jobs	2017 Jobs	Change	% Change
Mechanical Drafters (17-3013)	115	117	2	2%
Electrical and Electronics Engineering Technicians (17-3023)	879	872	-7	-1%
Electro-Mechanical Technicians (17-3024)	32	32	0	0%
Engineering Technicians, Except Drafters, All Other (17-3029) (manufacturing production technicians)	367	361	-6	-2%
First-Line Supervisors of Production and Operating Workers (51-1011)	1,249	1,264	15	1%
Electrical and Electronic Equipment Assemblers (51-2022)	925	924	-1	0%
Electromechanical Equipment Assemblers (51-2023)	142	146	4	3%
Team Assemblers (51-2092)	1,864	1,952	88	5%
Computer-Controlled Machine Tool Operators, Metal and Plastic (51-4011)	324	357	33	10%
Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic (51-4012)	57	65	8	14%
Machinists (51-4041)	1,103	1,165	62	6%
Inspectors, Testers, Sorters, Samplers, and Weighers (51-9061)	1,458	1,417	-41	-3%



Percentile Earnings

\$15.61/hr	\$20.47/hr	\$26.95/hr
25th Percentile Earnings	Median Earnings	75th Percentile Earnings



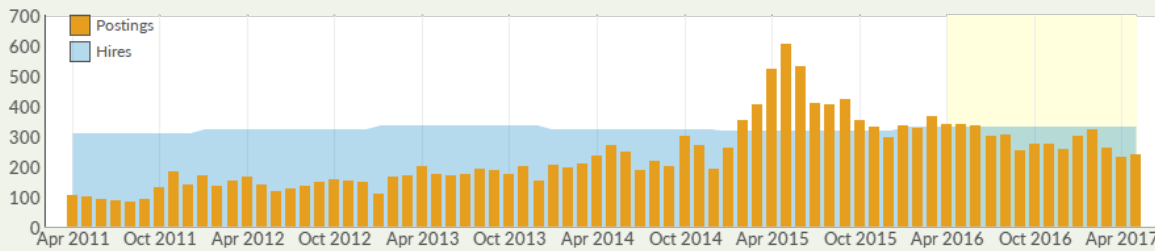
Occupation	25th Percentile Earnings	Median Earnings	75th Percentile Earnings
Mechanical Drafters (17-3013)	\$18.37	\$22.53	\$31.15
Electrical and Electronics Engineering Technicians (17-3023)	\$25.20	\$34.19	\$44.82
Electro-Mechanical Technicians (17-3024)	\$22.95	\$29.00	\$34.69
Engineering Technicians, Except Drafters, All Other (17-3029)	\$29.25	\$36.63	\$43.57
First-Line Supervisors of Production and Operating Workers (51-1011)	\$18.97	\$25.72	\$35.98
Electrical and Electronic Equipment Assemblers (51-2022)	\$10.76	\$12.76	\$17.92
Electromechanical Equipment Assemblers (51-2023)	\$12.97	\$16.04	\$18.41
Team Assemblers (51-2092)	\$10.18	\$13.31	\$17.76
Computer-Controlled Machine Tool Operators, Metal and Plastic (51-4011)	\$16.68	\$20.86	\$28.99
Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic (51-4012)	\$21.60	\$26.13	\$30.40
Machinists (51-4041)	\$15.38	\$19.58	\$23.97
Inspectors, Testers, Sorters, Samplers, and Weighers (51-9061)	\$13.00	\$18.08	\$23.76

REAL-TIME LMI

The greatest amount of job postings for the top 12 production and design occupations occurred in the field of First-line supervisors of Production and Operating Workers. There were an average of 82 postings per month with average hires of approximately 45 per month between April of 2016 and May of 2017. Electrical and Electronics Engineering Technicians, Inspectors, Machinists, and Electrical and Electronic Equipment assemblers had the next greatest quantity of job postings per month with an average of 23 to 62 monthly postings. Although posted less often, Team Assemblers hold the highest amount of hires with an average of 111 hires per month over the past year.

Job Postings vs. Hires 12 Occupations

288	330
Avg. Monthly Postings (Apr 2016 - May 2017)	Avg. Monthly Hires (Apr 2016 - May 2017)



Occupation	Avg Monthly Postings (Apr 2016 - May 2017)	Avg Monthly Hires (Apr 2016 - May 2017)
First-Line Supervisors of Production and Operating Workers	82	45
Electrical and Electronics Engineering Technicians	62	23
Inspectors, Testers, Sorters, Samplers, and Weighers	44	52
Machinists	25	35
Electrical and Electronic Equipment Assemblers	23	29
Team Assemblers	12	111
Computer-Controlled Machine Tool Operators, Metal and Plastic	11	9
Mechanical Drafters	9	4
Electromechanical Equipment Assemblers	9	4
Engineering Technicians, Except Drafters, All Other (manufacturing production technicians)	5	15
Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	5	2
Electro-Mechanical Technicians	1	1

SKILLS ALIGNMENT

The work completed in this research is dedicated to delivering a meaningful contribution to the goals of these workforce development partner organizations. Providing a platform for discussion built on comprehensive labor market analysis will assist these groups in the efficient interpretation of local labor demands for the region, and facilitate the development of effective initiatives for workforce development. A primary strategy for producing this type of research is maintaining consistent industry engagement to qualify traditional labor market information and real-time labor market data.

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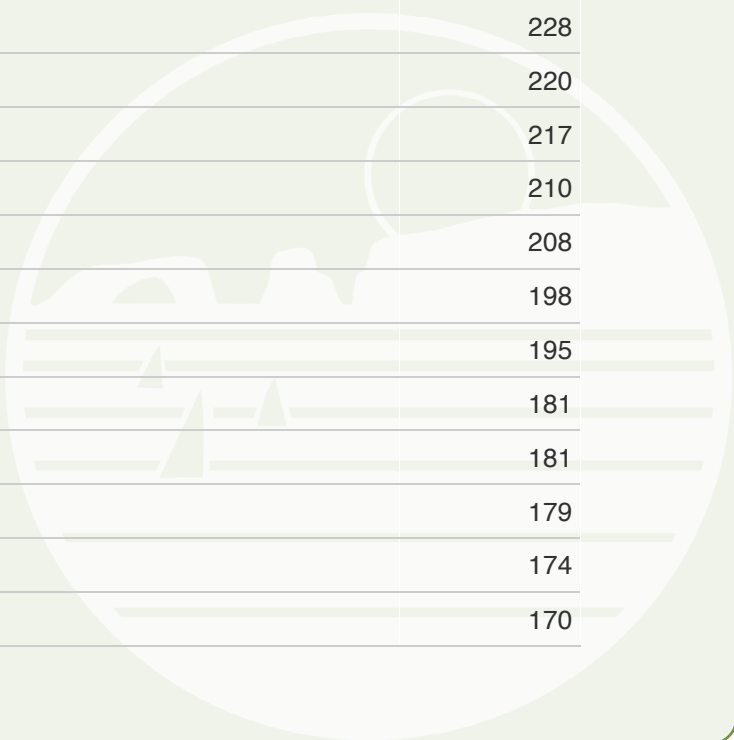
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As a result of labor market data collection and informational interviews with employers, twelve top occupations were identified as having immediate demand in the regional economy. The following report provides statistical information pertaining to the demand for these positions and discussion of potential education and training alignment.

Top Hard Skills Listed in Job Postings 2016-2017

Skill	Postings with Skill
Manufacturing	1,494
Testing	1,124
Operations	1,014
Engineering	994
Training	787
Management	773
Maintenance	662
Materials	549
Instructions	494
Communications	455
Recruitment	412

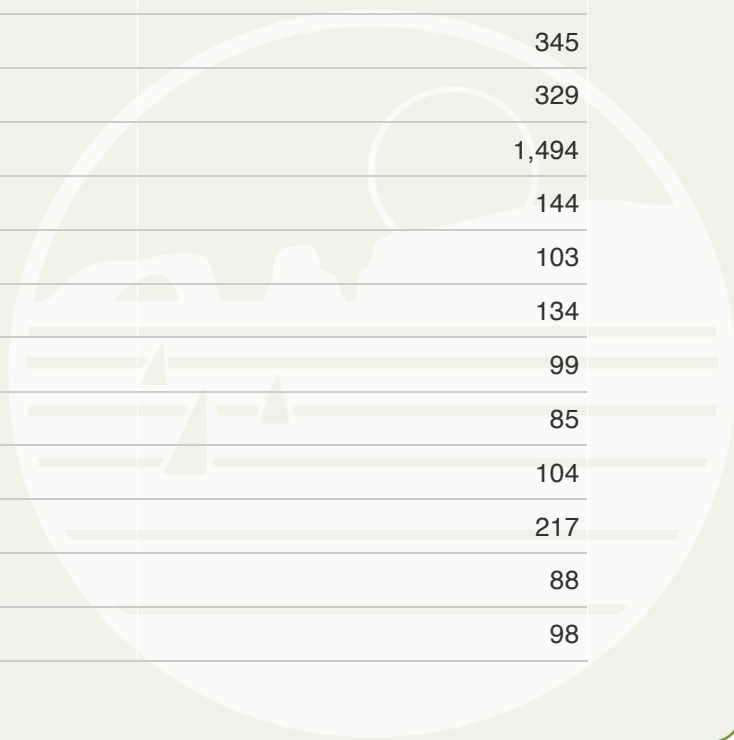
Troubleshooting (Problem Solving)	403
Repairing (Computer Systems)	367
Soldering	366
Defense (Legal)	364
Staffing	358
Machining	355
Lathes	349
Test Equipment	345
Documentation	335
Tooling	329
Problem Solving	282
Electronics	277
Lifting	267
Mills	258
Reports	258
Microsoft Office	243
Microsoft Excel	239
Innovation	232
Cleaning	231
Information Security	229
Quality Control	228
Appointment Scheduling	220
Radio Frequency	217
Quality Assurance	210
Human Resources	208
Computer Numerical Control (CNC)	198
Blueprinting	195
Inspector	181
Manuals	181
Computer Literacy	179
Written Communication	174
Mathematics	170



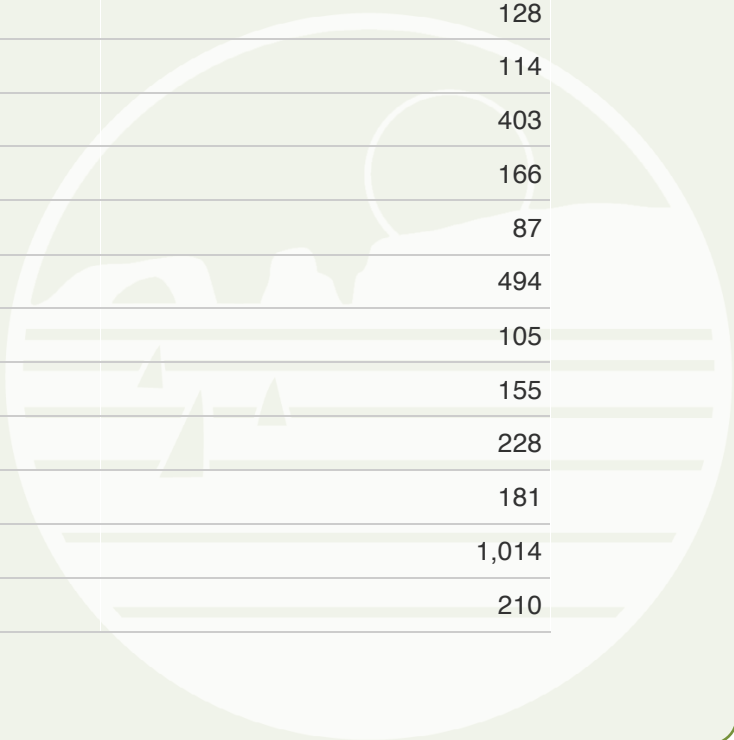
Warehousing	169
Continuous Improvement Process	166
Analogs	160
Fabrication	160
Calibration	158
Interpersonal Skills	155
Lean Manufacturing	155

Top In-demand Technical Skills 2016-2017

Skill	Postings with Skill
Soldering	366
Signal Generators	144
Lathes	349
Transistor	79
Computer Numerical Control (CNC)	198
Metal Lathes	102
Mills	258
Machining	355
Test Equipment	345
Tooling	329
Manufacturing	1,494
Printed Circuit Board	144
Coordinate Measuring Machine (CMM)	103
Microwaves	134
Cleanrooms	99
Solder	85
Engineering Drawing	104
Radio Frequency	217
Electromechanics	88
Electronic Components	98



Skill	Postings with Skill
Analogs	160
Inspector	181
Calibration	158
Tolerance	85
Defense (Legal)	364
Blueprinting	195
Testing	1,124
Manufacturing Operations	104
Engineering	994
Fabrication	160
Materials	549
Electronics	277
Test Engineering	87
Good Manufacturing Practices	116
Raw Materials	103
Electrical Wirings	154
Prototype (Manufacturing)	141
Grinding	88
Drilling	128
Computer-Aided Design	114
Troubleshooting (Problem Solving)	403
Continuous Improvement Process	166
AutoCAD	87
Instructions	494
Welding	105
Lean Manufacturing	155
Quality Control	228
Manuals	181
Operations	1,014
Quality Assurance	210



The U.S. Department of Labor inventories occupations and related skill sets through their O-Net Code Connector Sites. The top 12 production occupations presented in this analysis were cross-referenced against the tasks and detailed work activities listed under each occupation code. Generalizable tasks and work activities were identified that can be collapsed into a non-credit, short-term entry level certificate/pre-apprenticeship program. These generalizable skills can also be reiterated in a credit-bearing format as a student/employee moves through stackable credentials. The education level required for all 12 occupations analyzed is an associate's degree or lower combined with on-the-job training.

O-Net Generalizable Occupational Skills

Tasks/Detailed Work Activities/Knowledge	Quantity of occupations with requirement
Technical document reading/writing; Studying and analyzing blueprints	12
Measuring dimensions; Producing geometric layouts	12
Quality checks	12
Knowledge of production & processing	12
Knowledge of Microsoft Office/Excel	12
Reading/writing Standard Operating Procedures	3 (all assembly positions)
Enhancing efficiency/Improving processes	4 (supervisors, inspectors, machinists, programmers)



The top twelve occupations identified through research correspond to the following educational programs offered throughout Ventura County. The programs are delivered mostly through the Community College system and Ventura County Office of Education Adult School system. Taking into account in-county movement from one company to another, the completion rate in 2015 fell far below the demand for talent in these occupations.

Ventura County Educational/Vocational Programs & Completion Rate

11		63	313
Programs (2015)		Completions (2015)	Openings (2015)
CIP Code	Program	Completions (2015)	
48.0503	Machine Shop Technology/Assistant	38	
15.0303	Electrical, Electronic and Communications Engineering Technology/Technician	16	
15.1306	Mechanical Drafting and Mechanical Drafting CAD/CADD	7	
15.0000	Engineering Technology, General	2	
11.0201	Computer Programming/Programmer, General	0	

Top In-demand Soft Skills 2016-2017

Skill	Postings with Skill
Scheduling (Project Management)	736
Leadership	366
Coordinating	175
Leading	127
Team Building	106
Learning	79
Literacy	75
Creativity	63
Reliability	60
Ethics	51
Critical Thinking	42
Cooperation	39
Depth Perception	36
Listening	29
Workmanship	28
Cleanliness	23

Fine Motor Skills	23
Leadership Development	23
Perception	7
Imagination	5
Creative Problem-Solving	4
Telephone Skills	3
Career Development	2

VENTURA COUNTY COMMUNITY COLLEGE DISTRICT

Existing programs at VCCCD provide a strong foundation from which increased proficiencies in the labor pool can be realized. Currently, the community college district offers six programs related to the manufacturing sector in Ventura County. There were 26 Certificates and Associate degrees awarded by Ventura College and Moorpark College for the following programs between 2014 and 2017, not including proficiency awards. Enrollment at Ventura College in the primary courses containing the knowledge required for manufacturing occupations has remained relatively high. In the past three years, 594 students enrolled and completed machining courses, 122 students enrolled in blueprint reading, 114 enrolled and completed the manufacturing processes course, and 83 completed the measurements and computations course. As is typical in the current labor market, many students may have been recruited into full-time employment prior to completion which may explain lower completion rates.

Ventura College

Biomedical Device Manufacturing Certificate of Achievement
 Manufacturing Applications Proficiency Award
 CNC Machine Operator

Moorpark College

Biotechnology Associates of Science
 Biotechnology Certificate of Achievement
 Biotechnology Manufacturing Operator Certificate of Achievement

Industry certifications such as NIMS and the Manufacturing Skills Standards Council's Certified Production Technician provide generic examples of competency-based training programs that may be offered at post-secondary institutions (See Appendix).



OCCUPATIONAL ANALYSIS

In the manufacturing sector in Ventura County, 202 occupations were identified as primary and secondary occupations. These jobs were analyzed based on the following parameters: existing program connection, leveraged resources from other programs/ connectivity to existing programs, associates or less formal education required, percent increase in jobs over 5 years, quantity of total jobs, frequency of job postings, average monthly hires per occupation, propensity for custom education for skills training, relationship to “short-term” job training needs, and wages.

Of those occupations, 47 were identified that can readily be connected to a current or potential educational program in the county. These were then categorized into the type of educational program that would best suit the skill development needs.

Twenty five occupations could be connected to credit-bearing programs with a concurrent track for registered apprentices. Four were identified as appropriate for Associate Degrees with stackable credentials built into the degree. Note that occupations requiring a Bachelor’s Degree are additional opportunities for transferable programs, though they are not included in this category. Another eighteen occupations were identified as a fit for non-credit, short-term entry level education or contract education.

The table below cross-references occupations with the aforementioned categories of educational tracks that can be feasibly implemented. Categories are color coded for easy reference.

- Apprenticeship with credit program 25
- Associates program with stackable credentials 4
- Non-credit entry level or contract education 18

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Team Assemblers	1,290	1,378	7%	\$13.31	High school diploma or equivalent	None	Moderate-term on-the-job training
Machinists	964	1,030	7%	\$19.58	High school diploma or equivalent	None	Long-term on-the-job training
Inspectors, Testers, Sorters, Samplers, and Weighers	911	882	(3%)	\$18.08	High school diploma or equivalent	None	Moderate-term on-the-job training
First-Line Supervisors of Production and Operating Workers	868	883	2%	\$25.72	High school diploma or equivalent	Less than 5 years	None
Electrical and Electronic Equipment Assemblers	828	803	(3%)	\$12.76	High school diploma or equivalent	None	Moderate-term on-the-job training
Helpers--Production Workers	721	763	6%	\$11.45	No formal educational credential	None	Short-term on-the-job training

⁷ Though not included in this analysis due to inadequate occupation codes, a transferable mechatronics program inclusive of robotics curriculum with mechanical and electrical engineering concepts will likely be a high demand requiring additional research and grant capacity.

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
General and Operations Managers	706	735	4%	\$47.27	Bachelor's degree	5 years or more	None
Managers, All Other	612	688	12%	\$22.75	Bachelor's degree	Less than 5 years	None
Packaging and Filling Machine Operators and Tenders	685	632	(8%)	\$11.28	High school diploma or equivalent	None	Moderate-term on-the-job training
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	551	600	9%	\$28.90	High school diploma or equivalent	None	Moderate-term on-the-job training
Chemists	641	548	(15%)	\$30.07	Bachelor's degree	None	None
Electronics Engineers, Except Computer	537	535	(0%)	\$51.16	Bachelor's degree	None	None
Shipping, Receiving, and Traffic Clerks	554	560	1%	\$15.04	High school diploma or equivalent	None	Short-term on-the-job training
Laborers and Freight, Stock, and Material Movers, Hand	523	561	7%	\$12.31	No formal educational credential	None	Short-term on-the-job training
Electrical and Electronics Engineering Technicians	508	489	(4%)	\$34.19	Associate's degree	None	None
Mixing and Blending Machine Setters, Operators, and Tenders	484	505	4%	\$9.57	High school diploma or equivalent	None	Moderate-term on-the-job training
Industrial Engineers	433	425	(2%)	\$41.63	Bachelor's degree	None	None
Printing Press Operators	388	443	14%	\$13.03	High school diploma or equivalent	None	Moderate-term on-the-job training
Welders, Cutters, Solderers, and Brazers	382	421	10%	\$16.18	High school diploma or equivalent	None	Moderate-term on-the-job training
Paper Goods Machine Setters, Operators, and Tenders	397	398	0%	\$27.28	High school diploma or equivalent	None	Moderate-term on-the-job training
Office Clerks, General	370	377	2%	\$15.82	High school diploma or equivalent	None	Short-term on-the-job training
Maintenance and Repair Workers, General	375	377	1%	\$19.47	High school diploma or equivalent	None	Long-term on-the-job training
Production Workers, All Other	323	362	12%	\$12.96	High school diploma or equivalent	None	Moderate-term on-the-job training
Computer-Controlled Machine Tool Operators, Metal and Plastic	317	354	12%	\$20.86	High school diploma or equivalent	None	Moderate-term on-the-job training
Production, Planning, and Expediting Clerks	331	335	1%	\$22.59	High school diploma or equivalent	None	Moderate-term on-the-job training
Industrial Production Managers	336	339	1%	\$38.64	Bachelor's degree	5 years or more	None

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	332	324	(2%)	\$16.55	High school diploma or equivalent	None	Moderate-term on-the-job training
Electrical Engineers	324	321	(1%)	\$50.17	Bachelor's degree	None	None
Mechanical Engineers	326	327	0%	\$44.30	Bachelor's degree	None	None
Bookkeeping, Accounting, and Auditing Clerks	313	307	(2%)	\$21.32	Some college, no degree	None	Moderate-term on-the-job training
Assemblers and Fabricators, All Other	265	309	17%	\$12.70	High school diploma or equivalent	None	Moderate-term on-the-job training
Medical Scientists, Except Epidemiologists	337	288	(15%)	\$53.18	Doctoral or professional degree	None	None
Architectural and Engineering Managers	292	289	(1%)	\$64.79	Bachelor's degree	5 years or more	None
Industrial Machinery Mechanics	288	297	3%	\$26.59	High school diploma or equivalent	None	Long-term on-the-job training
Biological Technicians	313	269	(14%)	\$22.07	Bachelor's degree	None	None
Packers and Packagers, Hand	264	281	6%	\$10.44	No formal educational credential	None	Short-term on-the-job training
Industrial Truck and Tractor Operators	263	281	7%	\$14.91	No formal educational credential	None	Short-term on-the-job training
Business Operations Specialists, All Other	285	267	(6%)	\$36.44	Bachelor's degree	None	None
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	261	259	(1%)	\$17.72	High school diploma or equivalent	None	Short-term on-the-job training
Purchasing Agents, Except Wholesale, Retail, and Farm Products	253	253	0%	\$28.84	Bachelor's degree	None	Long-term on-the-job training
Customer Service Representatives	260	257	(1%)	\$17.30	High school diploma or equivalent	None	Short-term on-the-job training
Semiconductor Processors	226	233	3%	\$17.94	Associate's degree	None	Moderate-term on-the-job training
Accountants and Auditors	251	238	(5%)	\$31.17	Bachelor's degree	None	None
Sewing Machine Operators	172	248	44%	\$13.79	No formal educational credential	None	Short-term on-the-job training
Software Developers, Systems Software	228	215	(6%)	\$54.25	Bachelor's degree	None	None
Cutting, Punching, and Press Machine Setters,	208	215	3%	\$14.83	High school diploma or	None	Moderate-term on-the-job

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Operators, and Tenders, Metal and Plastic					equivalent		training
Market Research Analysts and Marketing Specialists	201	208	3%	\$33.48	Bachelor's degree	None	None
Cabinetmakers and Bench Carpenters	163	212	30%	\$14.17	High school diploma or equivalent	None	Moderate-term on-the-job training
Sales Managers	191	200	5%	\$44.15	Bachelor's degree	Less than 5 years	None
Computer Hardware Engineers	193	179	(7%)	\$48.74	Bachelor's degree	None	None
Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	170	196	15%	\$14.78	High school diploma or equivalent	None	Moderate-term on-the-job training
Natural Sciences Managers	200	173	(14%)	\$62.47	Bachelor's degree	5 years or more	None
First-Line Supervisors of Office and Administrative Support Workers	176	181	3%	\$25.88	High school diploma or equivalent	Less than 5 years	None
Microbiologists	197	169	(14%)	\$38.19	Bachelor's degree	None	None
Graphic Designers	177	180	2%	\$21.27	Bachelor's degree	None	None
Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	189	166	(12%)	\$10.20	High school diploma or equivalent	None	Moderate-term on-the-job training
Stock Clerks and Order Fillers	168	173	3%	\$11.48	No formal educational credential	None	Short-term on-the-job training
Molders, Shapers, and Casters, Except Metal and Plastic	166	176	6%	\$14.92	High school diploma or equivalent	None	Long-term on-the-job training
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	172	165	(4%)	\$30.85	Bachelor's degree	None	Moderate-term on-the-job training
Grinding and Polishing Workers, Hand	156	164	5%	\$11.81	No formal educational credential	None	Moderate-term on-the-job training
Logisticians	160	154	(4%)	\$41.35	Bachelor's degree	None	None
Executive Secretaries and Executive Administrative Assistants	154	139	(10%)	\$28.04	High school diploma or equivalent	Less than 5 years	None
Engineers, All Other	142	142	0%	\$44.70	Bachelor's degree	None	None
Dental Laboratory Technicians	118	147	25%	\$16.13	High school diploma or equivalent	None	Moderate-term on-the-job training
Chief Executives	138	145	5%	\$48.99	Bachelor's degree	5 years or more	None
Janitors and Cleaners, Except Maids and Housekeeping Cleaners	138	139	1%	\$12.48	No formal educational credential	None	Short-term on-the-job training

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Maintenance Workers, Machinery	133	138	4%	\$22.29	High school diploma or equivalent	None	Moderate-term on-the-job training
Electromechanical Equipment Assemblers	130	133	2%	\$16.04	High school diploma or equivalent	None	Moderate-term on-the-job training
Financial Managers	136	131	(4%)	\$43.12	Bachelor's degree	5 years or more	None
Engineering Technicians, Except Drafters, All Other	128	127	(1%)	\$36.63	Associate's degree	None	None
Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	137	128	(7%)	\$18.46	High school diploma or equivalent	None	Moderate-term on-the-job training
Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	122	128	5%	\$18.35	High school diploma or equivalent	None	Moderate-term on-the-job training
Bakers	93	139	49%	\$10.40	No formal educational credential	None	Long-term on-the-job training
Heavy and Tractor-Trailer Truck Drivers	111	131	18%	\$19.56	Postsecondary nondegree award	None	Short-term on-the-job training
Unclassified Occupation	113	131	16%	\$18.32	N/A	None	N/A
Management Analysts	131	116	(11%)	\$36.91	Bachelor's degree	Less than 5 years	None
Computer and Information Systems Managers	123	115	(7%)	\$56.58	Bachelor's degree	5 years or more	None
Light Truck or Delivery Services Drivers	95	118	24%	\$15.31	High school diploma or equivalent	None	Short-term on-the-job training
Computer Systems Analysts	118	109	(8%)	\$46.32	Bachelor's degree	None	None
Software Developers, Applications	118	111	(6%)	\$44.18	Bachelor's degree	None	None
Machine Feeders and Offbearers	103	111	8%	\$11.99	No formal educational credential	None	Short-term on-the-job training
Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	117	104	(11%)	\$13.57	High school diploma or equivalent	None	Moderate-term on-the-job training
Coil Winders, Tapers, and Finishers	96	98	2%	\$10.44	High school diploma or equivalent	None	Moderate-term on-the-job training
Order Clerks	92	97	5%	\$18.28	High school diploma or equivalent	None	Short-term on-the-job training
Computer User Support Specialists	99	92	(7%)	\$23.17	Some college, no degree	None	None
Sheet Metal Workers	51	98	92%	\$19.39	High school diploma or equivalent	None	Apprenticeship
Welding, Soldering, and Brazing Machine Setters,	84	88	5%	\$15.77	High school diploma or	None	Moderate-term on-the-job

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Operators, and Tenders					equivalent		training
Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders	83	89	7%	\$10.54	High school diploma or equivalent	None	Moderate-term on-the-job training
First-Line Supervisors of Mechanics, Installers, and Repairers	89	86	(3%)	\$31.88	High school diploma or equivalent	Less than 5 years	None
Biomedical Engineers	81	86	6%	\$45.55	Bachelor's degree	None	None
Chemical Plant and System Operators	90	83	(8%)	\$23.65	High school diploma or equivalent	None	Long-term on-the-job training
Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic	85	78	(8%)	\$15.37	High school diploma or equivalent	None	Moderate-term on-the-job training
Chemical Engineers	78	80	3%	\$47.25	Bachelor's degree	None	None
Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	87	78	(10%)	\$14.98	High school diploma or equivalent	None	Moderate-term on-the-job training
Jewelers and Precious Stone and Metal Workers	61	82	34%	\$17.50	High school diploma or equivalent	None	Long-term on-the-job training
Mechanical Engineering Technicians	77	77	0%	\$14.98	Associate's degree	None	None
Cutting and Slicing Machine Setters, Operators, and Tenders	75	78	4%	\$10.72	High school diploma or equivalent	None	Short-term on-the-job training
Food Batchmakers	74	77	4%	\$10.80	High school diploma or equivalent	None	Moderate-term on-the-job training
Compliance Officers	81	71	(12%)	\$35.03	Bachelor's degree	None	Moderate-term on-the-job training
Plating and Coating Machine Setters, Operators, and Tenders, Metal and Plastic	72	75	4%	\$13.12	High school diploma or equivalent	None	Moderate-term on-the-job training
Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	80	67	(16%)	\$24.29	High school diploma or equivalent	None	Moderate-term on-the-job training
Cost Estimators	62	73	18%	\$28.28	Bachelor's degree	None	None
Network and Computer Systems Administrators	72	69	(4%)	\$35.96	Bachelor's degree	None	None
Computer Programmers	73	67	(8%)	\$37.18	Bachelor's degree	None	None
Print Binding and Finishing Workers	65	73	12%	\$13.86	High school diploma or equivalent	None	Short-term on-the-job training
Milling and Planing Machine Setters, Operators, and Tenders,	72	66	(8%)	\$17.67	High school diploma or equivalent	None	Moderate-term on-the-job training

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Metal and Plastic							
Financial Analysts	67	66	(1%)	\$30.75	Bachelor's degree	None	None
Engine and Other Machine Assemblers	67	67	0%	\$21.13	High school diploma or equivalent	None	Moderate-term on-the-job training
Administrative Services Managers	67	64	(4%)	\$43.28	Bachelor's degree	Less than 5 years	None
Woodworking Machine Setters, Operators, and Tenders, Except Sawing	49	70	43%	\$14.63	High school diploma or equivalent	None	Short-term on-the-job training
Receptionists and Information Clerks	63	62	(2%)	\$15.08	High school diploma or equivalent	None	Short-term on-the-job training
Mechanical Drafters	59	62	5%	\$22.53	Associate's degree	None	None
Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	55	64	16%	\$26.13	High school diploma or equivalent	None	Long-term on-the-job training
Tool and Die Makers	70	61	(13%)	\$26.24	High school diploma or equivalent	None	Long-term on-the-job training
Aerospace Engineers	63	58	(8%)	\$42.35	Bachelor's degree	None	None
Chemical Equipment Operators and Tenders	85	60	(29%)	\$19.66	High school diploma or equivalent	None	Moderate-term on-the-job training
Extruding and Forming Machine Setters, Operators, and Tenders, Synthetic and Glass Fibers	47	60	28%	\$13.80	High school diploma or equivalent	None	Moderate-term on-the-job training
Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders	55	60	9%	\$13.40	No formal educational credential	None	Moderate-term on-the-job training
Structural Metal Fabricators and Fitters	48	61	27%	\$18.05	High school diploma or equivalent	None	Moderate-term on-the-job training
Sales Engineers	54	55	2%	\$41.24	Bachelor's degree	None	Moderate-term on-the-job training
Industrial Engineering Technicians	65	55	(15%)	\$23.94	Associate's degree	None	None
Sales Representatives, Services, All Other	62	52	(16%)	\$23.88	High school diploma or equivalent	None	Moderate-term on-the-job training
Chemical Technicians	69	50	(28%)	\$20.98	Associate's degree	None	Moderate-term on-the-job training
Cleaners of Vehicles and Equipment	54	51	(6%)	\$10.52	No formal educational credential	None	Short-term on-the-job training
Commercial and Industrial Designers	49	50	2%	\$27.83	Bachelor's degree	None	None

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand	48	49	2%	\$20.79	High school diploma or equivalent	Less than 5 years	None
Electrical and Electronics Repairers, Commercial and Industrial Equipment	49	48	(2%)	\$22.57	Postsecondary nondegree award	None	Long-term on-the-job training
Operations Research Analysts	48	46	(4%)	\$30.40	Bachelor's degree	None	None
Carpenters	31	52	68%	\$18.78	High school diploma or equivalent	None	Apprenticeship
Technical Writers	52	44	(15%)	\$38.67	Bachelor's degree	Less than 5 years	Short-term on-the-job training
Sawing Machine Setters, Operators, and Tenders, Wood	32	51	59%	\$15.50	High school diploma or equivalent	None	Short-term on-the-job training
Billing and Posting Clerks	43	47	9%	\$18.68	High school diploma or equivalent	None	Moderate-term on-the-job training
Training and Development Specialists	45	44	(2%)	\$29.38	Bachelor's degree	Less than 5 years	None
Adhesive Bonding Machine Operators and Tenders	38	44	16%	\$14.70	High school diploma or equivalent	None	Moderate-term on-the-job training
First-Line Supervisors of Non-Retail Sales Workers	39	42	8%	\$19.04	High school diploma or equivalent	Less than 5 years	None
Metal Workers and Plastic Workers, All Other	37	40	8%	\$16.65	High school diploma or equivalent	None	Moderate-term on-the-job training
Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	40	39	(3%)	\$13.57	High school diploma or equivalent	None	Moderate-term on-the-job training
First-Line Supervisors of Retail Sales Workers	25	43	72%	\$17.00	High school diploma or equivalent	Less than 5 years	None
Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	36	36	0%	\$14.73	High school diploma or equivalent	None	Moderate-term on-the-job training
Transportation, Storage, and Distribution Managers	34	37	9%	\$42.91	High school diploma or equivalent	5 years or more	None
Food Cooking Machine Operators and Tenders	34	37	9%	\$10.94	High school diploma or equivalent	None	Moderate-term on-the-job training
Computer Occupations, All Other	38	34	(11%)	\$40.48	Bachelor's degree	None	None
Procurement Clerks	34	33	(3%)	\$20.43	High school diploma or equivalent	None	Moderate-term on-the-job training
Driver/Sales Workers	20	37	85%	\$9.99	High school diploma or equivalent	None	Short-term on-the-job training
Sewers, Hand	28	35	25%	\$12.63	No formal	None	Moderate-term

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	332	324	(2%)	\$16.55	High school diploma or equivalent	None	Moderate-term on-the-job training
Electrical Engineers	324	321	(1%)	\$50.17	Bachelor's degree	None	None
Mechanical Engineers	326	327	0%	\$44.30	Bachelor's degree	None	None
Bookkeeping, Accounting, and Auditing Clerks	313	307	(2%)	\$21.32	Some college, no degree	None	Moderate-term on-the-job training
Assemblers and Fabricators, All Other	265	309	17%	\$12.70	High school diploma or equivalent	None	Moderate-term on-the-job training
Medical Scientists, Except Epidemiologists	337	288	(15%)	\$53.18	Doctoral or professional degree	None	None
Architectural and Engineering Managers	292	289	(1%)	\$64.79	Bachelor's degree	5 years or more	None
Industrial Machinery Mechanics	288	297	3%	\$26.59	High school diploma or equivalent	None	Long-term on-the-job training
Biological Technicians	313	269	(14%)	\$22.07	Bachelor's degree	None	None
Packers and Packagers, Hand	264	281	6%	\$10.44	No formal educational credential	None	Short-term on-the-job training
Industrial Truck and Tractor Operators	263	281	7%	\$14.91	No formal educational credential	None	Short-term on-the-job training
Business Operations Specialists, All Other	285	267	(6%)	\$36.44	Bachelor's degree	None	None
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	261	259	(1%)	\$17.72	High school diploma or equivalent	None	Short-term on-the-job training
Purchasing Agents, Except Wholesale, Retail, and Farm Products	253	253	0%	\$28.84	Bachelor's degree	None	Long-term on-the-job training
Customer Service Representatives	260	257	(1%)	\$17.30	High school diploma or equivalent	None	Short-term on-the-job training
Semiconductor Processors	226	233	3%	\$17.94	Associate's degree	None	Moderate-term on-the-job training
Accountants and Auditors	251	238	(5%)	\$31.17	Bachelor's degree	None	None
Sewing Machine Operators	172	248	44%	\$13.79	No formal educational credential	None	Short-term on-the-job training
Software Developers, Systems Software	228	215	(6%)	\$54.25	Bachelor's degree	None	None
Cutting, Punching, and Press Machine Setters,	208	215	3%	\$14.83	High school diploma or	None	Moderate-term on-the-job

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
					educational credential		on-the-job training
Occupational Health and Safety Specialists	32	32	0%	\$39.89	Bachelor's degree	None	None
Materials Engineers	33	31	(6%)	\$57.38	Bachelor's degree	None	None
Tailors, Dressmakers, and Custom Sewers	26	32	23%	\$13.78	No formal educational credential	None	Moderate-term on-the-job training
Tile and Marble Setters	26	31	19%	\$17.58	No formal educational credential	None	Long-term on-the-job training
Biochemists and Biophysicists	39	28	(28%)	\$52.31	Doctoral or professional degree	None	None
Aircraft Mechanics and Service Technicians	32	27	(16%)	\$28.74	Postsecondary nondegree award	None	None
Computer Network Support Specialists	29	27	(7%)	\$36.37	Associate's degree	None	None
Tool Grinders, Filers, and Sharpeners	28	28	0%	\$14.38	High school diploma or equivalent	None	Moderate-term on-the-job training
Patternmakers, Metal and Plastic	29	26	(10%)	\$13.64	High school diploma or equivalent	None	Moderate-term on-the-job training
Foundry Mold and Coremakers	42	24	(43%)	\$16.61	High school diploma or equivalent	None	Moderate-term on-the-job training
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	21	29	38%	\$9.88	No formal educational credential	None	Short-term on-the-job training
Statisticians	27	26	(4%)	\$38.38	Master's degree	None	None
Medical Appliance Technicians	23	27	17%	\$20.05	High school diploma or equivalent	None	Long-term on-the-job training
Fiberglass Laminators and Fabricators	24	27	13%	\$13.66	High school diploma or equivalent	None	Moderate-term on-the-job training
Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders	27	25	(7%)	\$16.92	High school diploma or equivalent	None	Moderate-term on-the-job training
Office and Administrative Support Workers, All Other	24	24	0%	\$15.65	High school diploma or equivalent	None	Short-term on-the-job training
Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	25	25	0%	\$17.94	High school diploma or equivalent	None	Moderate-term on-the-job training
Ophthalmic Laboratory Technicians	20	24	20%	\$14.68	High school diploma or equivalent	None	Moderate-term on-the-job training
Computer and Information Research Scientists	26	22	(15%)	\$54.91	Doctoral or professional degree	None	None
Prepress Technicians and	24	24	0%	\$18.89	Postsecondary	None	None

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Workers					nondegree award		
First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators	22	24	9%	\$26.44	High school diploma or equivalent	Less than 5 years	None
Forging Machine Setters, Operators, and Tenders, Metal and Plastic	22	21	(5%)	\$15.94	High school diploma or equivalent	None	Moderate-term on-the-job training
Installation, Maintenance, and Repair Workers, All Other	20	22	10%	\$14.50	High school diploma or equivalent	None	Moderate-term on-the-job training
Craft Artists	15	22	47%	\$7.60	No formal educational credential	None	Long-term on-the-job training
Fine Artists, Including Painters, Sculptors, and Illustrators	15	22	47%	\$11.97	Bachelor's degree	None	Long-term on-the-job training
Life, Physical, and Social Science Technicians, All Other	20	20	0%	\$25.49	Associate's degree	None	None
Electro-Mechanical Technicians	20	20	0%	\$29.00	Associate's degree	None	None
Food Processing Workers, All Other	18	21	17%	\$10.91	No formal educational credential	None	Moderate-term on-the-job training
Computer Network Architects	21	19	(10%)	\$58.01	Bachelor's degree	5 years or more	None
Graders and Sorters, Agricultural Products	16	19	19%	\$10.29	No formal educational credential	None	Short-term on-the-job training
Compensation, Benefits, and Job Analysis Specialists	19	18	(5%)	\$34.51	Bachelor's degree	Less than 5 years	None
Sales and Related Workers, All Other	16	19	19%	\$21.27	High school diploma or equivalent	None	None
Etchers and Engravers	18	19	6%	\$14.92	High school diploma or equivalent	None	Moderate-term on-the-job training
Materials Scientists	17	18	6%	\$54.74	Bachelor's degree	None	None
Stationary Engineers and Boiler Operators	16	19	19%	\$34.16	High school diploma or equivalent	None	Long-term on-the-job training
Weighers, Measurers, Checkers, and Samplers, Recordkeeping	19	17	(11%)	\$15.14	High school diploma or equivalent	None	Short-term on-the-job training
Food and Tobacco Roasting, Baking, and Drying Machine Operators and Tenders	15	17	13%	\$12.78	No formal educational credential	None	Moderate-term on-the-job training
Electrical and Electronics Drafters	18	16	(11%)	\$30.47	Associate's degree	None	None
Cutters and Trimmers,	17	17	0%	\$11.82	No formal	None	Short-term on-

Manufacturing Sector Occupations	Employed in Industry Group (2012)	Employed in Industry Group (2018)	% Change (2012 - 2018)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Hand					educational credential		the-job training
Layout Workers, Metal and Plastic	14	16	14%	\$20.34	High school diploma or equivalent	None	Moderate-term on-the-job training
Plumbers, Pipefitters, and Steamfitters	15	16	7%	\$20.88	High school diploma or equivalent	None	Apprenticeship
Database Administrators	21	15	(29%)	\$42.19	Bachelor's degree	Less than 5 years	None
First-Line Supervisors of Construction Trades and Extraction Workers	11	15	36%	\$29.38	High school diploma or equivalent	5 years or more	None
Material Moving Workers, All Other	12	14	17%	\$20.11	No formal educational credential	None	Short-term on-the-job training
Data Entry Keyers	14	14	0%	\$17.05	High school diploma or equivalent	None	Moderate-term on-the-job training
Upholsterers	13	14	8%	\$13.12	High school diploma or equivalent	None	Moderate-term on-the-job training
Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	13	13	0%	\$48.02	Bachelor's degree	None	None
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	16	13	(19%)	\$20.21	Postsecondary nondegree award	None	Long-term on-the-job training
Environmental Scientists and Specialists, Including Health	12	12	0%	\$37.41	Bachelor's degree	None	None
Water and Wastewater Treatment Plant and System Operators	11	12	9%	\$28.95	High school diploma or equivalent	None	Long-term on-the-job training
Crane and Tower Operators	13	12	(8%)	\$41.55	High school diploma or equivalent	Less than 5 years	Moderate-term on-the-job training
Counter Attendants, Cafeteria, Food Concession, and Coffee Shop	<10	12	20%	\$9.64	No formal educational credential	None	Short-term on-the-job training
Architectural and Civil Drafters	<10	12	50%	\$26.57	Associate's degree	None	None
Public Relations Specialists	10	11	10%	\$28.20	Bachelor's degree	None	None
Furniture Finishers	<10	12	33%	\$14.11	High school diploma or equivalent	None	Short-term on-the-job training
Construction Laborers	<10	11	10%	\$15.16	No formal educational credential	None	Short-term on-the-job training
Helpers--Installation, Maintenance, and Repair Workers	<10	11	10%	\$14.79	High school diploma or equivalent	None	Short-term on-the-job training

CONCLUSION

Based on the quantitative and qualitative research performed in this analysis, the following gaps, challenges, and opportunities have been identified. Some opportunities provide solutions for multiple gaps and challenges, reflecting the interrelatedness of facets within the workforce development paradigm. These cross-factor solutions provide a venue for leveraged resources that have high impact results for workforce development initiatives. The district colleges have begun to address challenges and implement solutions with added capacity afforded by Strong Workforce Program funding.

Industry input and the correlation of existing collegiate programming to current needs both contributed to the suggested learning model for advanced manufacturing found on page 32 and entitled the “Increased Proficiency Platform.” This is a model based on best practices for instructional design that addresses the needs for entry-level and middle-skilled workers using three educational approaches and accommodating various types of students/workers. It is a platform built on a foundation of repetition and problem-based learning so that as a student moves through the levels of education they become more technically adept at their chosen occupational field while maintaining a knowledge base that can be transferable to another position or withstand technological changes to modes of production. The model reflects a layered approach to proficiency gain inclusive of reading comprehension, writing for business communication, technical writing, and technical mathematics, over technical training using problem-based learning projects that are derived from industry. Active learning is embedded into the curriculum which provides the venue for industry participation. Competency-based learning and assessment may also be applied to increase connectivity to employer needs.

Enrollment management is closely aligned with the model, requiring that course design and scheduling accommodate two target populations, the full-time student and the full-time worker. The subjects included in the model reflect the greatest occupational demand for workers and greatest demand for business start-up in the manufacturing sector.

Gaps/Challenges & Opportunities in Manufacturing Education

Gaps and Challenges	Opportunities
<p><u>Proficiency Levels</u> Input received from industry can be narrowed to two primary categories for entry level employees:</p> <ol style="list-style-type: none"> 1. The need for increased proficiency in fundamentals of manufacturing 2. The need for reliability and verbal and written communication skills 	<ul style="list-style-type: none"> ▪ Education should include more repetition for proficiency gains. ▪ Training must be interdisciplinary inclusive of reading, writing, and arithmetic in every course. ▪ Problem-based learning techniques and projects can be derived from industry which can then be applied. ▪ Application of an Increased Proficiency Platform for education and training to accommodate workforce demands.
<p><u>Industry Engagement</u></p> <ol style="list-style-type: none"> 1. Continuously advancing technologies and modes of production require consistent updates to curriculum content and problem-based learning applications. 2. Industry requires connectivity for recruitment purposes. 3. Industry recognized credentials out of the community college district increases propensity for placement 	<ul style="list-style-type: none"> ▪ Quarterly roundtables and a consistent workforce development contact for industry. ▪ Problem-based learning activities can be derived directly from industry on a regular basis ▪ Job Placement Specialist explicitly trained to correlate academic programs to occupations and to garner substantial industry relations for recruitment. ▪ Contextually designed training programs should be formally approved and recognized by firms through a letter of acknowledgment to ensure continuum of education and placement in the county.

<p><u>Student Placement Services</u></p> <p>1. Industry views placement after completion as a measure of success. Alignment of industry and academic performance metrics can alleviate disconnects between labor needs and educational programming.</p> <p>2. Demand from students (both traditional and non-traditional) now includes job placement services.</p>	<ul style="list-style-type: none"> ▪ Job Placement specialist trained to match academic programs to occupations and develop industry connections, can also track student placement. Resume writing and interviewing skills should be reserved for other student services departments already performing these tasks and partner workforce organizations. ▪ This specialist can also perform internship placement activities –a strategy which has statistically proven to increase the probability of hire. ▪ These supplemental initiatives may increase demand for college programs and enrollment.
<p><u>Enrollment Management</u></p> <p>1. Community college programs are in demand by two primary markets seeking traditional and continuing education; full-time students and full-time workers</p>	<ul style="list-style-type: none"> ▪ Course scheduling should be guided by two consumer populations in this industry sector: <ol style="list-style-type: none"> 1. Traditional full-time students 2. Non-traditional full-time workers/ Registered Apprentices ▪ Full-time employees require a schedule that is not too intensive on a weekly basis and that fits into a typical work schedule.
<p><u>Recruitment of non-traditional students</u></p> <p>1. Recruitment of workers is a primary problem for employers and a top priority for investment.</p> <p>2. Enrollment at community colleges is inversely related to regional employment rates. The demand for entry-level workers in the manufacturing sector combined with the need to increase enrollment has created the opportunity to focus on recruitment of non-traditional students.</p> <ol style="list-style-type: none"> 1. Veterans 2. Returning Adults 3. Adult remedial learners 	<ul style="list-style-type: none"> ▪ Optimizing practices for attracting skilled workers to the manufacturing sector includes innovative program mix (stackable credentials) and delivery (scheduling) that fit the full-time worker life style. ▪ Recruiting incumbent workers for upskilling, this can be through a registered apprenticeship program. ▪ Prior Learning Assessment program for veterans ▪ Create continuum from remedial adult education/GED/ESL to non-credit/credit to employment OR from remedial adult education/GED/ESL to non-credit/pre-apprenticeship to employment via apprenticeship
<p><u>Completion in a high-demand economy</u></p> <p>1. How do you encourage completion of awards when students are recruited after initial classes?</p>	<ul style="list-style-type: none"> ▪ Advocacy for registered apprenticeship programs that involve full-time employment with a set educational path. ▪ Scheduling to accommodate full-time workers.
<p><u>Student tracking for outcomes</u></p> <p>1. Local industry has iterated that the academic world is not measuring success in the same terms as industry, hence the disconnect in workforce development.</p>	<ul style="list-style-type: none"> ▪ Academia and industry require common performance metrics. A Job Placement Specialist that focuses solely on placement and tracking can provide this data. Partner programs such as the WDB and SCCRC apply public

Industry is time-based, academia is not. Traditional academic measures of success include access (enrollment) and completion. The 21st century populous, including student consumers and industry partners, demands that academia also be measured by student success after completion.

funding that is funneled to the educational system, and require placement and wage data (see below).

Strong Workforce Program Metrics:

Employment Rate

Employment in field of study

Earnings

Median change in earnings

Proportion of students who attain a living wage

CTE Enrollment

Completion

Job placement output may be used for the following areas at VCCCD:

- Gainful Employment reporting
- Student recruitment/attraction – success after completion is a top priority for current students, both traditional and non-traditional
- ROI reports to county residents and officials
- Annual induced economic impact reports on the contribution of VCCCD graduates to the local economy
- Identifying if a student has been able to secure employment within their field of study assists in long term evaluation of college programs and proficiency levels of graduates
- Enhanced institutional research to align and track investments
- SCCRC SWP Reporting



INCREASED PROFICIENCY PLATFORM

PRE-APPRENTICESHIP ENTRY LEVEL MANUFACTURING CERTIFICATE

40 hr Non-credit/not-for-credit | Assemblers | \$14.75 median hourly wage

- Plant Tours
- Safety (OSHA10)
- ERP/MRP
- Microsoft Office
- Math
- Lean Principles
- Work Readiness/Communications
- SOPs/Reading Comprehension

INSPECTION/
QUALITY
CONTROL

Industry Engagement
in deriving
Problem-based
Learning Projects

CNC MACHINE OPERATOR

MANUFACTURING APPLICATIONS

MANUFACTURING TECHNOLOGIES CERTIFICATE

- Measuring Dimensions/Producing Geometric Layouts
- Lean Principles & Applications
- Geometry/Trigonometry/Some Algebra II
- Blueprint Reading
- Quality/ERP/MRP
- Writing Communications
- Intro to Operations Management
- Intro to Machining
- Intro to Programming
- Intro to Drafting
- Safety

ENTREPRENEURSHIP/
INTRAPRENEURSHIP

OPERATIONS
MANAGEMENT

CNC SET-UP OPERATOR

WAGES - \$22.45

- Blueprint Reading
- CNC Set-up
- CNC Operating
- PBL Repetition:
Blueprint >
Coding >
Manufacturing >
Reference against
blueprint

• Internship (10 Hrs)

MACHINIST

CNC PROGRAMMER

WAGES - \$26.61

- Programming
- Set-up
- Operating
- PBL Repetition:
Blueprint >
Coding >
Manufacturing >
Reference against
blueprint

• Internship (10 Hrs)

MACHINIST

MECHANICAL DRAFTER

WAGES - \$25.43

- Auto-cad
- Trigonometry
- Writing
- Solid-works (industry exam)
- PBL Repetition:
Blueprint >
Coding >
Manufacturing >
Reference against
blueprint

• Internship (10 Hrs)

CONSISTENT INDUSTRY ENGAGEMENT

Work-based learning | Job Placement | Curriculum review for emerging skills

APPENDIX

Appendix A – Data Sources

Demographic Data

The demographic data in this report is compiled from several sources using a specialized process. Sources include annual population estimates and population projections from the US Census Bureau, birth and mortality rates from the US Health Department, and projected regional job growth.

Industry Data

QCEW (Quarterly Census of Employment and Wages), with supplemental estimates from County Business Patterns.

Non-QCEW employees data are based on a number of sources including QCEW, Current Employment Statistics, County Business Patterns, BEA State and Local Personal Income reports, the National Industry-Occupation Employment Matrix (NIOEM), the American Community Survey, and Railroad Retirement Board statistics. Self-Employed and Extended Proprietor classes of worker data are primarily based on the American Community Survey, Nonemployer Statistics, and BEA State and Local Personal Income Reports. Projections for QCEW and Non-QCEW Employees are informed by NIOEM and long-term industry projections published by individual states. EMSI Database.

This report uses state data from the following agencies: California Labor Market Information Department and California Economic Development Department.

District Data

Ventura County Community College District Institutional Research

CareerBuilder/Emsi Job Postings

Job postings are collected from various sources and processed/enriched by Careerbuilder to provide information such as standardized company name, occupation, skills, and geography. Emsi performs additional filtering and processing to improve compatibility with Emsi data.

Appendix B – NIMS Credentials

Appendix C – MSSC Manufacturing Production Technician

Special Thanks

Ventura County Workforce Development Board

Workforce Education Coalition

P-20 Council

South Central Coast Regional Consortium

VCCCD Institution Research

Haas Automation

TMJ Concepts

Elite Robotics Corp.

Amgen

Kinamed Inc.

APMC

Laritech Inc.

Wholesome Harvest Baking

Jaxx Manufacturing Inc.

*And all the manufacturers who graciously devoted
time to surveys and inquiry in the name of workforce
development!*



For further information please contact Dr. Alexandria M. Wright
Ventura County Community College District I Division of Economic & Workforce
Development awright1@vcccd.edu | 761 E. Daily Dr., Camarillo, CA 93010 | 805-652-5516
A report by the VCCCD Economic & Workforce Development Division

In Partnership with:

