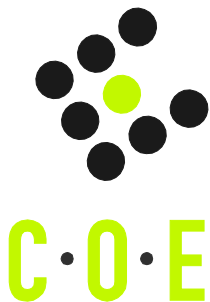


AEROSPACE MANUFACTURING AND SUPPORT INDUSTRIES IN CALIFORNIA



2010





This report was prepared by the Northern California Center of Excellence and the Center for Applied Competitive Technologies affiliate at Cerritos College.

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Economic and Workforce Development Program

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Introduction

California is home to a robust aerospace sector with a strong supplier presence, world-class higher education system, and more NASA centers than any other state. The clustering of aerospace supplier industries promotes knowledge transfer and innovation, reduces operating expenditures, and attracts new aerospace businesses to the state. The higher education system provides a pipeline of highly skilled workers as well as partners with local businesses and research institutions, like NASA, to support the technological advancement of the sector. There are also four air force bases that support research, design, and testing of commercial and military aerospace systems (Vandenberg, Edwards, Los Angeles, and Air Force Plant 42).¹ Combined, these assets have positioned California as a leader in the aerospace sector.

The purpose of this study is to assess and map the workforce and economic trends of the aerospace sector for 10 regions in California. This information will be used by the California Community College’s Centers for Applied Competitive Technologies (CACT) to determine how to best serve the industry. The CACTs offer technology education, manufacturing training, and consulting services that contribute to continuous workforce development, technology deployment and business development. More information about the CACTs can be found in Appendix B.

This study provides data comparisons for the following regions:

Region²	Counties
Bay Area	Alameda, Contra Costa, Marin, Napa, San Francisco, Solano, Sonoma
Central Valley	Alpine, Amador, Amador, Calaveras, Fresno, Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, Tuolumne
Far North	Butte, Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Plumas, Shasta, Sierra, Siskiyou, Tehama, Trinity
Greater Sacramento	El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, Yuba
Inland Empire	Inland Empire, Riverside, San Bernardino
Los Angeles	Los Angeles
Orange	Orange
San Diego & Imperial	Imperial, San Diego
Silicon Valley	Monterey, San Benito, San Mateo, Santa Clara, Santa Cruz
South Central	San Luis Obispo, Santa Barbara, Ventura

¹ California Space Authority, “California’s Ten Key Space Assets,” http://www.californiaspaceauthority.org/html/government_pages/caindex.html.

² Regions are defined based on the California Community College Economic and Workforce Development delineations.

Industry Overview

This section defines the aerospace sector, analyzes and maps the industry and employment trends, and provides job growth projections.

Industry Composition

The aerospace sector is dominated by a few large firms that produce aircrafts (passage and cargo) for the government and private organizations. These large firms subcontract with smaller suppliers to manufacture or design parts for the aircraft systems.³ The aerospace sector is composed of the following six major industry groups:

- Aircraft manufacturing – firms that manufacture or assemble complete aircraft; develop prototypes; and/or complete aircraft conversions or restorations.
- Aircraft engines & engine parts – firms that manufacture and/or develop prototypes of aircraft engine & engine parts.
- Other aircraft parts & equipment - firms that manufacture and/or develop prototypes of manufacturing aircraft parts or auxiliary equipment, excluding engines and aircraft fluid power subassemblies.
- Aircraft support - firms that provide expertise in design and production in areas such as precision tuning, control systems, and fluid power valve design. These firms may produce or design specific aircraft components, but it is not their primary business function.
- Missiles, space vehicles & parts – firms that manufacture and/or develop prototypes of guided missiles and space vehicles, vehicle propulsion units and propulsion unit parts, and auxiliary equipment.
- Search, detection & navigation instruments – firms that manufacture search, detection, navigation, guidance, aeronautical, and nautical systems and instruments.

Appendix C provides the NAICS codes and industry descriptions for each major industry group in the aerospace sector. As shown in Table 1, aircraft support is the largest industry group with about 4,060 establishments and 65,000 jobs, followed by search, detection & navigation instruments with over 340 businesses and 42,000 jobs.

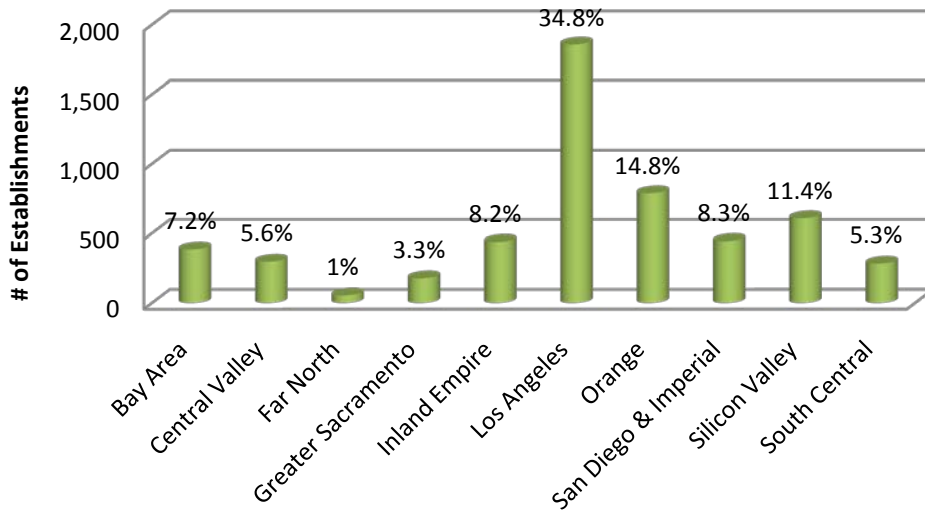
³ U.S. Bureau of Labor Statistics, Career Guide to Industries, 2010-11 Edition, Aerospace Product and Parts Manufacturing, <http://data.bls.gov/cgi-bin/print.pl/oco/cg/cgs006.htm>.

Table 1: Aerospace Establishments and Jobs by Major Industry Group in California⁴

Industry Group	2009 Jobs	2009 Jobs % of Total	2008 Establishments	2008 Est. % of Total
Aircraft Manufacturing	22,644	13%	223	4%
Aircraft Engines & Engine Parts	3,561	2%	78	1%
Other Aircraft Parts & Equipment	25,152	14%	466	9%
Aircraft Support	64,865	37%	4,069	76%
Missiles, Space Vehicles & Parts	18,006	10%	174	3%
Search, Detection & Navigation Instruments	42,717	24%	343	6%
Total	176,894	100%	5,338	100%

In 2008, there were about 5,300 aerospace firms located in California, with the majority of located in Los Angeles County (1,850 firms), followed by Orange County (790 firms), the Silicon Valley (610 firms), and San Diego & Imperial Region (450 firms).

Exhibit 1: Aerospace Establishments by Region⁴

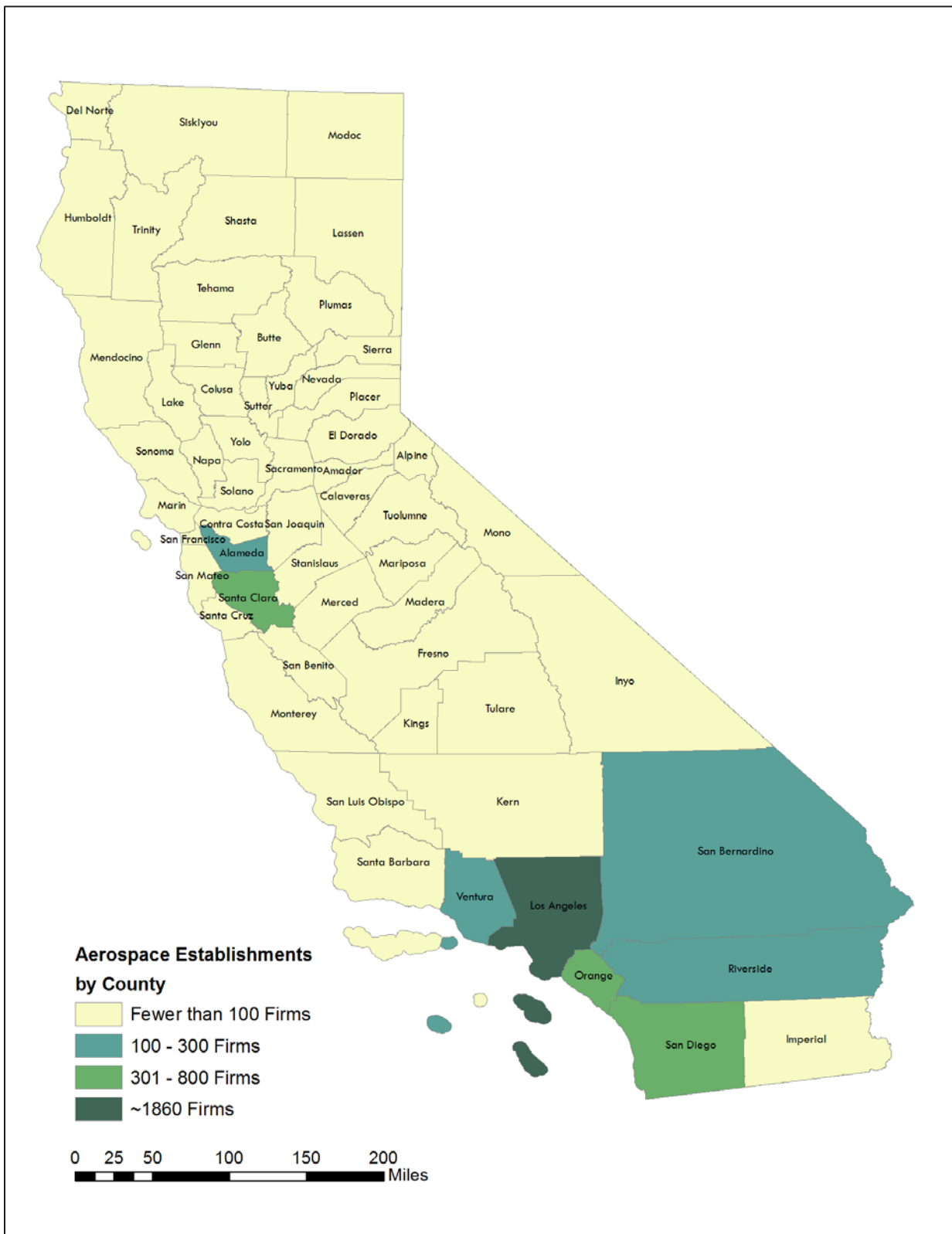


Map 1 displays the number of aerospace establishments by county. As shown, there are 50 counties that have fewer than 100 firms, 4 counties that have between 100 and 300 firms, and 4 counties with more than 300 firms. The largest aerospace centers are located in southern California and the bay area.

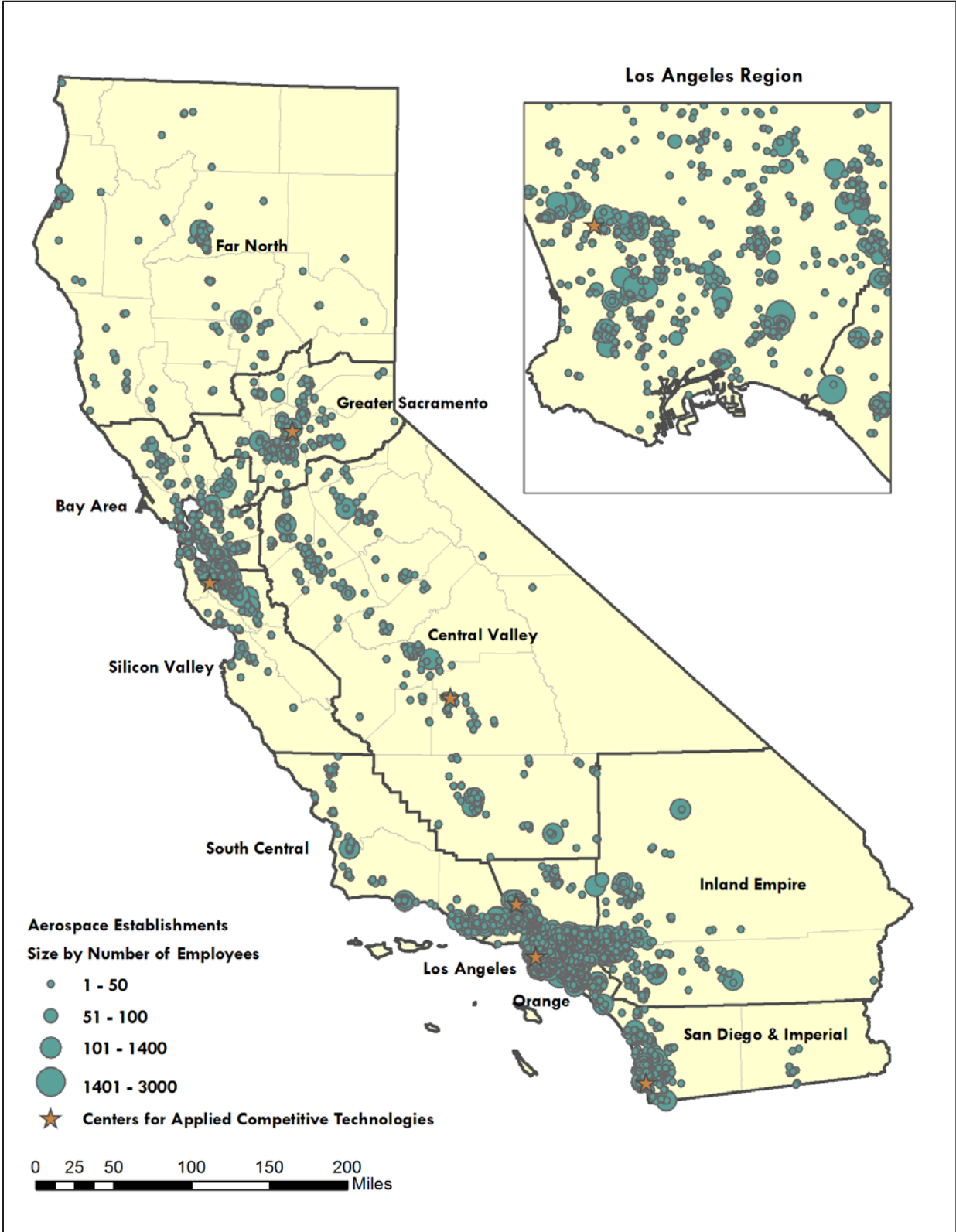
Map 2 displays the density of aerospace firms in proximity to the Centers for Applied Technologies. As shown, five of the eight CACTS are strategically located in regions that have a high concentration of aerospace employment. The Greater Sacramento and Central Valley regions have a lower concentration of firms located near their CACTS, which may make it difficult to serve this sector in those regions.

⁴ EMSI Complete Employment - 4th Quarter 2009.

Map 1: Aerospace Establishments in California by County



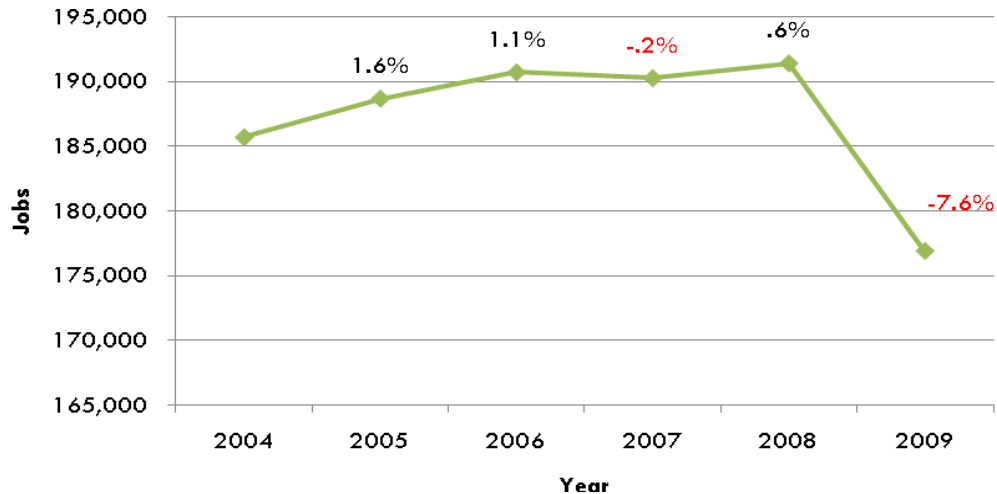
Map 2: Aerospace Establishment Density in California by Region



Employment Trends

Between 2004 and 2008, the aerospace sector added over 5,500 jobs, but then experienced a sharp decline in 2009 with the loss of nearly 14,500 jobs over the previous year. This decline indicates that the sector was significantly impacted by the economic recession, which is expected to recede by 2011. Aerospace firms are performing relatively well when compared to the overall manufacturing sector. Between 2004 and 2009, the manufacturing sector declined by 12 percent in contrast to only 5 percent in the aerospace sector.

Exhibit 3: Aerospace Employment in California, 2004 – 2009⁵



As shown in table 3, the aerospace manufacturing sector declined in four of the 10 regions in California. The largest drop occurred in Los Angeles County, followed by Orange County, the Silicon Valley and the Inland Empire. The San Diego & Imperial region gained over 3,000 jobs, indicating a unique competitive position relative to the other regions.

Table 3: Aerospace Manufacturing Sector Employment by Region, 2004 - 2009⁵

Region	2004 Jobs	2009 Jobs	04-09 Job Change	% Change	2009 Jobs % of Total
Bay Area	5,966	6,079	113	1.9%	3.4%
Central Valley	4,667	4,865	198	4.2%	2.8%
Far North	795	915	120	15.1%	0.5%
Greater Sacramento	3,470	4,043	573	16.5%	2.3%
Inland Empire	8,059	6,841	(1,218)	-15.1%	3.9%
Los Angeles	92,050	84,711	(7,339)	-8.0%	47.9%
Orange	31,845	28,999	(2,846)	-8.9%	16.4%
San Diego & Imperial	12,330	15,348	3,018	24.5%	8.7%
Silicon Valley	19,681	17,850	(1,831)	-9.3%	10.1%
South Central	6,814	7,243	429	6.3%	4.1%
California	185,677	176,894	(8,783)	-4.7%	100.0%

⁵ EMSI Complete Employment - 4th Quarter 2009.

Revenue & Wages

As shown below, the aerospace sector generated over \$27 billion in sales in 2009. The Los Angeles Region generated 42 percent of the total revenue and provided the highest average earnings per worker in that year. Orange County, Silicon Valley, and San Diego & Imperial were also high performers in terms of generating revenue.

Exhibit 4: Aerospace Revenue and Earnings Per Worker (EPW) by Region^{6&7}

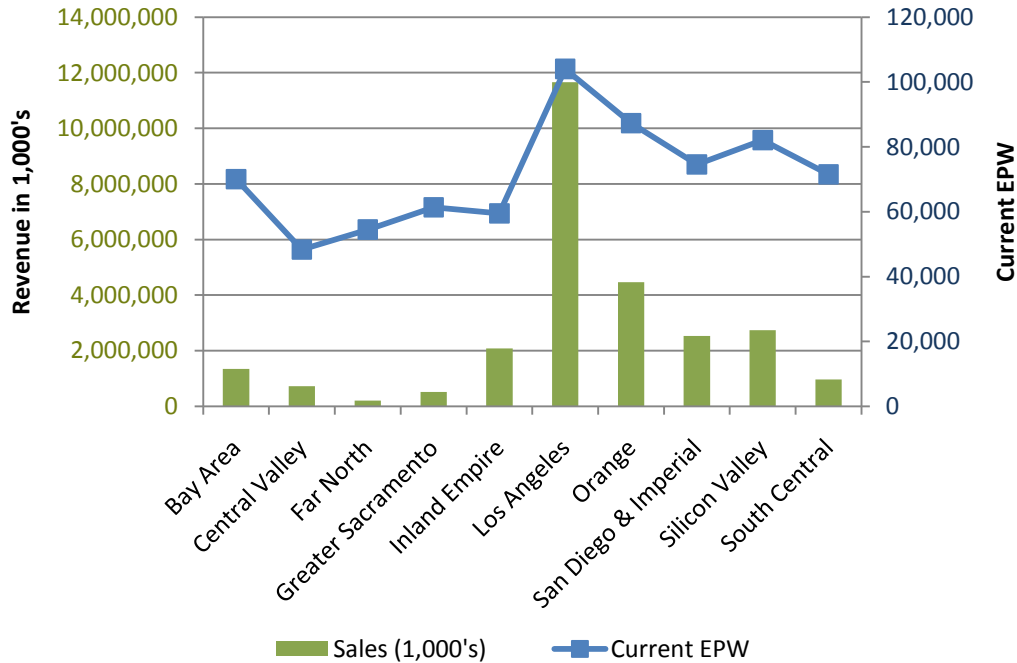


Table 4: Aerospace Revenue and Earnings Per Worker (EPW) by Region^{7&8}

Region	Revenue (thousands)	Revenue % of Total	Current EPW
Bay Area	\$1,348,982	5.0%	\$70,067
Central Valley	\$725,058	2.7%	\$48,365
Far North	\$202,062	0.7%	\$54,504
Greater Sacramento	\$519,249	1.9%	\$61,354
Inland Empire	\$2,079,545	7.6%	\$59,521
Los Angeles	\$11,654,161	42.8%	\$104,028
Orange	\$4,464,319	16.4%	\$87,311
San Diego & Imperial	\$2,535,731	9.3%	\$74,555
Silicon Valley	\$2,737,246	10.1%	\$82,096
South Central	\$960,902	3.5%	\$71,531
Total	\$27,227,255	100.0%	\$62,936

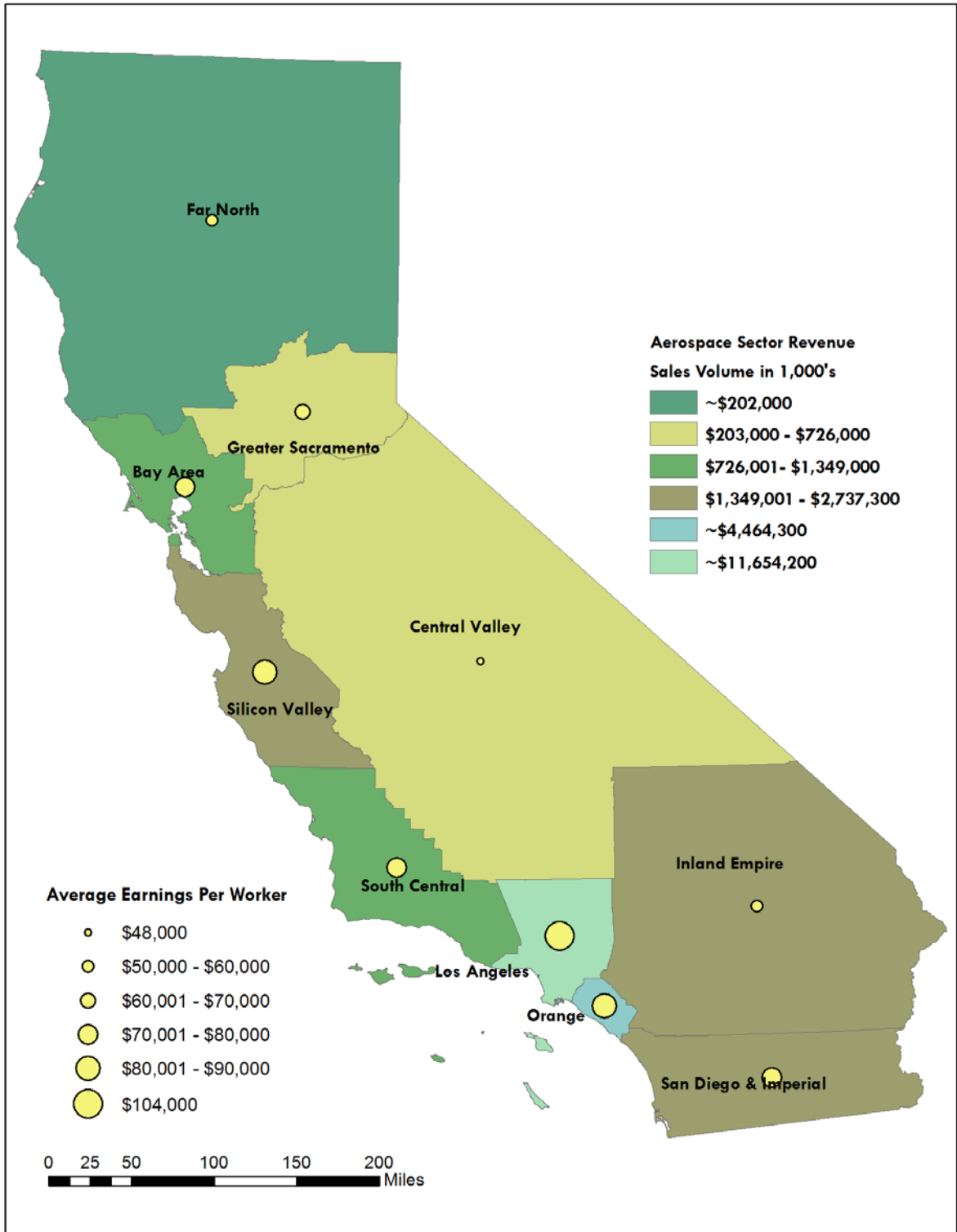
⁶ The earnings per worker includes wages, salaries, profits, benefits, and all other compensation.

⁷ EMSI Complete Employment - 4th Quarter 2009.

⁸ InfoUSA Data, January 2009.

Map 3 displays the aerospace sector's revenue by region as well as the current earnings per worker. This visual representation contrasts the disparity in revenue and average earnings among the Southern, Central and Northern California regions.

Map 3: Aerospace Revenue and Average Earnings Per Worker in California by Region



Growth Projections

In the next five years, the aerospace manufacturing sector is expected to experience slow growth, regaining less than half of the jobs lost in the previous five years. As shown in Table 5, all of the regions except Los Angeles County are expected to add jobs in the next five years. Orange County and San Diego & Imperial are expected to experience the largest gain with the addition of about 1,550 and 1,630 jobs respectively. Employment in Los Angeles County is expected to continue to decline by about 4 percent or nearly 3,300 jobs.

Exhibit 5: Aerospace Manufacturing Sector Projected Employment in California, 2009 – 2014⁹

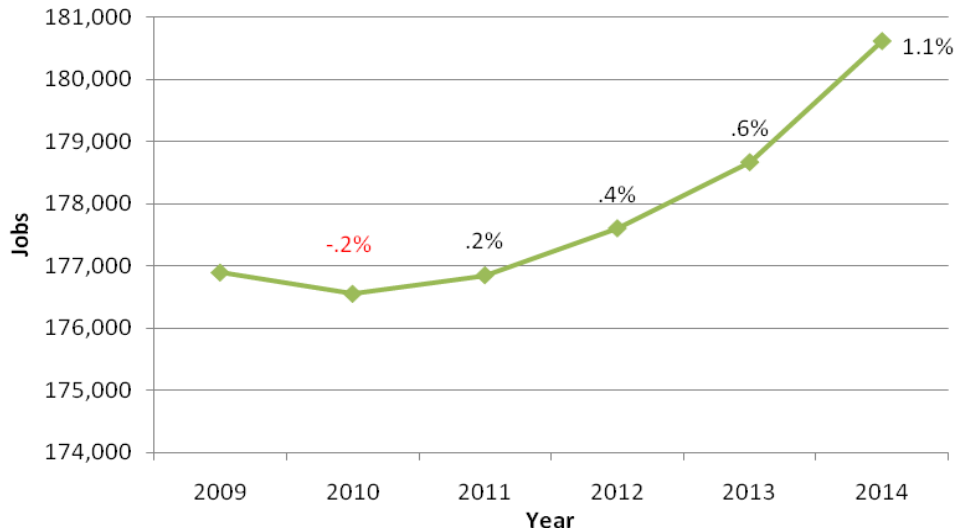


Table 5: Aerospace Manufacturing Sector Projected Employment by Region, 2009 - 2014⁹

Region	2009 Jobs	2014 Jobs	Change	% Change
Bay Area	6,079	6,493	414	7%
Central Valley	4,865	5,352	487	10.0%
Far North	915	1,019	104	11.4%
Greater Sacramento	4,043	4,979	936	23.2%
Inland Empire	6,841	7,244	403	5.9%
Los Angeles	84,711	81,422	-3,289	-3.9%
Orange	28,999	30,548	1,549	5.3%
San Diego & Imperial	15,348	16,980	1,632	10.6%
Silicon Valley	17,850	18,759	909	5.1%
South Central	7,243	7,819	576	8.0%
California	176,894	180,615	3,721	2.1%

⁹ EMSI Complete Employment - 4th Quarter 2009.

Occupational Analysis

Table 6 displays the top 10 fastest-growing aerospace occupations in California. The machinist occupation is expected to have the most job openings in the next five years, followed by aircraft mechanics/service technicians, and computer-controlled machine tool operators. The education level for six of the 10 occupations is a bachelor's degree with the remaining four occupations requiring work experience, on-the-job training or a postsecondary award (such as a vocational training certificate). Appendix D provides occupational profiles, including tasks, skills, and educational requirements.

Table 6: Top 10 Fastest Growing Aerospace Occupations in California^{10&11}

SOC Code	Description	2009 Jobs	2014 Jobs	Change	% Change	Current Hourly Earnings ¹²	Education Level
11-9041	Engineering managers	3,811	3,909	98	3%	\$62.06	Degree plus work experience
11-9199	Managers, all other	2,613	2,762	149	6%	\$23.65	Work experience in a related field
13-1199	Business operation specialists, all other	2,513	2,663	150	6%	\$30.57	Bachelor's degree
15-1031	Computer software engineers, applications	3,020	3,317	297	10%	\$43.29	Bachelor's degree
15-1032	Computer software engineers, systems software	2,724	2,839	115	4%	\$46.61	Bachelor's degree
17-2011	Aerospace engineers	8,951	9,098	147	2%	\$48.72	Bachelor's degree
17-2112	Industrial engineers	3,070	3,369	299	10%	\$39.43	Bachelor's degree
49-3011	Aircraft mechanics and service technicians	3,154	3,578	424	13%	\$27.62	Postsecondary vocational award
51-1011	First-line supervisors/managers of production and operating workers	4,508	4,592	84	2%	\$25.38	Work experience in a related field
51-4011	Computer-controlled machine tool operators, metal and plastic	3,883	4,202	319	8%	\$14.96	Moderate-term on-the-job training
51-4041	Machinists	12,842	13,422	580	5%	\$17.53	Long-term on-the-job training

Between 2009 and 2014, some occupations in the aerospace sector are expected to decline in California including electrical and electronic equipment assemblers (270 jobs); general and operations managers (65 jobs); cutting, punching, and press machine setters, operators, and tenders (45 jobs); and inspectors, testers, sorters, samplers, and weighers (37 jobs). Most of this decline is expected to occur in the Los Angeles region.

¹⁰ EMSI Complete Employment - 4th Quarter 2009.

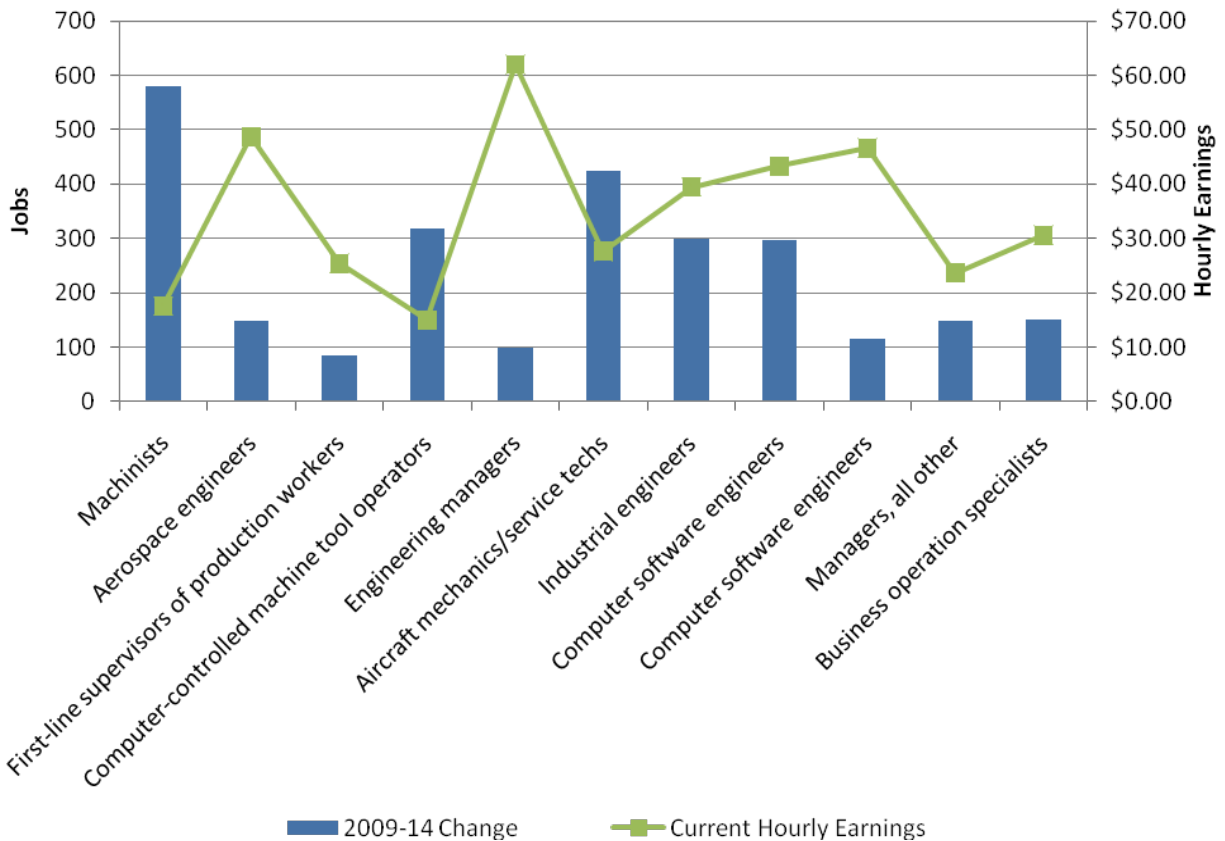
¹¹ Occupation estimates represent employment in the aerospace sector, not employment demand across all industries/sectors.

¹² Hourly earnings is the median wages of a worker, excluding benefits.

Exhibit 6 displays the projected job openings over the next five years and median hourly earnings for the top 10 aerospace occupations in California. This exhibit illustrates the following:

- Engineering manager is the highest paid position with median earnings at \$62 per hour or approximately \$128,960 per year; however the number of job openings is relatively low compared to the other occupations.
- Computer-controlled machine tool operator is the lowest paid position at \$15 per hour or about \$31,115 annually; yet it is expected to have a large number of job openings.
- Aircraft mechanics/service technician provides good wages at \$27 per hour/\$57,500 annually and has a large number of expected job openings over the next five years.

Exhibit 6: Job Openings & Median Hourly Earnings for the Top 10 Fastest Growing Aerospace Occupations in California¹³



¹³ EMSI Complete Employment - 4th Quarter 2009.

Summary

The aerospace sector was significantly impacted by the economic recession with a loss of nearly 14,500 jobs in the last year. Over the next five years, the aerospace sector is projected to grow slowly adding only about one-quarter of the jobs lost. Even with the challenges facing the aerospace sector, aerospace employers will continue to be significant economic drivers in several regions. The San Diego/Imperial, Orange County, Greater Sacramento and Silicon Valley Regions are expected to add 180+ aerospace jobs each year for the next five years. Unfortunately, the region with almost 50 percent of the current employment, Los Angeles, is expected to decline, potentially eliminating as many as 3,200 positions by 2014.

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Appendix A: About the Centers of Excellence

The Centers of Excellence (COE), in partnership with business and industry, deliver regional workforce research customized for community college and workforce system decision making and resource development. The Northern California COE is one of five regional Centers of Excellence sponsored by the Chancellor's Office of the California Community Colleges and is tasked with conducting environmental scanning, partnership development and technical assistance activities.

The COE's research team represents expertise in labor market analysis, labor-management partnership projects, project management, and primary research. COE staff are experienced researchers with a focus on research design, partnership development, educational and training program mapping, and identifying skill sets for emerging occupations as well as key skill sets and geospatial analysis.

The COE maintains strategic alliances with research organizations whose relationships and technical expertise enhance COE's research efforts. These alliances enable COE to access information from over 80 public databases using EMSI economic modeling software, GIS technology via the use of a customized geo-mapping software that ties industry codes (NAICS) to a private business database of over 1 million business records. The COE maintains robust partnerships with industry associations that assist in validating research findings, ensuring that the most recent industry and labor market conditions are captured.

COE studies are used to inform policy discussions, industry-wide legislative efforts, and regional workforce development strategies, as well as guide program and resource development efforts by the California Community Colleges. These reports can be accessed at www.coecc.net.

Appendix B: About the Centers for Applied Competitive Technologies

The Centers for Applied Competitive Technologies (CACT) specialize in providing workforce training and technical consultation to help businesses solve operational, personnel, and technical problems in the manufacturing environment. The CACTs offer technology education, manufacturing training, and consulting services that contribute to continuous workforce development, technology deployment and business development. Our services include:

- Customized workforce training in areas such as just-in-time production, distribution cycles, and six sigma deployment.
- Consulting services in areas such as organization assessment, quality system audits, process capability, and strategic planning.
- Technical services that provide an unbiased professional evaluation of your advanced technology processes.

The CACTS are funded primarily by the California Community College Economic and Workforce Development Program. These grant funds allow us to offer cost-effective workforce training and consultative services for California's advanced technology businesses. Our goal is to provide companies the technical expertise they need to compete successfully in changing markets and the global economy. The CACTS are conveniently located at community colleges across the state. To learn more, please contact your closest CACT or visit: <http://www.makingitincalifornia.com/>.

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CACT @ San Diego City College
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CACT @ Sierra College
Roseville Gateway Center
5000 Rocklin Rd.
Rocklin, CA 95677
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Appendix C: Aerospace Manufacturing Sector, Major Industry Groups

Major Industry Group 1: Aircraft

NAICS 336411 - Aircraft manufacturing

This U.S. industry comprises establishments primarily engaged in one or more of the following: (1) manufacturing or assembling complete aircraft; (2) developing and making aircraft prototypes; (3) aircraft conversion (i.e., major modifications to systems); and (4) complete aircraft overhaul and rebuilding (i.e., periodic restoration of aircraft to original design specifications).

Major Industry Group 2: Aircraft Engines & Engine Parts

NAICS 336412 - Aircraft engine and engine parts mfg.

This U.S. industry comprises establishments primarily engaged in one or more of the following: (1) manufacturing aircraft engines and engine parts; (2) developing and making prototypes of aircraft engines and engine parts; (3) aircraft propulsion system conversion (i.e., major modifications to systems); and (4) aircraft propulsion systems overhaul and rebuilding (i.e., periodic restoration of aircraft propulsion system to original design specifications).

Major Industry Group 3: Other Aircraft Parts & Equipment

NAICS 336413 - Other aircraft parts and equipment

This U.S. industry comprises establishment primarily engaged in (1) manufacturing aircraft parts or auxiliary equipment (except engines and aircraft fluid power subassemblies) and/or (2) developing and making prototypes of aircraft parts and auxiliary equipment. Auxiliary equipment includes such items as crop dusting apparatus, armament racks, in-flight refueling equipment, and external fuel tanks.

Major Industry Group 4: Aircraft Support

NAICS 332510 – Hardware manufacturing

This industry comprises establishments primarily engaged in manufacturing metal hardware, such as metal hinges, metal handles, keys, and locks (except coin-operated, time locks).

NAICS 332710 - Machine shops

This industry comprises establishments known as machine shops primarily engaged in machining metal and plastic parts and parts of other composite materials on a job or order basis. Generally machine shop jobs are low volume using machine tools, such as lathes (including computer numerically controlled); automatic screw machines; and machines for boring, grinding, and milling.

NAICS 332721 - Precision turned product manufacturing

This U.S. industry comprises establishments known as precision turned manufacturers primarily engaged in machining precision products of all materials on a job or order basis. Generally precision turned product jobs are large volume using machines, such as automatic screw machines, rotary transfer machines, computer numerically controlled (CNC) lathes, or turning centers.

NAICS 332722 - Bolt, nut, screw, rivet, and washer manufacturing

This U.S. industry comprises establishments primarily engaged in manufacturing metal bolts, nuts, screws, rivets, and washers, and other industrial fasteners using machines, such as headers, threaders, and nut forming machines.

NAICS 332912 - Fluid power valve and hose fitting manufacturing

This U.S. industry comprises establishments primarily engaged in manufacturing fluid power valves and hose fittings.

NAICS 332995 - Other ordnance and accessories manufacturing

This U.S. industry comprises establishments primarily engaged in manufacturing ordnance (except small arms) and accessories.

NAICS 333924 - Industrial truck, trailer, and stacker manufacturing¹⁴

This U.S. industry comprises establishments primarily engaged in manufacturing industrial trucks, tractors, trailers, and stackers (i.e., truck-type) such as forklifts, pallet loaders and unloaders, and portable loading docks.

NAICS 334519 - Other measuring and controlling device manufacturing

This U.S. industry comprises establishments primarily engaged in manufacturing measuring and controlling devices (except search, detection, navigation, guidance, aeronautical, and nautical instruments and systems; automatic environmental controls for residential, commercial, and appliance use; instruments for measurement, display, and control of industrial process variables; totalizing fluid meters and counting devices; instruments for measuring and testing electricity and electrical signals; analytical laboratory instruments; watches, clocks, and parts; irradiation equipment; and electromedical and electrotherapeutic apparatus).

NAICS 336321 - Vehicular lighting equipment manufacturing

This U.S. industry comprises establishments primarily engaged in manufacturing vehicular lighting fixtures.

NAICS 336360 - Motor vehicle seating and interior trim manufacturing

This industry comprises establishments primarily engaged in manufacturing motor vehicle seating, seats, seat frames, seat belts, and interior trimmings.

NAICS 339993 - Fastener, button, needle, and pin manufacturing

This U.S. industry comprises establishments primarily engaged in manufacturing fasteners, buttons, needles, pins, and buckles (except precious metals or precious and semiprecious stones and gems).

NAICS 488190 - Other support activities for air transport

This industry comprises establishments primarily engaged in providing specialized services for air transportation (except air traffic control and other airport operations).

Major Industry Group 5: Missiles, Space Vehicles & Parts

NAICS 336414 - Guided missile and space vehicle manufacturing

This U.S. industry comprises establishments primarily engaged in (1) manufacturing complete guided missiles and space vehicles and/or (2) developing and making prototypes of guided missiles or space vehicles.

NAICS 336415 - Space vehicle propulsion units and parts manufacturing

This U.S. industry comprises establishments primarily engaged in (1) manufacturing guided missile and/or space vehicle propulsion units and propulsion unit parts and/or (2) developing and making prototypes of guided missile and space vehicle propulsion units and propulsion unit parts.

NAICS 336419 - Other guided missile and space vehicle parts

This U.S. industry comprises establishments primarily engaged in (1) manufacturing guided missile and space vehicle parts and auxiliary equipment (except guided missile and space vehicle propulsion units and propulsion unit parts) and/or (2) developing and making prototypes of guided missile and space vehicle parts and auxiliary equipment.

¹⁴ This industry also manufactures aircraft engine cradles and aircraft loading hoists.

Major Industry Group 6: Search, Detection & Navigation Instruments

NAICS 334511 - Search, detection, and navigation instruments

This U.S. industry comprises establishments primarily engaged in manufacturing search, detection, navigation, guidance, aeronautical, and nautical systems and instruments. Examples of products made by these establishments are aircraft instruments (except engine), flight recorders, navigational instruments and systems, radar systems and equipment, and sonar systems and equipment.

Source: U.S. Census Bureau, North American Industry Classification System (NAICS),
<http://www.census.gov/eos/www/naics/index.html>.

Appendix D: Occupation Profiles

The following eight occupations are projected to increase employment by 2014. Each occupation profile includes a description of the main tasks performed, top skills and education requirements.

Aerospace engineers – SOC 17-2011

Aerospace engineers perform a variety of engineering work in designing, constructing and testing aircraft, missiles and spacecraft. They may conduct basic and applied research to evaluate adaptability of materials and equipment to aircraft design and manufacture. In addition, they may recommend improvements in testing equipment and techniques. The top skills of machinists include:

- Ability to consider the relative costs and benefits of potential actions and choose the most appropriate one.
- Ability to monitor and assess performance of yourself, other individuals or organizations to make improvements or take corrective action.
- Ability to motivate, develop and direct people as they work and identify the best people for the job.
- Ability to identify measures or indicators of system performance and the actions needed to improve or correct performance relative to the goals of the system.

A bachelor's degree in engineering is required for almost all entry-level engineering jobs. Some college graduates with a degree in a natural science or mathematics occasionally may qualify for engineering jobs, especially in specialties that are in high demand.

Aircraft mechanics and service technicians – SOC 49-3011

Aircraft mechanics and service technicians diagnose, adjust, repair or overhaul aircraft engines and assemblies, such as hydraulic and pneumatic systems. The top skills of machinists include:

- Ability to repair machines or systems using the needed tools.
- Ability to determine causes of operating errors and deciding what to do about it.
- Ability to perform routine maintenance on equipment and determine when and what kind of maintenance is needed.
- Ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.

Most aircraft mechanics and service technicians learn the skills needed to do their jobs in one of about 170 Aviation Maintenance Technician schools certified by the FAA. By law, FAA standards require that certified mechanic schools offer students a minimum of 1,900 class-hours. The FAA requires that all maintenance work on aircraft be performed by certified mechanics or under the supervision of a certified mechanic. As a result, most airlines hire mechanics that have FAA certification.

Computer-controlled machine tool operators, metal and plastic – SOC 51-4011

Computer-controlled machine tool operators operate computer-controlled machines or robots to perform one or more machine functions on metal or plastic work pieces. Some of the skills required are the following:

- Ability to watch gauges, dials, or other indicators to make sure a machine is working properly.
- Ability to control operations of equipment or systems.
- Ability to conduct tests and inspections of products, services, or processes to evaluate quality or performance.
- Ability to detect or tell the differences between sounds that vary in pitch and loudness.

Computer-controlled machine tool operators can receive their training in various ways—in apprenticeship programs, informally on the job, and in secondary, vocational, or postsecondary schools. Some receive their formal education and training from community or technical colleges

Computer software engineers, applications - SOC 15-1031

Computer software engineers (applications) develop, create and modify general computer applications software or specialized utility programs. In addition, they analyze user needs and develop software solutions and design software or customize software for client use with the aim of optimizing operational efficiency. The top skills of computer software engineers include:

- Ability to write computer programs for various purposes.
- Ability to determine causes of operating errors and deciding what to do about it.
- Ability to generate or adapt equipment and technology to serve user needs.
- Ability to determine how a system should work and how changes in conditions, operations, and the environment will affect outcomes.

A bachelor's degree is commonly required for software engineering jobs, although a master's degree is preferred for some positions. Employers favor applicants who already have relevant skills and experience in computer software engineering.

Computer software engineers, systems software – SOC 15-1032

Computer software engineers (systems software) research, design, develop and test operating systems-level software, compilers, and network distribution software for medical, industrial, military, communications, aerospace, business and scientific general computing applications. They also set operational specifications and formulate and analyze software requirements. The top skills of computer software engineers include:

- Ability to generate or adapt equipment and technology to serve user needs.
- Ability to determine causes of operating errors and deciding what to do about it.
- Ability to writing computer programs for various purposes.
- Ability to determine how a system should work and how changes in conditions, operations and the environment will affect outcomes.

A bachelor's degree is commonly required for software engineering jobs, although a master's degree is preferred for some positions. Employers favor applicants who already have relevant skills and experience in computer software engineering.

Engineering managers – SOC 11-9041

Engineering managers plan, direct or coordinate activities in such fields as architecture and engineering or research and development. The top skills of engineering managers include:

- Ability to identify complex problems and review related information to develop and evaluate options and implement solutions.
- Ability to motivate, develop and direct people as they work, identifying the best people for the job.
- Ability to monitoring or assess performance of yourself, other individuals, or organizations to make improvements or take corrective action.
- Ability to listen to and understand information and ideas presented through spoken words and sentences.

Nearly all engineering managers have at least a bachelor's degree in some specialty of engineering. Many also gain business management skills by completing a master's degree in engineering management (MEM) or business administration (MBA), either before or after advancing to management positions.

First-line supervisors/managers of production and operating workers – SOC 51-1011

First-line supervisors/managers supervise and coordinate the activities of production and operating workers, such as inspectors, precision workers, machine setters and operators, assemblers, fabricators and plant and system operators. The top skills of first-line supervisors include:

- Ability to motivate, develop and direct people as they work, identifying the best people for the job.
- Ability to teach others how to do something.
- Ability to monitor or assess performance of yourself, other individuals, or organizations to make improvements or take corrective action.
- Ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.

First-line supervisors/managers of production typically have at least two years of related on-the-job experience plus training from a recognized apprenticeship program or community college.

Industrial engineers – SOC 17-2112

Industrial engineers design, develop, test and evaluate integrated systems for managing industrial production processes including human work factors, quality control, inventory control, logistics and material flow, cost analysis, and production coordination. The top skills of industrial engineers include:

- Ability to use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
- Ability to identify complex problems and review related information to develop and evaluate options and implement solutions.
- Ability to consider the relative costs and benefits of potential actions to choose the most appropriate one.
- Ability to choose the right mathematical methods or formulas to solve a problem.

A bachelor's degree in engineering is required for almost all entry-level engineering jobs. College graduates with a degree in a natural science or mathematics occasionally may qualify for some engineering jobs, especially in specialties that are in high demand. Continuing education to keep current with rapidly changing technology is important for engineers.

Machinists – SOC 51-4041

Machinists set up and operate a variety of machine tools to produce precision parts and instruments. They may also fabricate and modify parts to make or repair machine tools or maintain industrial machines, applying knowledge of mechanics, shop mathematics, metal properties, layout and machining procedures. The top skills of machinists include:

- Ability to monitor gauges, dials, or other indicators to make sure a machine is working properly.
- Ability to conducting tests and inspections of products, services, or processes to evaluate quality or performance.
- Ability to control ongoing operations of equipment or systems.
- Ability to performing routine maintenance on equipment and determining when and what kind of maintenance is needed.

The minimum education requirement is a high school degree. Employers prefer training from a community college or apprenticeship program.

Source: O*Net; U.S. Bureau of Labor Statistics

Note: Profiles for Managers, all other – SOC 11-9199 and Business operation specialists, all other – SOC 13-1199 were not included because they represent a group of more specific occupations, rather than a single occupation.

Appendix E: Locating Aerospace Related Degree & Certificate Programs

The California Community Colleges offer a range of instructional programs that support aerospace manufacturing. To locate the programs use the Taxonomy of Programs (TOP) list below with the searchable data base found on the California Community College Chancellor's Office website. The URL is: https://misweb.cccco.edu/webproginv/prod/topodelist_n.cfm. Using these codes you can find which colleges have programs. For example if one puts in TOP code 0956.80, these colleges will be identified: Cerritos, El Camino, Sacramento City, and Santiago Canyon.

While not every program found will be oriented to aerospace manufacturing, the following TOP codes are those most closely associated with it:

- 0924.00 Engineering Technology
- 0934.30 Instrumentation
- 0934.80 Laser and Optical
- 0935.20 Industrial Electronics
- 0945.00 Industrial Systems Technology and Maintenance
- 0945.40 Avionics
- 0950.50 Aircraft Fabrication
- 0953.00 Drafting Technology
- 0953.30 Electronic Drafting
- 0953.40 Mechanical Drafting
- 0953.60 Technical Illustration
- 0954.20 Plastics/Composites
- 0956.00 Manufacturing and Industrial Technology
- 0956.30 Machine Tool Technology
- 0956.50 Welding
- 0956.80 Industrial Quality Control