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ADVANCED MANUFACTURING CLUSTER: WORKFORCE NEEDS ASSESSMENT

SACRAMENTO CAPITAL REGION

October 2015

Prepared by: Centers of Excellence,
Los Rios Community College District

Valley Vision

Burris Service Group

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TABLE OF CONTENTS

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INTRODUCTION

Starting in 2008, the six-county Sacramento Capital region (El Dorado, Placer, Sacramento, Sutter, Yolo and Yuba counties) was rocked by the global recession, losing 10 percent of the region's jobs. In response, regional leaders initiated Next Economy, an action plan to accelerate job creation and new investment in six high-growth business (industry) clusters. Valley Vision, a regional civic leadership organization, managed the three-year Next Economy design, research and implementation process on behalf of a wide range of private and public sector partners.

As of late 2015, after a lagging recovery, the region's economy is picking up momentum, with the unemployment rate decreasing while job growth accelerating. Valley Vision received funding from JPMorgan Chase & Co. to better understand how the region's key growth industry clusters have changed since the original Next Economy research was conducted in 2012, and what new opportunities are emerging. Valley Vision is partnering with the Los Rios Center of Excellence and the Burris Service Group on this effort.

Cluster research is a widely accepted standard of practice for developing regional prosperity strategies to address multiple facets of a region's complex economy. Industry clusters reduce operating costs by shortening supply chains; increasing the flow of information regarding new business opportunities; concentrating workforce training needs in select occupations; and speeding up the identification of gaps in products or services. Firms in identified clusters may also have a reduced risk of failure, as these firms are better supported by the supply chain and can respond more rapidly to shifts in the marketplace.

This report presents findings on the analysis of the Advanced Manufacturing cluster. It is the first in a series covering the six Next Economy-identified clusters. Additional reports are forthcoming in the areas of the "clean economy," education and knowledge creation, food and agriculture, information and communications technologies, and life sciences and health services. Each report provides an overview of the cluster, industry trends and economic impact, as well as an overview of the top demand occupations in the cluster requiring postsecondary education or training, along with projected occupational demand, institutions providing related education and training, and possible workforce gaps.

This research will be used to develop cluster-based workforce action plans. Valley Vision will work alongside regional education, and workforce and economic development partners to convene six cluster-based employer forums, setting priorities and developing strategies to address critical workforce gaps, better align education and workforce development resources to meet employer and workforce needs, and strengthen the regional economy overall.

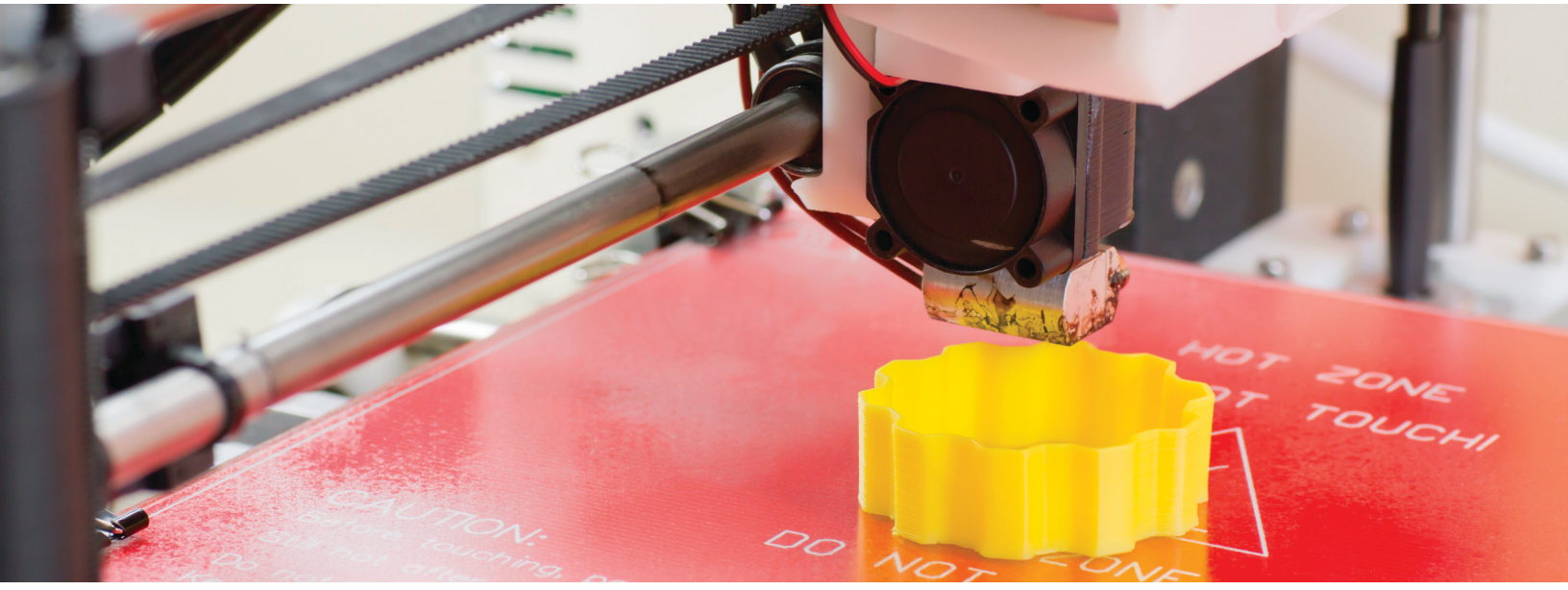
[1] Cluster Manufacturing: A Supply Chain Perspective

[2] Sacramento Area Council of Governments (SACOG) is the principal researcher for the Agriculture Cluster study, which will focus primarily on industry trends and excludes workforce development and training needs.

CLUSTER DEFINITION

Advanced manufacturing is a process that integrates the coordinated use of information, automation, software, sensing and networking to improve the efficiency and reduce costs of manufacturing.[3] Although advanced manufacturing methods may be utilized by any manufacturing industry, high use of these methods tends to cluster in the following six subsectors:[4]

- **Aerospace Manufacturing** – firms that manufacture or assemble complete aircraft, aircraft engine, engine parts, aircraft parts, guided missiles, space vehicles, auxiliary equipment, and search, detection and navigation instruments. Support firms that provide expertise in design and production in areas such as precision tuning, control systems, and fluid power valve design are also included in this cluster.
- **Chemical Manufacturing** – firms that manufacture industrial chemicals, fertilizers/pesticides, and miscellaneous chemical products.
- **Computers/Electronics Manufacturing** – firms that manufacture computer and peripheral equipment, communications equipment, audio and video equipment, semiconductors, electronic components, and measuring, electromedical, and control instruments. This cluster also includes firms that manufacture and produce magnetic and optical media.
- **Machinery Manufacturing** – firms that manufacture agriculture, construction, and mining machinery; industrial machinery; commercial and service industry machinery; ventilation, heating, air-conditioning, and commercial refrigeration equipment; metalworking machinery; engine, turbine, and power transmission equipment; and other general purpose machinery.
- **Plastic Products Manufacturing** – firms that engage in manufacturing plastic products, such as plastic bags, packaging film, polystyrene foam products, and plastic bottles. This cluster also includes chemical industries that support plastic production.
- **Transportation Manufacturing** – firms that engage in manufacturing motor vehicles, trailers, and related parts; railroad rolling stock; ships and boats; and other transportation equipment. This cluster also includes supportive industries such as oils/lubricants and component parts.



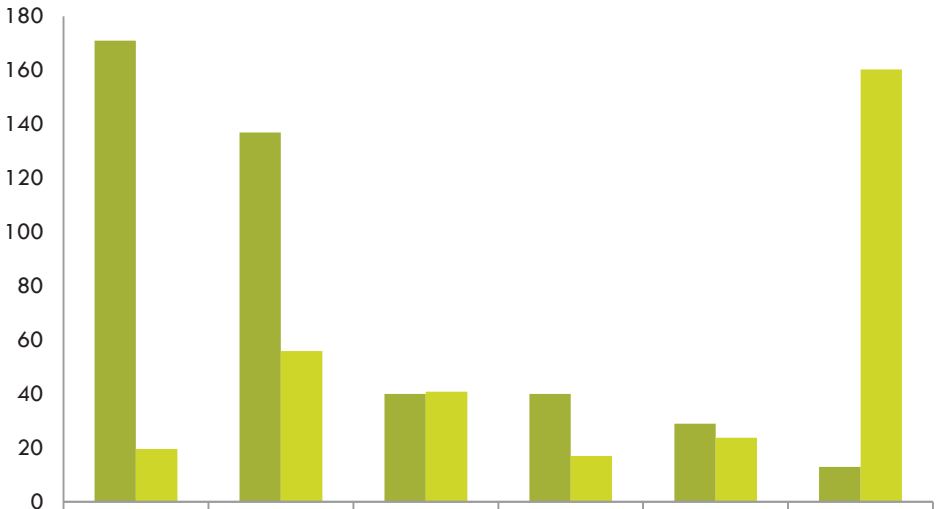
[3] Advanced Manufacturing Portal: manufacturing.gov.

[4] Establishments that use advanced manufacturing processes can be found in any manufacturing subsector. Subsectors that are known to have infrequent use of advanced manufacturing techniques were excluded from the analysis. Food processing which may represent a significant number of establishments that utilize advanced manufacturing techniques was excluded from the analysis to avoid duplication of industry employment counts published in the agriculture supply chain cluster study.

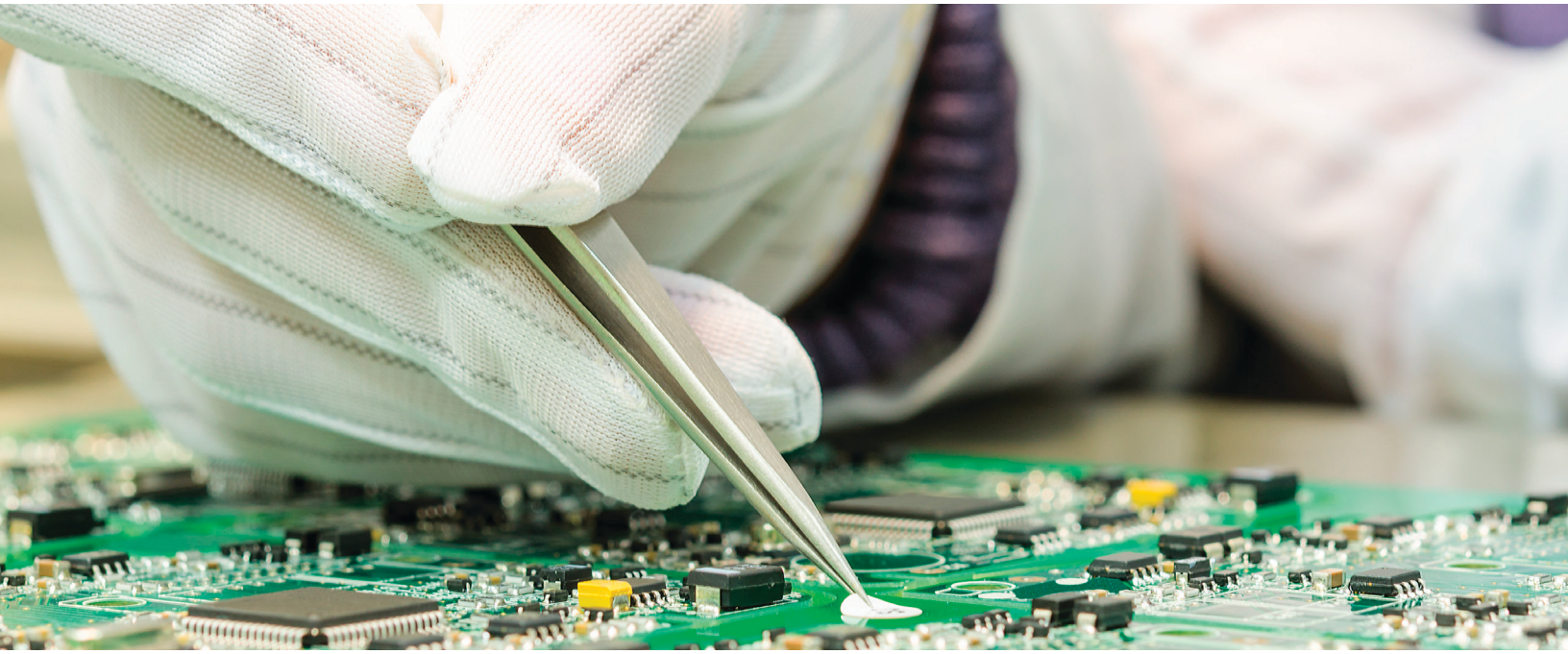
ESTABLISHMENTS

Exhibit 1 displays establishments and the average number of jobs per establishment for the advanced manufacturing subsectors in the Sacramento Capital region. As shown, the machinery subsector has the most firms, with a low number of workers per establishment compared to other subsectors in the region. The computer and electronic subsector is the second largest subsector in terms of total establishments, and it has a relatively high number of workers per establishment. Aerospace has the fewest establishments and the highest average number of jobs per establishment, most likely due to the dominance of Aerojet Rocketdyne, a large aerospace firm located in Rancho Cordova.

Exhibit 1: Establishments and Average Employment by Subsector, 2014[5]



	Machinery	Computers & Electronics	Trans-portation	Chemical	Plastics	Aerospace
2014 Establishments	171	137	40	40	29	13
Average Number of Jobs per Establishment	20	56	41	17	24	160



[5] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

CONCENTRATION OF EMPLOYMENT

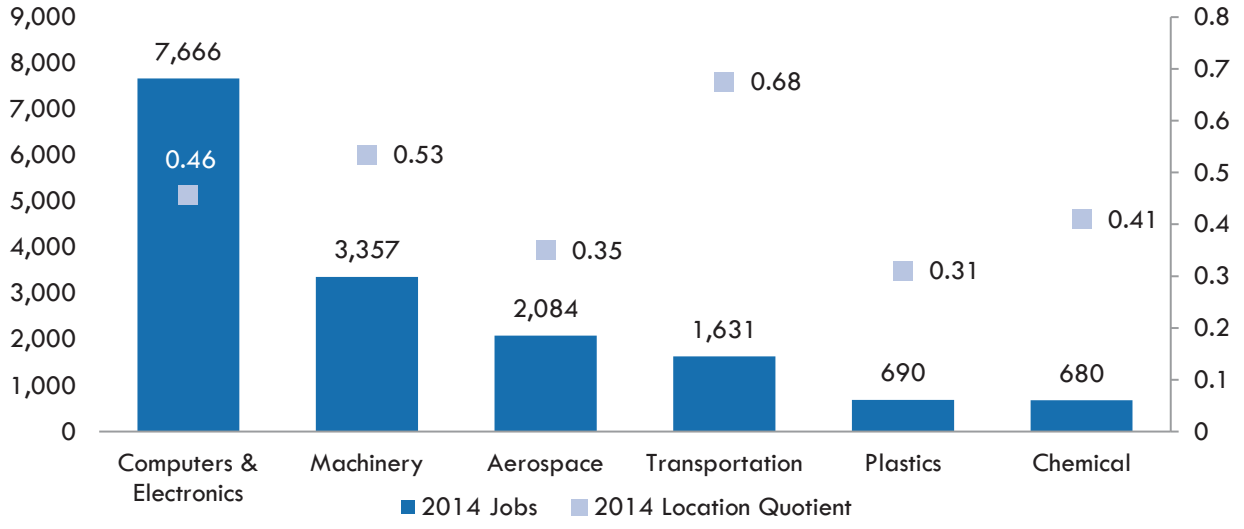
In 2014, there were about 16,100 advanced manufacturing jobs, 42 percent of the total manufacturing employment and 1.5 percent of the total employment in the Sacramento Capital region. As shown in Exhibit 2, the majority of advanced manufacturing jobs were in computer and electronic product manufacturing (48%; 7,666 jobs), followed by machinery (21%; 3,357 jobs) and aerospace (13%; 2,084 jobs).

Location quotient analysis compares the total employment in a region relative to the total employment in a larger area—in this case, California. A location quotient of less than one indicates a lower concentration of employment for that industry in the region than in the state overall. A location quotient of more than one indicates a higher concentration of employment for the region than in the state overall. All of the advanced manufacturing subsectors in the Sacramento Capital region have a location quotient that is less than one, indicating a lower concentration of employment compared to other areas of the state.

Within the subsectors, there are industries with above average location quotients, indicating a high concentration of employment for those industries than in the state overall. These include:

- **Computers & Electronics**: computer terminal and other computer peripheral equipment manufacturing (6.52 LQ); electronic computer manufacturing (2.9 LQ); carbon and graphite product manufacturing (2.81 LQ); switchgear and switchboard apparatus manufacturing (1.63 LQ) and audio and video equipment manufacturing (1.41 LQ).
- **Machinery**: printing machinery and equipment manufacturing (3.75 LQ); machine tool manufacturing (1.4 LQ); and packaging machinery manufacturing (1.25 LQ).
- **Aerospace**: guided missile and space vehicle propulsion unit and propulsion unit parts manufacturing (17.94 LQ); and guided missile and space vehicle manufacturing (1.2 LQ).
- **Transportation**: railroad rolling stock manufacturing (3.45 LQ) and travel trailer and camper manufacturing (1.22).
- **Plastics**: plastics packaging film and sheet (including laminated) manufacturing (1.87 LQ).
- **Chemical**: printing ink manufacturing (1.57 LQ).

Exhibit 2: Total Employment and Location Quotient by Subsector, 2014[6]



[6] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

TRENDS AND PROJECTIONS

During the recession, the Advanced Manufacturing cluster declined significantly, shedding 1,770 jobs in three years (2007–09). However, in 2010, the cluster started to rebound. Over the next five years, the Advanced Manufacturing cluster is projected to grow moderately, adding as many as 755 jobs by 2019. Aerospace is projected to add the most jobs, followed by machinery manufacturing and plastics. The computers and electronics subsector is expected to slightly decline with a loss of about 100 jobs over the next five years.[7]

Exhibit 3: Employment Trends and Projections, 2009–2019[8]

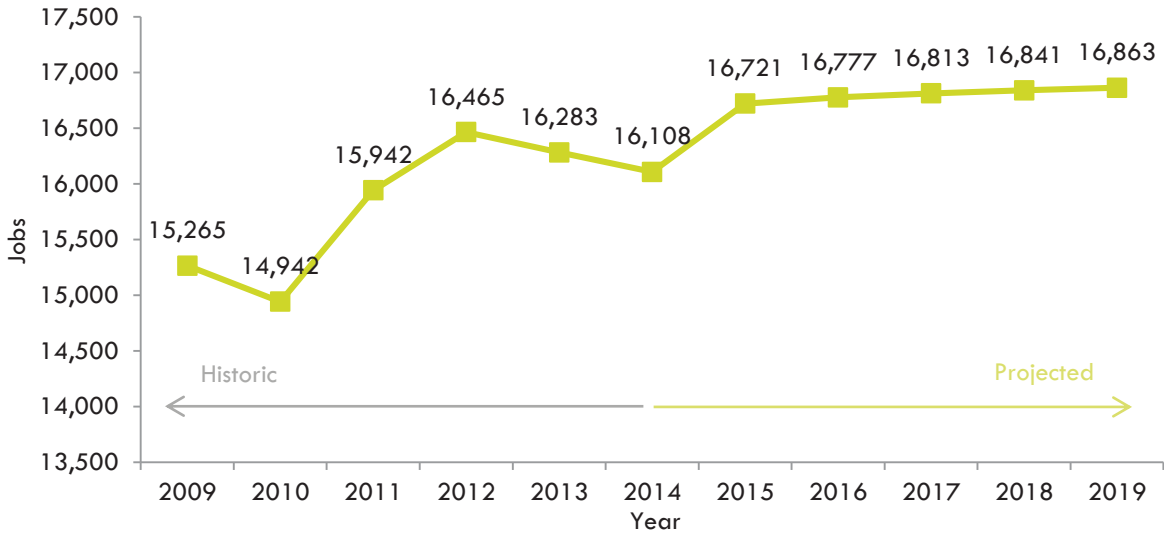


Exhibit 4: Employment Projections by Subsector, 2014–2019[8]

Advanced Manufacturing Subsector	2014 Jobs	2019 Jobs	Change	% Change
Aerospace	2,084	2,410	326	16%
Chemical	680	711	31	5%
Computers & Electronics	7,666	7,564	(102)	(1%)
Machinery	3,357	3,609	252	8%
Plastics	690	863	173	25%
Transportation	1,631	1,706	75	5%
Total Advanced Manufacturing Jobs	**16,108**	**16,863**	**755**	**5%**

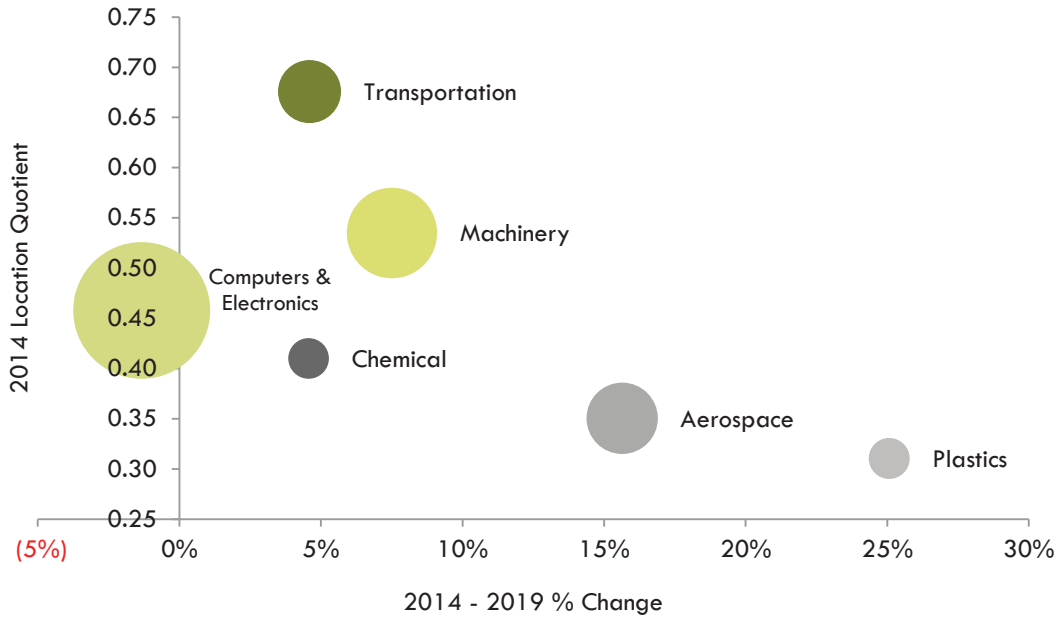
[7] Projection data indicates that the aerospace subsector is projected to add the most jobs over the next five years. However, recent articles in the Sacramento Business Journal report that Aerojet Rocketdyne, the largest aerospace business in the region, is reducing the size of its workforce. As such, the growth of this subsector may be less than projected by historic trends.

[8] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

TRENDS AND PROJECTIONS

The bubble chart below compares the projected five-year growth rate to the concentration of employment in the region, where the size of the bubble indicates the total number of jobs for that subsector. While all of the advanced manufacturing subsectors in the Sacramento Capital region have a lower concentration of employment than the statewide average, some subsectors are closer to the average than others. The transportation and machinery subsectors have a higher location quotient than other subsectors and a moderate projected growth rate. Aerospace and plastics have a relatively low concentration of employment in the region but high projected growth rates when compared to the other subsectors.

Exhibit 5: Growth Rate vs. Subsector Concentration[9]

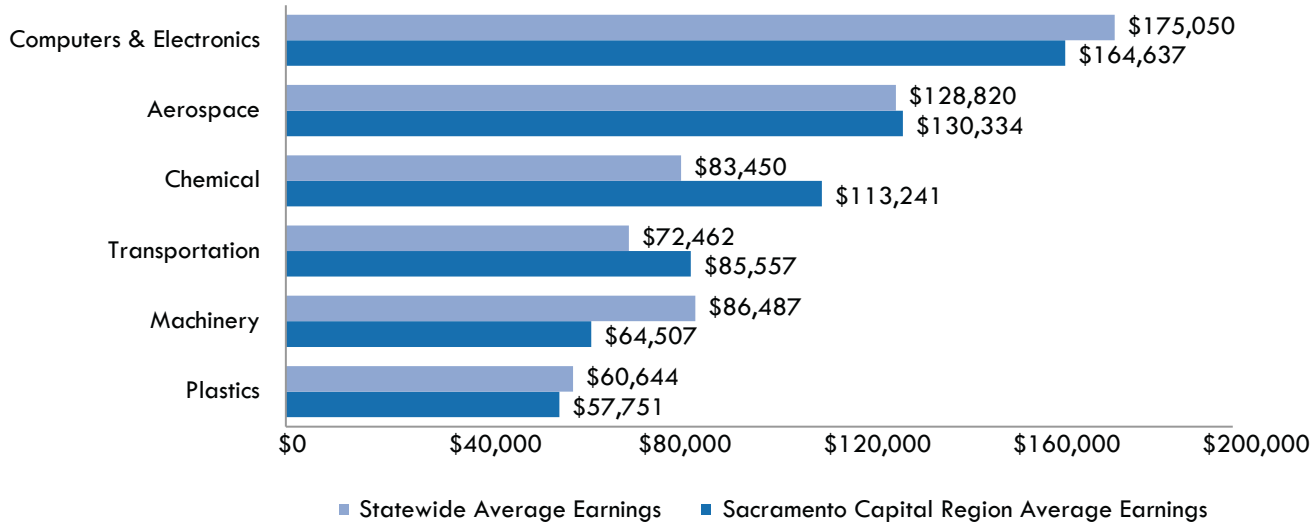


[9] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

EARNINGS

The computer and electronics subsector provides the best earnings in the Sacramento Capital region, followed by aerospace and chemical product manufacturing. The earning calculation includes an average of all wages, salaries, proprietor earnings and supplemental earnings (such as retirement benefits, bonuses, etc.) for all occupations in the sector. All of the subsectors, with the exception of plastics, provide earnings above the average earnings across all industries in the Sacramento Capital region.[10]

Exhibit 6: Earnings by Manufacturing Subsector, 2014[11]



[10] The average earnings across all industries in the Sacramento Capital region is $63,377.

[11] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

SHIFT SHARE ANALYSIS

Shift share analysis is a method for determining how much of regional job growth can be attributed to national trends and how much is due to unique regional factors. Exhibit 7 displays four key components:

- **Industrial Mix Effect** – represents the share of regional industry growth explained by the growth of the specific industry at the national level.
- **National Growth Effect** – represents how much of the regional industry's growth is explained by the overall growth of the national economy. Given that the nation's economy is growing, it is normal to see positive change in each subsector.
- **Expected Change** – the change expected due to national growth effect and industry mix effects.
- **Regional Competitive Effect** – explains how much of the change in the subsectors is due to some unique competitive advantage that the region possesses, because the growth cannot be explained by national trends in the industry or the economy as a whole.

Five of the six subsectors are outperforming national trends (both overall national trends and national trends in the specific subsectors), while transportation is underperforming compared to national trends. This suggests that the region has a competitive advantage in the Advanced Manufacturing cluster compared to other areas of the nation.

Exhibit 7: Shift Share Analysis by Subsector, 2013–2018[12]

	Industrial Mix Effect	National Growth Effect	Expected Change	Regional Competitive Effect
Aerospace	(360)	133	(227)	553
Chemical	(48)	43	(5)	35
Computers & Electronics	(881)	487	(394)	293
Machinery	(226)	213	(13)	264
Plastics	25	44	69	105
Transportation	(12)	104	92	(17)

[12] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

ECONOMIC IMPACT

Economic impact provides a quantitative method to estimate the total economic benefit from a project, or in this case, an industry cluster. In other words, it is the "ripple effect" of all economic activities resulting from that cluster. Impact analysis is typically comprised of direct, indirect and induced impacts:

- Direct impacts are those resulting from the expenditures of operations within that industry cluster.
- Indirect impacts are those resulting from suppliers of that cluster spending money and hiring employees.
- Induced impacts are the combined value of employees of the industry cluster spending money at a household level.

Combined, these three variables equate to the total economic impact of a project or industry cluster.

The Advanced Manufacturing cluster impacts the Sacramento Capital region's economy in several ways. The IMPLAN input-output model was used to measure the cluster's total economic impacts.[13] First, the cluster directly benefits the economy through the operations and jobs supported by the establishments within its subsectors. Exhibits 8 and 9 show that the Advanced Manufacturing cluster directly contributes over $8.3 billion in output and 16,000 jobs to the regional economy. In addition to this direct effect, these establishments generate an indirect impact through their supplier purchases—around $2.3 billion in output and 13,000 jobs are created within sectors that generally supply this cluster. Finally, the Advanced Manufacturing cluster creates an induced effect of almost $1.8 billion and approximately 13,000 jobs as a result of consumption activities within the local economy of both direct (cluster) and indirect (supplier) employees.

Exhibit 8: Total Output Impacts[14]

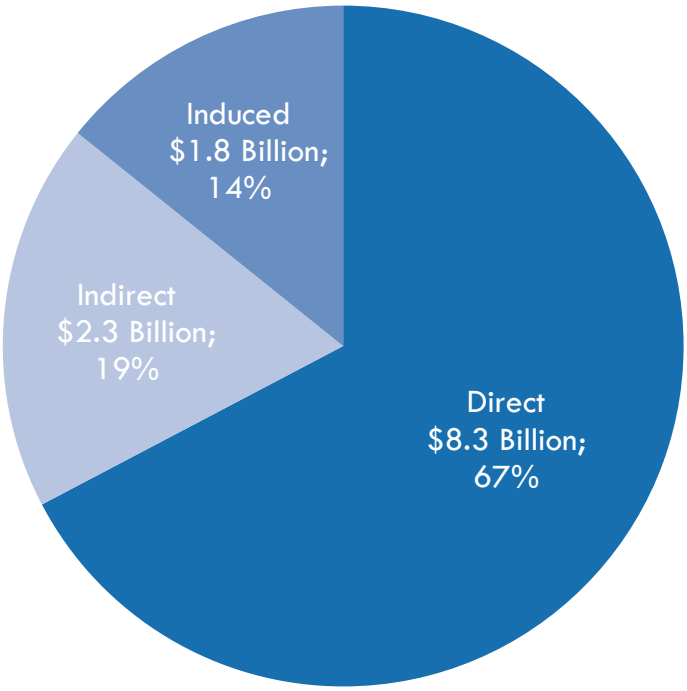
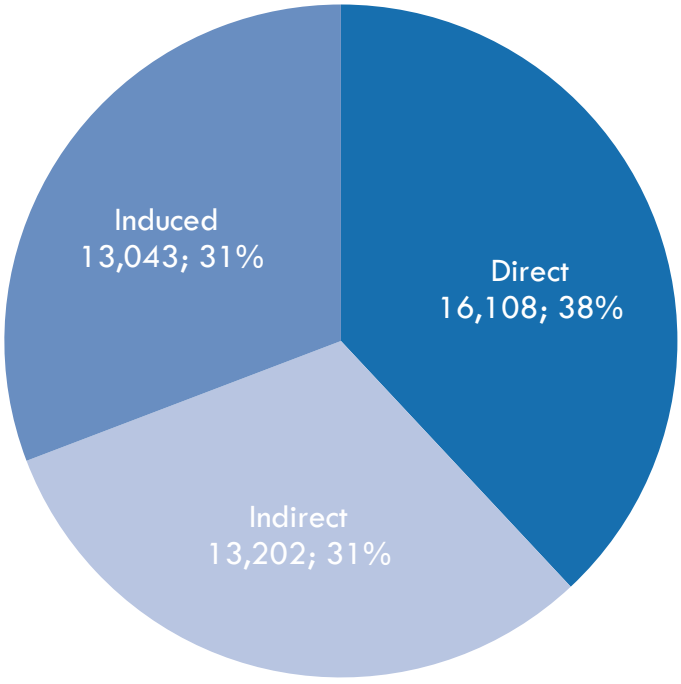


Exhibit 9: Total Employment Impacts[14]



[13] IMPLAN is input-output modeling system used to conduct economic analysis.

[14] IMPLAN: 2013 data supplemented with EMSI data.

ECONOMIC IMPACT

The Advanced Manufacturing cluster contributes a total of $12.4 billion in output, more than 42,000 jobs and $3.3 billion in labor income. Exhibit 10 breaks down the employment impacts by each subsector within the Advanced Manufacturing cluster and by output, employment, and labor income (which includes all forms of employment income, including employee compensation and proprietor income). With about $7.1 billion in output, 23,000 jobs, and $1.9 billion in labor income, the computers and electronics subsector, by far, accounts for the largest share of the cluster's total economic impacts while the plastics subsector has the smallest share.

Exhibit 10: Total Economic Impacts by Cluster Subsector[15]

	Direct	Indirect	Induced	Total
Output				
Total	**$8,347,285,605**	**$2,291,152,989**	**$1,765,912,765**	**$12,404,351,359**
Aerospace	$757,451,735	$149,331,040	$219,653,590	$1,126,436,365
Chemical	$684,756,534	$180,982,176	$81,623,742	$947,362,451
Computers & Electronics	$4,752,630,388	$1,342,687,005	$1,044,749,216	$7,140,066,609
Machinery	$1,027,404,219	$276,375,394	$215,496,190	$1,519,275,803
Plastics	$231,389,984	$52,409,098	$38,065,334	$321,864,415
Transportation	$893,652,746	$289,368,276	$166,324,693	$1,349,345,715
Employment				
Total	**16,108**	**13,202**	**13,043**	**42,353**
Aerospace	2,084	848	1,622	4,554
Chemical	680	994	603	2,277
Computers & Electronics	7,666	7,605	7,717	22,988
Machinery	3,357	1,710	1,592	6,658
Plastics	690	308	281	1,279
Transportation	1,631	1,737	1,229	4,596
Total Labor Income				
Total	**$1,891,401,897**	**$798,205,403**	**$597,013,936**	**$3,286,621,236**
Aerospace	$276,493,645	$59,169,162	$74,253,710	$409,916,516
Chemical	$62,219,040	$62,245,734	$27,594,309	$152,059,083
Computers & Electronics	$1,130,725,534	$459,711,044	$353,209,954	$1,943,646,532
Machinery	$230,027,954	$97,913,785	$72,855,596	$400,797,335
Plastics	$40,220,556	$17,761,606	$12,868,960	$70,851,122
Transportation	$151,715,169	$101,404,071	$56,231,407	$309,350,647

[15] IMPLAN, 2013 data supplemented with EMSI data.

ECONOMIC LEAKAGE

Supply chain leakage is a primary factor in determining the value of an industry multiplier used to define the total "ripple effect" of that industry cluster. Stronger supply chain linkages, better described as a cluster using more locally sourced products and services, has a reciprocal benefit of lower leakage, increasing the multiplier and the total impact on the surrounding economy.

It was determined through an in-depth analysis of the advanced manufacturing industry cluster and its subsets, that there is a relatively high level of supply chain leakage, roughly 68 percent. Conversely, 32 percent of goods and services supporting the industry cluster are purchased within the region.[16]

CHALLENGES AND OPPORTUNITIES

The manufacturing sector has had a tumultuous history in the Sacramento Capital region. To encourage growth, the Advanced Manufacturing cluster must address a variety of challenges, from navigating a complex regulatory environment to developing strategies to compete with low-cost economies. National, state and local legislators can support the cluster by developing and adopting policies that eliminate barriers to success, creating incentives for local production, and reducing supply chain leakage. This section of the report reviews some of the cluster's major challenges, as well as a few opportunities that may help drive regional growth in the future.

Challenges

There are a number of factors that have inhibited the manufacturing sector's ability to compete locally and internationally. Some of these challenges include:

- **Complex regulatory environment**. Employers have communicated that California's complex regulatory climate is difficult, expensive and time-consuming to navigate, such as conducting environmental impact studies or obtaining permits.
- **International competition from low-cost economies** such as China, Singapore, South Korea, Russia, etc. According to a recent study, California manufacturing firms have:[17]
  - Higher health care expenditures compared to countries where health care is paid for by general tax revenues;
  - Higher salaries and other benefits, such as paid leave, insurance, and retirement plans;
  - Higher costs associated with litigation claims;
  - Higher costs associated with environmental compliance;
  - Higher corporate tax rates than most other countries (the tax rate in the United States is 40 percent, the second highest tax rate among major trading partners).
- **U.S. competition**. In addition to international competition, California-based manufacturers are targets of state government programs to recruit manufacturers from California through incentive and off-set programs. These programs target high wage jobs that will most likely not return to California.
- **U.S. high school students lag** behind in math and science based on Program for International Student Assessment (PISA) test scores.[18]
- **U.S. manufacturers report a shortage of skilled production workers** (machinists, operators, craft workers, etc.) which is hindering their ability to expand operations or improve productivity.[19]

[16] IMPLAN, 2013 data supplemented with EMSI data.

[17] The Facts About Modern Manufacturing, 9th Edition, Manufacturing Institute, Manufacturers Alliance for Productivity and Innovation (MAPI), and National Association of Manufacturers.

[18] Manufacturing 2.0: A More Prosperous California, Milken Institute.

[19] Boiling Point? The Skills Gap in U.S. Manufacturing, Deloitte and Manufacturing Institute.

CHALLENGES AND OPPORTUNITIES

Opportunities

Competition from low-cost economies is one of the major challenges faced by the manufacturing sector. However, the total cost of outsourcing to other countries is often miscalculated. According to the Reshore Initiative, the sticker price provided by out-of-the-country manufacturing firms does not include costs associated with:

- National policy issues (trade negotiations, etc.)
- Changes in currency exchange rates
- Trade secret thefts
- Supply chain disruptions
- Lengthy delivery times
- Traveling to the manufacturing site to assess and resolving production issues

Further, in the last few years many countries have started to raise their prices to adjust for increases in wages and higher transportation/fuel expenses in their own country. By examining the total cost of outsourcing, the Reshore Initiative argues that hiring local production firms is just as price-sensitive as hiring firms from low-cost economies. Also, there are several benefits to working local, such as

- Improved quality and consistency of inputs;
- Ability to create just-in-time operations that reduce costs and improve business-to-business relations;
- A reduction of issues related to securing intellectual property;[20] and,
- Good public relations/marketing for "made in America" goals. As this viewpoint gains popularity, it may shift production back to the United States, creating jobs in the process.

The Sacramento Capital region offers several benefits to businesses that choose to locate their facilities in the region. Compared to other regions in the state, the Sacramento Capital region offers a lower cost of operations, lower cost of housing for employees, access to the Port of West Sacramento, Interstate 5 and Interstate 80 to keep shipping costs low, and access to local universities and colleges with established engineering programs to support research and development, as well as workforce needs. In addition, some manufacturers may find it beneficial to be located near the state's capital to influence policy and regulatory issues.

[20] The Reshore Initiative: http://www.reshorenow.org/

OCCUPATION OVERVIEW

Staffing patterns were utilized to identify the top 15 occupations in the Advanced Manufacturing cluster. Occupations selected for inclusion in the study had to meet the following criteria:

- Cluster businesses employ 100 or more workers in the occupation.
- The percent of total jobs employed by the cluster is significant.
- The minimum education requirement is a high school diploma plus on-the-job training, postsecondary award, associate degree, or bachelor's degree.

Exhibit 11 displays the top occupations that meet the criteria, sorted by percent employed by cluster. As shown, the majority of semiconductor processors are employed by the advanced manufacturing sector, followed by computer-controlled machine tool operators and machinists. This report provides occupational data across all industries to provide a complete picture of the employment demand. Training requirements may vary depending on the industry that employs the occupation.

Exhibit 11: Top 15 Occupations, 2014[21]

SOC	Description	Percent Employed by Cluster	Percent Employed by All Other Industries
51-9141	Semiconductor Processors	86%	14%
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	73%	27%
51-4041	Machinists	54%	46%
17-2061	Computer Hardware Engineers	47%	53%
51-9011	Chemical Equipment Operators and Tenders	45%	55%
17-2112	Industrial Engineers	35%	65%
17-2011	Aerospace Engineers	28%	72%
11-3051	Industrial Production Managers	26%	74%
17-3023	Electrical and Electronics Engineering Technicians	26%	74%
17-2141	Mechanical Engineers	23%	77%
51-4121	Welders, Cutters, Solderers, and Brazers	21%	79%
17-2071	Electrical Engineers	21%	79%
51-1011	First-Line Supervisors of Production and Operating Workers	17%	83%
17-2072	Electronics Engineers, Except Computer	17%	83%

OCCUPATION DEMAND

Exhibit 12 displays the employment demand for the top occupations, across all industries. For each occupation, replacement estimates include retirements and general separations, but not turnover within the occupation. As such, replacements and new job growth combined is a good measure of demand for workers.

First-line supervisors of production and operating workers is the largest occupation in the group with the most annual openings over the next five years. Electrical engineers as well as welders are also large occupations with significant annual openings created by new job growth and replacement needs. Semiconductor processors is the only occupation in the group projected to decline; with a loss of three jobs over five years. While there is no new job growth for this occupation, there is a demand for replacement workers.

[21] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

OCCUPATION DEMAND

Exhibit 12: Employment Outlook, 2014–2019[22]

Description	2014 Jobs	2019 Jobs	2014–2019 Change	2014–2019 % Change	Total Replace-ments	Total Openings	Annual Openings
First-Line Supervisors of Production and Operating Workers	2,200	2,268	68	3%	192	260	52
Electrical Engineers	1,515	1,648	133	9%	178	311	62
Welders, Cutters, Solderers, and Brazers	1,389	1,503	114	8%	207	321	64
Mechanical Engineers	1,059	1,199	140	13%	199	339	68
Electronics Engineers, Except Computer	1,007	1,071	64	6%	115	179	36
Machinists	892	1,007	115	13%	123	238	48
Electrical and Electronics Engineering Technicians	811	859	48	6%	94	142	28
Computer Hardware Engineers	797	808	11	1%	134	145	29
Industrial Production Managers	681	708	27	4%	68	95	19
Industrial Engineers	542	635	93	17%	88	181	36
Aerospace Engineers	379	452	73	19%	49	122	24
Computer-Controlled Machine Tool Operators, Metal and Plastic	272	324	52	19%	43	95	19
Chemical Equipment Operators and Tenders	271	288	17	6%	60	77	15
Semiconductor Processors	146	143	(3)	(2%)	25	25	5

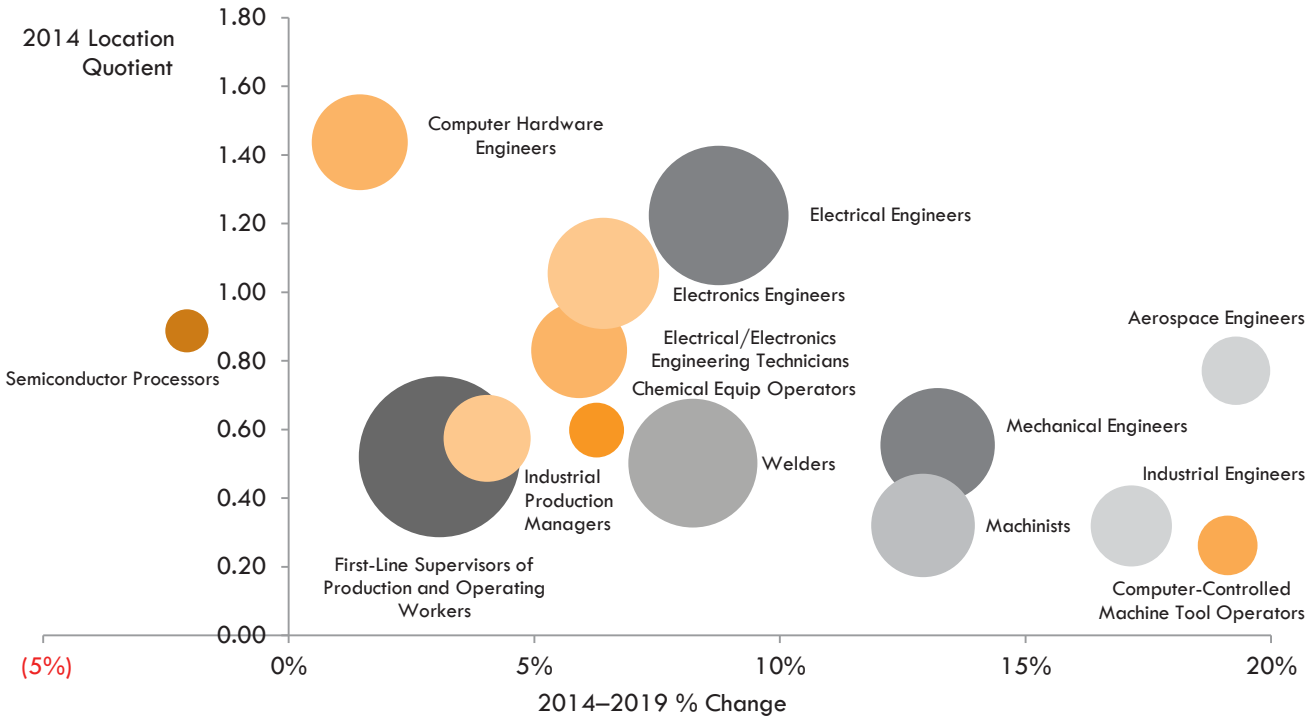
In addition to industry analysis, location quotient can also be applied to occupations. In this case, the location quotient compares an occupation's total employment in a region relative to the state's total employment for that occupation. A location quotient of less than one indicates a lower concentration of employment for that occupation in the region than in the state overall. A location quotient of more than one indicates a higher concentration of employment for the occupation than in the state overall.

The bubble chart on the following page compares the concentration of occupation employment to the projected five-year growth rate in the region, where the size of the bubble indicates the total number of jobs for each occupation. As shown below, the majority of advanced manufacturing occupations have a location quotient less than one, indicating a lower concentration of employment than in other regions of the state. Relative to the other occupations in the group, aerospace engineers, industrial engineers and computer-controlled machine tool operators are relatively small occupations with aggressive projected growth rates. Electrical engineers, mechanical engineers and machinists are mid-size occupations with moderate projected growth rates. First-line supervisors of production and operating workers is the largest occupation in the group with a modest projected growth rate.

[22] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

OCCUPATION DEMAND

Exhibit 13: Growth Rate vs. Occupation Concentration[23]

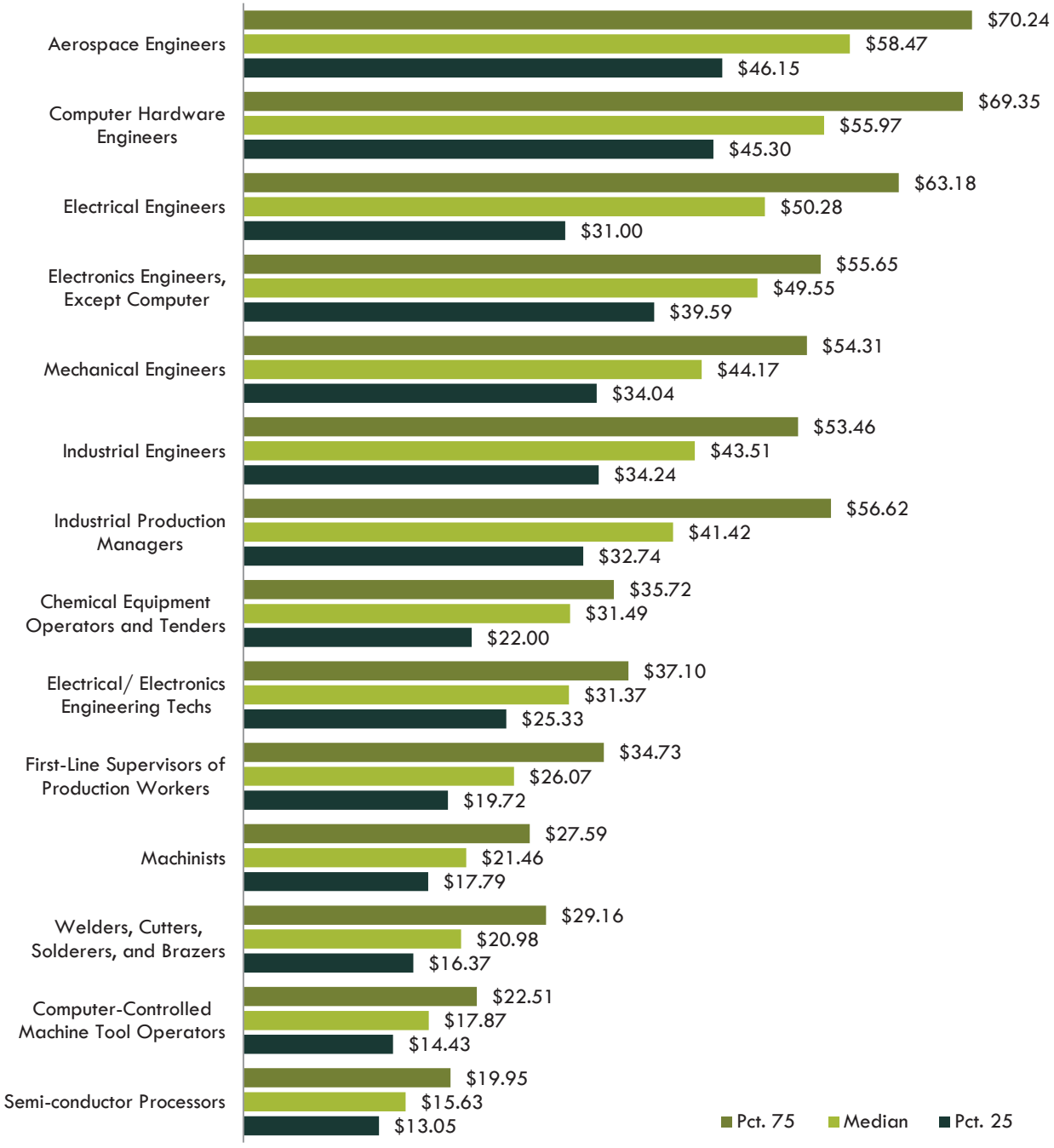


[23] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

OCCUPATIONAL WAGES

The majority of occupations in the Advanced Manufacturing cluster earn wages above the regional median wage. Aerospace engineers is the highest paid occupation, followed by computer hardware engineers and electrical engineers. The lowest paid occupations in the group include semi-conductor processors, computer-controlled machine tool operators and welders. The median hourly wage across all occupations in the Sacramento Capital region is $22.69 per hour.

Exhibit 14: Hourly Wages, 2015[24]



[24] EMSI: QCEW Employees, Non-QCEW Employees, and Self-Employed, 2015.2

EDUCATION ASSESSMENT

This section provides an overview of the educational programs that support occupations in the Advanced Manufacturing cluster in the Sacramento Capital region. Minimum education requirements are assigned to three categories:

- **Entry-level occupations** require a high school degree plus moderate to long-term on-the-job training. In this category, employers may prefer applicants if they have a formal education, such as a certificate or degree.
- **Mid-level occupations** require postsecondary training, certificate or associate degree.
- **Advanced-level occupations** require a bachelor's degree. Most of these positions do not require related work experience.

Exhibit 15 identifies the minimum education requirements for the top 15 occupations in the Advanced Manufacturing cluster by education category.

Exhibit 15: Minimum Education Requirements

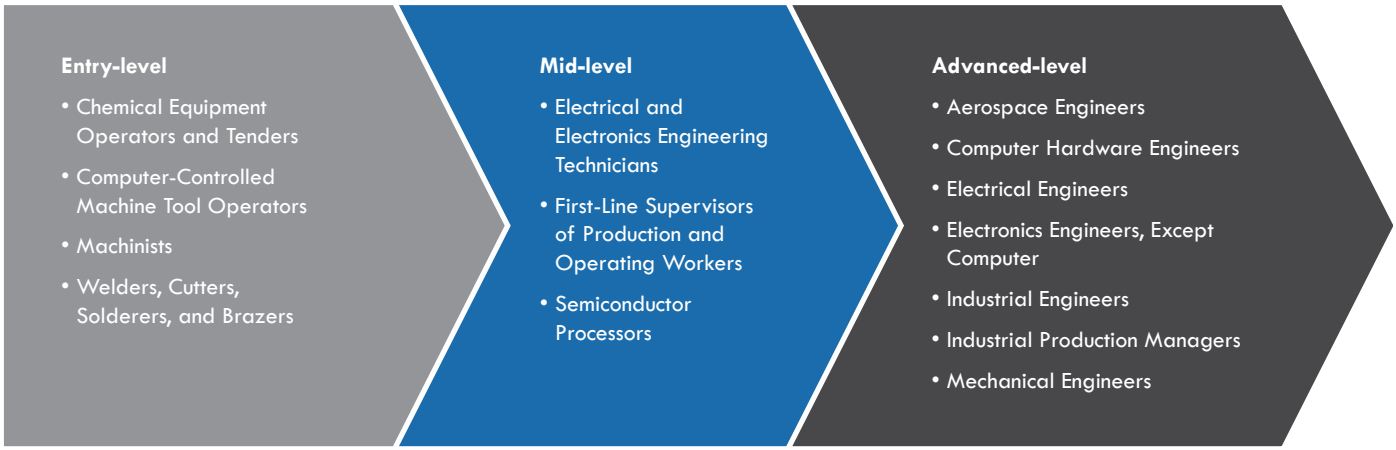


Exhibit 16 lists the colleges and programs with certificate and degree programs that provide a workforce pipeline to the Advanced Manufacturing cluster. The table organizes the programs by category: entry-level, mid-level and advanced-level. There are six programs in the entry-level occupation group, conferring 110 certificates and associate degrees annually. The welding program directly prepares for careers as welders, cutters, solderers and brazers. The manufacturing and industrial technology program provides a range of educational pathway options. There are no training programs for chemical equipment operators and tendors, computer-controlled machine tool operators or machinists.

Three public community colleges and two private education institutions provide training programs that support the mid-level occupation group. Combined, these education institutions confer an average of 345 certificates and associate degrees annually. The electronics and electric technology program prepares students for electrical and electronics engineering technicians, while industrial electronics is aligned with the semiconductor processors occupation.

There are three universities (two public, one private) with training programs that support the advanced-level occupation group. Combined, these education institutions confer an average of 825 bachelor's, master's, and PhD degrees annually. With the exception of industrial engineers, there is a training program that directly prepares students for each of the occupations in the advanced-level occupation group.

The total certificates and degrees conferred provide some information about the supply of workers to an industry or cluster. However, it is limited in that there are several unknown variables that impact the supply, such as migration trends, employer preferences, worker preparedness, and graduate/completion duplication.

Exhibit 16: Advanced Manufacturing Education Programs & Awards, Sacramento Capital Region[25&26]

Category	College/Program	Award Type	3-Year Average Certificate/Degrees Conferred
Entry-Level Occupations	American River College, Welding Technology	Associate of Science, Certificate	66
	Cosumnes River College, Welding Technology	Certificate	2
	Sierra College, Welding Technology	Certificate	18
	Sierra College, Manufacturing and Industrial Technology	Associate of Science, Associate of Arts, Certificate	12
	Yuba College, Welding Technology	Associate of Science, Certificate	11
	Yuba College, Manufacturing and Industrial Technology	Associate of Science	1
Mid-Level Occupations	American River College, Electronics and Electric Technology	Associate of Science, Certificate	188
	American River College, Industrial Electronics	Certificate	3
	Sacramento City College, Electronics and Electric Technology	Associate of Science, Certificate	9
	Sierra College, Electronics and Electric Technology	Associate of Science, Certificate	1
	Sierra College, Industrial Electronics	Associate of Science, Associate of Arts, Certificate	78
	Charles A Jones Career and Education Center, Electrical and Electronic Engineering Technologies/ Technicians	Certificate	29
	ITT Technical Institute-Rancho Cordova, Electrical, Electronic and Communications Engineering Technology/Technician	Associate	37
Advanced Occupations	University of California-Davis, Aerospace, Aeronautical and Astronautical/Space Engineering	Bachelor's degree	50
	University of California-Davis, Computer Engineering, General	Bachelor's degree	52
	California State University-Sacramento, Computer Engineering, General	Bachelor's degree, Master's degree	22
	University of California-Davis, Computer Science	Bachelor's degree, Master's degree, PhD	152
	California State University-Sacramento, Computer Science	Bachelor's degree, Master's degree	82
	California State University-Sacramento, Electrical and Electronics Engineering	Bachelor's degree, Master's degree	97
	University of California-Davis, Electrical and Electronics Engineering	Bachelor's degree, Master's degree, PhD	45
	University of Phoenix-Sacramento Valley Campus, Operations Management and Supervision	Bachelor's degree	0
	California State University-Sacramento, Mechanical Engineering	Bachelor's degree, Master's degree	110
	University of California-Davis, Mechanical Engineering	Bachelor's degree, Master's degree, PhD	215

[25] California Community College Chancellor's Office Data Mart. National Center for Education Statistics (NCES). Higher education institutions are required to report completion data to NCES if they participate in any federal financial assistance program authorized by Title IV of the Higher Education Act. Completion data not reported to the NCES or CCCCO Data Mart were not included in the estimate.

[26] The 3-year average includes academic years 2011-12, 2012-13 and 2013-14.

SKILLS ASSESSMENT

Exhibit 17 displays the top skills and professional credentials for the Advanced Manufacturing cluster occupations selected for inclusion in this study. The data is based on analysis of job posting data, aggregated by Burning Glass. This online tool uses intelligent "spidering" to search the Internet for job listings, removes duplication, and aggregates the data into a search database. As shown below, most of the skills/knowledge areas are specialized and require specific training and/or certification.

Exhibit 17: Skill and Professional Credential Preferences, Advanced Manufacturing Cluster Occupations[27]

Occupation	Top Skill/Knowledge Areas	Top Certifications/ Professional Credentials
Aerospace Engineers	Computer aided drafting/design (CAD), CATIA, systems engineering, physics, validation, product development, mathematics & chemistry	Federal Aviation Administration (FAA) Certification
Chemical Equipment Operators and Tenders	Forklift operation, inspection, machinery cleaning, chemical reactions and international traffic in arms regulations	Forklift Operator Certification
Computer Hardware Engineers	Electrical engineering, hardware design, validation, verilog, simulation, C++, debugging, concept development, PCB layout and design, oscilloscopes and product design	None Listed
Computer-Controlled Machine Tool Operators, Metal and Plastic	Computer Numerical Control (CNC), inspection, machine operation, machining, lathes, capability maturity model (CMM), micrometers, blueprints, calipers and mathematics	None Listed
Electrical and Electronics Engineering Technicians	Repair, test equipment, schematic diagrams, calibration, oscilloscopes, inspection, soldering, robotics, wiring, and programmable logic controller programming	None Listed
Electrical Engineers	Simulation, AutoCAD, electrical design, computer aided drafting/ design (CAD), electrical systems, validation, schematic diagrams, programmable logic controller (PLC) programming	Professional Engineer, Leadership in Energy and Environmental Design (LEED), Engineer in Training Certification
Electronics Engineers, Except Computer	Simulation, test equipment, radio frequency engineering, circuit design, optimation, product development, C++, MATLAB	None Listed
First-Line Supervisors of Production and Operating Workers	Scheduling, merchandising, process improvement, administrative functions, loss prevention, payroll administration, inspection of packages, access and/or egress control, and forklift operation	Forklift Operator Certification
Industrial Engineers	Inspection, six sigma, validation, medical device, process improvement, product development, manufacturing processes, process control, failure modes and effective analysis, packaging, ISO 9001 standards, and JAVA	Certified Qualified Engineer, American Society for Quality (ASQ) Certification, Six Sigma Certification
Industrial Production Managers	Inspection, scheduling, good management practices (GMP), process improvement, six sigma, manufacturing processes, validation, lean manufacturing, collaboration, packaging, and product development	Six Sigma Certification, Quality Management Certification
Machinists	Machining, computer numerical control (CNC), lathes, inspection, blueprints, dimensions, mathematics, and mirometers	None Listed
Mechanical Engineers	Computer aided drafting/design (CAD), mechanical design, product development, validation, manufacturing processes, AutoCAD, HVAC, product design, and concept development	American Society of Mechanical Engineers (ASME) Certified, Professional Engineer
Semiconductor Processors	Inspection, process equipment, clean room experience, physics	None Listed
Welders, Cutters, Solderers, and Brazers	TIG welding, blueprints, MIG welding, inspection, inventory maintenance, hand tools, power tools, Arc welding, and flux core welding	Welding Certification (e.g. AWS Certified Welder)

[27] Burning Glass, 2015.

SUMMARY

Advanced manufacturing is a process that integrates the coordinated use of information, automation, software, sensing and networking to improve the efficiency and reduce costs of manufacturing. Although advanced manufacturing methods may be utilized by any manufacturing industry, high use of these methods tends to cluster in the following subsectors: aerospace, chemical, computers/electronics, machinery, plastics production and transportation manufacturing.

In 2014, there were about 16,100 advanced manufacturing jobs, 42 percent of the total manufacturing employment and 1.5 percent of the total employment in the Sacramento Capital region. The majority of advanced manufacturing jobs were in computer and electronic product manufacturing, machinery and aerospace. Over the next five years, the Advanced Manufacturing cluster is projected to grow moderately about five percent. Overall, the Advanced Manufacturing cluster provides above average earnings compared to the average earnings across all industries in the Sacramento Capital region.

Fifteen (15) occupations were selected for inclusion based on three criteria: (1) cluster businesses employ 100 or more workers in the occupation, (2) the percent of total jobs employed by the cluster is significant, and (3) the minimum education requirement is a postsecondary award, associate degree, bachelor's degree or high school diploma plus on-the-job training. As these occupations are also employed by other industries (beyond the Advanced Manufacturing cluster), occupational data across all industries was provided for a complete picture of the employment demand.

Over the next five years, the top occupations in the Advanced Manufacturing cluster are projected to grow by 8 percent, adding over 190 new jobs and need about 315 replacement jobs annually. The majority of these occupations earn wages above the regional average. The minimum education requirements range from a high school degree plus on-the-job training to postsecondary training and associate degree to bachelor's degree. For the occupations that require a minimum of a high school degree plus on-the-job training, many employers prefer applicants if they have a formal education, such as a certificate or degree.

In the Sacramento Capital region, there are 10 education institutions supporting the advanced manufacturing occupations selected for this study. Key findings from the education assessment include:

- Four education institutions, conferring 110 certificates and associate degrees annually, support occupations in the entry-level group (i.e. minimum education is a high school degree plus on-the-job training).
- Three education institutions, conferring 345 certificates and associate degrees, provide training programs that support the mid-level occupation group (i.e. minimum education is postsecondary training, certificate or associate degree).
- Three education institutions, conferring 825 bachelor's, master's, and PhD degrees annually, have training programs that support the advanced-level occupation group.
- There are no specific training programs for chemical equipment operators, computer-controlled machine tool operators, machinists or industrial engineers. However, employers may accept other certificates/degrees when evaluating candidates for these positions.

From a high level supply and demand assessment, it appears that the region's education institutions are preparing more graduates than needed to support the top 15 occupations in the Advanced Manufacturing cluster. However, an actual oversupply may not be occurring due to unknown variables impacting the supply of workers in the region. For example, many graduates from four-year engineering programs do not stay in the region, but rather migrate to other areas to find their first job. In addition, graduate/completion duplication occurs when a student obtains more than one degree or certificate in the same year. Further, some students pursue additional education upon completion of a degree or certificate (i.e. transfer from a community college to a four-year program). Lastly, the identified educational training programs may crosswalk to occupations in other industry clusters, such as information and communication technologies (ICT). These factors inflate the total supply estimates, making it appear larger than it is.

SUMMARY

Valley Vision, along with the Center of Excellence and other partners, will be conducting forums with advanced manufacturing employers to review the cluster findings, high priority occupation and skills gaps that can be addressed through a concerted cluster workforce action plan. Priorities that may be elevated based on this analysis include:

1. Develop or expand training programs for machinist and computer-controlled machine tool operators. These programs have high projected growth and replacement needs, and no discernible education programs in the region exist.
2. Identify engineering specialties that are the most difficult to fill. Determine strategies to recruit engineers with specific specialties from outside the area.
3. Conduct primary research to assess potential skill gaps in existing training programs. Partner with regional employers and education institutions to identify skill requirements and competencies, and to close skills gaps.
4. Incorporate training to prepare students for the professional credential/certificates most in demand, such as Certified Qualified Engineer, American Society for Quality (ASQ) Certification, and Six Sigma Certification.

APPENDIX A: ADVANCED MANUFACTURING CLUSTER DEFINITION

The Advanced Manufacturing cluster is comprised of the following NAICS codes.

Aerospace

336411 Aircraft Manufacturing

336412 Aircraft Engine and Engine Parts Manufacturing

336413 Other Aircraft Parts and Auxiliary Equipment Manufacturing

336414 Guided Missile and Space Vehicle Manufacturing

336415 Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing

336419 Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing

334511 Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing

Chemical Manufacturing

325110 Petrochemical Manufacturing

325120 Industrial Gas Manufacturing

325130 Synthetic Dye and Pigment Manufacturing

325180 Other Basic Inorganic Chemical Manufacturing

325193 Ethyl Alcohol Manufacturing

325194 Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing

325199 All Other Basic Organic Chemical Manufacturing

325212 Synthetic Rubber Manufacturing

325220 Artificial and Synthetic Fibers and Filaments Manufacturing

325311 Nitrogenous Fertilizer Manufacturing

325312 Phosphatic Fertilizer Manufacturing

325314 Fertilizer (Mixing Only) Manufacturing

325320 Pesticide and Other Agricultural Chemical Manufacturing

325510 Paint and Coating Manufacturing

325520 Adhesive Manufacturing

325611 Soap and Other Detergent Manufacturing

325612 Polish and Other Sanitation Good Manufacturing

325613 Surface Active Agent Manufacturing

325620 Toilet Preparation Manufacturing

325910 Printing Ink Manufacturing

325920 Explosives Manufacturing

APPENDIX A: ADVANCED MANUFACTURING CLUSTER DEFINITION

325992 Photographic Film, Paper, Plate, and Chemical Manufacturing

325998 All Other Miscellaneous Chemical Product and Preparation Manufacturing

Computers & Electronics

334111 Electronic Computer Manufacturing

334112 Computer Storage Device Manufacturing

334118 Computer Terminal and Other Computer Peripheral Equipment Manufacturing

334210 Telephone Apparatus Manufacturing

334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing

334290 Other Communications Equipment Manufacturing

334310 Audio and Video Equipment Manufacturing

334412 Bare Printed Circuit Board Manufacturing

334413 Semiconductor and Related Device Manufacturing

334416 Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing

334417 Electronic Connector Manufacturing

334418 Printed Circuit Assembly (Electronic Assembly) Manufacturing

334419 Other Electronic Component Manufacturing

334513 Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables

334514 Totalizing Fluid Meter and Counting Device Manufacturing

334515 Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals

334613 Blank Magnetic and Optical Recording Media Manufacturing

334614 Software and Other Prerecorded Compact Disc, Tape, and Record Reproducing

335311 Power, Distribution, and Specialty Transformer Manufacturing

335312 Motor and Generator Manufacturing

335313 Switchgear and Switchboard Apparatus Manufacturing

335314 Relay and Industrial Control Manufacturing

335911 Storage Battery Manufacturing

335912 Primary Battery Manufacturing

335921 Fiber Optic Cable Manufacturing

335929 Other Communication and Energy Wire Manufacturing

335931 Current-Carrying Wiring Device Manufacturing

335932 Noncurrent-Carrying Wiring Device Manufacturing

335991 Carbon and Graphite Product Manufacturing

335999 All Other Miscellaneous Electrical Equipment and Component Manufacturing

511210 Software Publishers

Machinery

332710 Machine Shops

333111 Farm Machinery and Equipment Manufacturing

333112 Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing

333120 Construction Machinery Manufacturing

333131 Mining Machinery and Equipment Manufacturing

333132 Oil and Gas Field Machinery and Equipment Manufacturing

333241 Food Product Machinery Manufacturing

333242 Semiconductor Machinery Manufacturing

333243 Sawmill, Woodworking, and Paper Machinery Manufacturing

333244 Printing Machinery and Equipment Manufacturing

333249 Other Industrial Machinery Manufacturing

333314 Optical Instrument and Lens Manufacturing

333316 Photographic and Photocopying Equipment Manufacturing

333318 Other Commercial and Service Industry Machinery Manufacturing

APPENDIX A: ADVANCED MANUFACTURING CLUSTER DEFINITION

333413 Industrial and Commercial Fan and Blower and Air Purification Equipment Manufacturing

333414 Heating Equipment (except Warm Air Furnaces) Manufacturing

333415 Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing

333511 Industrial Mold Manufacturing

333514 Special Die and Tool, Die Set, Jig, and Fixture Manufacturing

333515 Cutting Tool and Machine Tool Accessory Manufacturing

333517 Machine Tool Manufacturing

333519 Rolling Mill and Other Metalworking Machinery Manufacturing

333611 Turbine and Turbine Generator Set Units Manufacturing

333612 Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing

333613 Mechanical Power Transmission Equipment Manufacturing

333618 Other Engine Equipment Manufacturing

333911 Pump and Pumping Equipment Manufacturing

333912 Air and Gas Compressor Manufacturing

333913 Measuring and Dispensing Pump Manufacturing

333921 Elevator and Moving Stairway Manufacturing

333922 Conveyor and Conveying Equipment Manufacturing

333923 Overhead Traveling Crane, Hoist, and Monorail System Manufacturing

333924 Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing

333991 Power-Driven Handtool Manufacturing

333992 Welding and Soldering Equipment Manufacturing

333993 Packaging Machinery Manufacturing

333994 Industrial Process Furnace and Oven Manufacturing

333995 Fluid Power Cylinder and Actuator Manufacturing

333996 Fluid Power Pump and Motor Manufacturing

333997 Scale and Balance Manufacturing

333999 All Other Miscellaneous General Purpose Machinery Manufacturing

Plastics

325211 Plastics Material and Resin Manufacturing

325991 Custom Compounding of Purchased Resins

326111 Plastics Bag and Pouch Manufacturing

326112 Plastics Packaging Film and Sheet (including Laminated) Manufacturing

326113 Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing

326121 Unlaminated Plastics Profile Shape Manufacturing

326130 Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing

326140 Polystyrene Foam Product Manufacturing

326150 Urethane and Other Foam Product (except Polystyrene) Manufacturing

326160 Plastics Bottle Manufacturing

326199 All Other Plastics Product Manufacturing

Transportation

314994 Rope, Cordage, Twine, Tire Cord, and Tire Fabric Mills

324191 Petroleum Lubricating Oil and Grease Manufacturing

326211 Tire Manufacturing (except Retreading)

326212 Tire Retreading

326220 Rubber and Plastics Hoses and Belting Manufacturing

326291 Rubber Product Manufacturing for Mechanical Use

332613 Spring Manufacturing

336111 Automobile Manufacturing

336112 Light Truck and Utility Vehicle Manufacturing

336120 Heavy Duty Truck Manufacturing

APPENDIX A: ADVANCED MANUFACTURING CLUSTER DEFINITION

336211 Motor Vehicle Body Manufacturing

336212 Truck Trailer Manufacturing

336213 Motor Home Manufacturing

336214 Travel Trailer and Camper Manufacturing

336310 Motor Vehicle Gasoline Engine and Engine Parts Manufacturing

336320 Motor Vehicle Electrical and Electronic Equipment Manufacturing

336330 Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing

336340 Motor Vehicle Brake System Manufacturing

336350 Motor Vehicle Transmission and Power Train Parts Manufacturing

336360 Motor Vehicle Seating and Interior Trim Manufacturing

336370 Motor Vehicle Metal Stamping

336390 Other Motor Vehicle Parts Manufacturing

336510 Railroad Rolling Stock Manufacturing

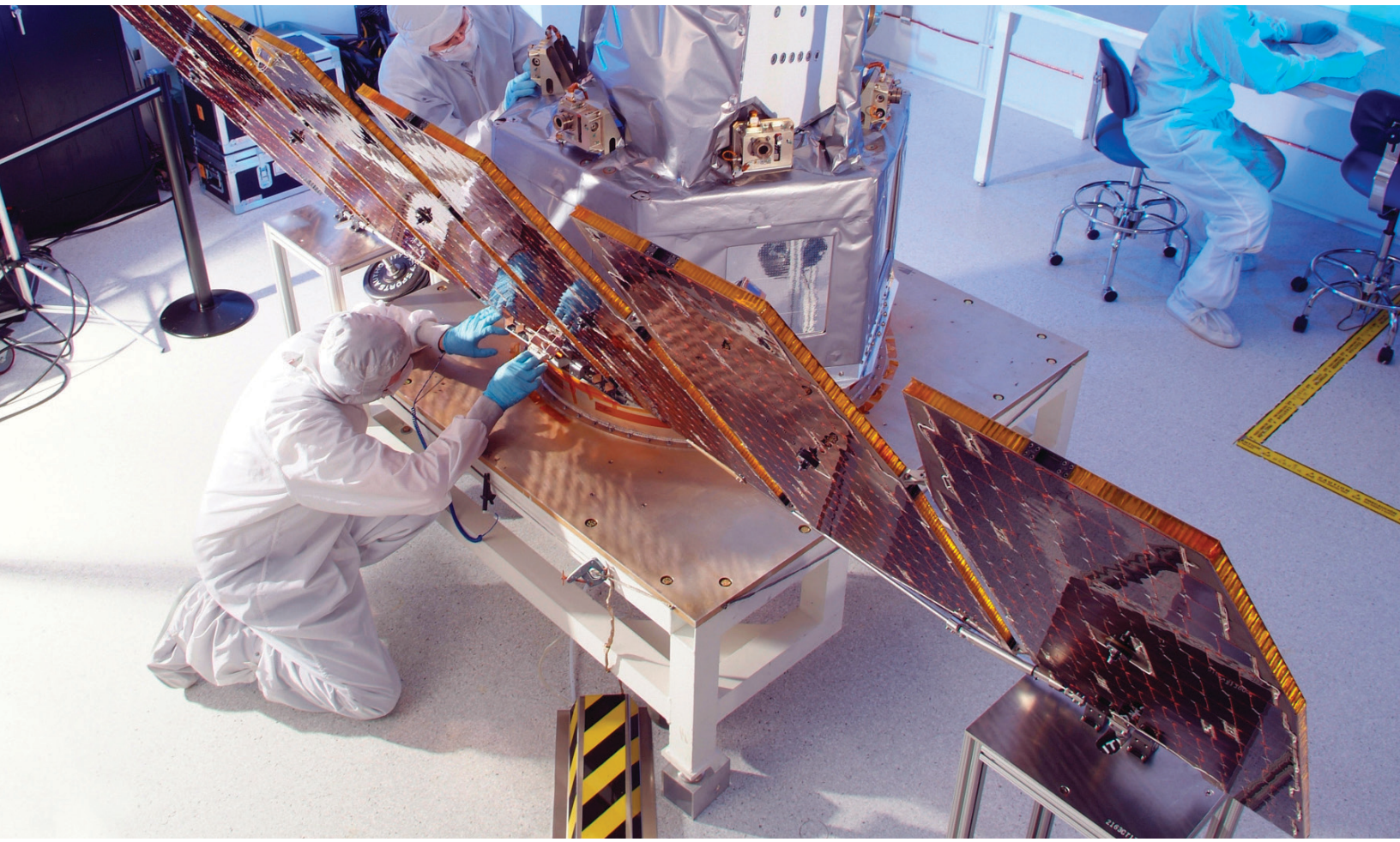
336611 Ship Building and Repairing

336612 Boat Building

336991 Motorcycle, Bicycle, and Parts Manufacturing

336992 Military Armored Vehicle, Tank, and Tank Component Manufacturing

336999 All Other Transportation Equipment Manufacturing



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The Centers of Excellence (COE) for Labor Market Research deliver regional workforce research and technical expertise to California community colleges for program decision making and resource development. This information has proven valuable to colleges in beginning, revising, or updating economic development and Career Technical Education (CTE) programs, strengthening grant applications, assisting in the accreditation process, and in supporting strategic planning efforts.

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More About Valley Vision

Since 1994, Valley Vision's work has driven transformative change and improved lives across Northern California. An independent social impact and civic leadership organization headquartered in Sacramento, Valley Vision strengthens our communities through unbiased research, boundary-crossing collaboration and change leadership. Our work improves overall quality of life and creates the conditions for economic prosperity and community health and vitality.

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The Burris Service Group (BSG) is a full-service consulting practice providing expertise in economic development, strategic economic research, real estate site strategy, management, and institutional growth. The company was established based on the clear need that advisory services be delivered in an "action-oriented" form. The founder of BSG, Robert Burris, brings to his clients an active local and international network of professionals, as well as 20 years of experience in economic development, market and economic analysis, commercial real estate information, corporate sales, and consulting.

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