

## Industry Overview

Colorado is an aerospace industry leader, ranking first in the nation in 2014 for private aerospace employment as a percentage of total employment, and third in total private-sector employment. Colorado supports a thriving aerospace ecosystem that includes a broad spectrum of companies, products, and systems for commercial, military, and civil space applications. Colorado's aerospace companies research, develop, design, and manufacture guided missiles, spacecraft, satellites and other communications equipment, and navigation and detection instruments. Companies in the aerospace cluster also produce planetary spacecraft and launch systems and provide mission support.



The breadth and depth of the aerospace cluster is rooted in support from four military commands, eight major space contractors, National Aeronautics and Space Administration (NASA) research activities, and several universities involved in extensive space research. The state's wealth of talent, research assets, and synergy between industry, commercialization, research, and workforce development supports its position as a space industry leader. Colorado has 160 businesses classified as aerospace companies, and more than 400 companies and suppliers providing space-related products and services. Direct employment in the aerospace cluster totals 25,110 private sector workers and approximately 27,890 military personnel. These nearly 53,000 workers in the aerospace cluster support an additional 109,680 workers in all industries throughout Colorado, bringing direct and indirect employment supported by the aerospace cluster to 162,680 workers.

The majority of Colorado's key aerospace businesses, facilities, and research institutions are located in the nine-county Metro Denver and Northern Colorado region.<sup>1</sup> The region's 19,560 private sector aerospace workers represent about 78 percent of all aerospace workers in Colorado. The region's 120 aerospace companies represent about 74 percent of the state's total companies in the cluster.

## Private Aerospace Economic Profile

The aerospace cluster consists of 19, six-digit North American Industry Classification System (NAICS) codes including search, detection, and navigation instrument manufacturing; guided missile and space vehicle manufacturing; satellite telecommunications; and research and development.

***The nine-county region ranked first in the nation for its 2014 concentration of private aerospace employment.*** The region's aerospace cluster ranked first out of the 50 largest metro areas in total private-sector employment.

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<sup>1</sup> The nine-county Metro Denver and Northern Colorado region consists of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, Larimer, and Weld Counties.

## Aerospace Employment and Company Profile, 2014

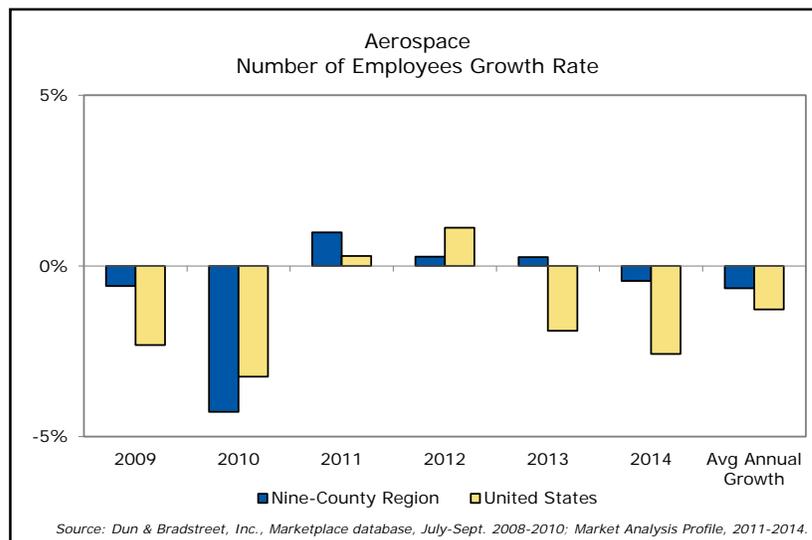
	Nine-County Region	United States
Direct employment, 2014	19,560	346,750
Number of direct companies, 2014	120	4,930
One-year direct employment growth, 2013-2014	-0.4%	-2.6%
Five-year direct employment growth, 2009-2014	-3.2%	-6.2%
Avg. annual direct employment growth, 2009-2014	-0.7%	-1.3%
Direct employment concentration	1.1%	0.2%

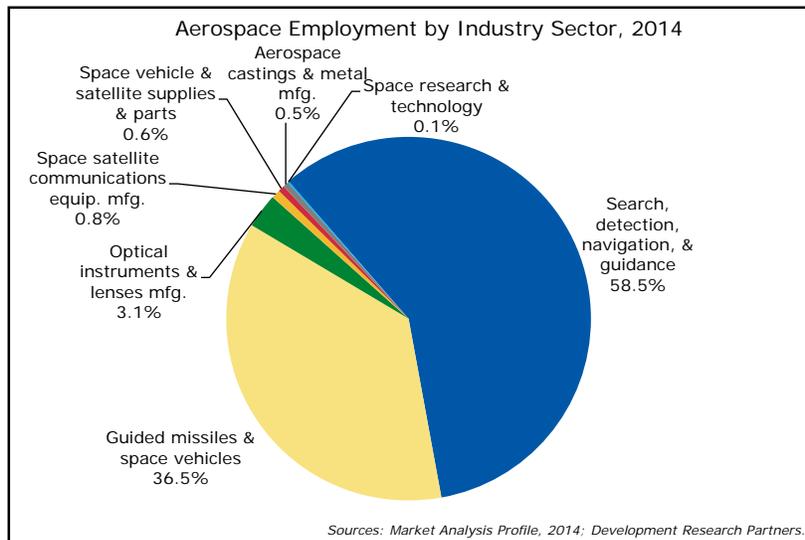
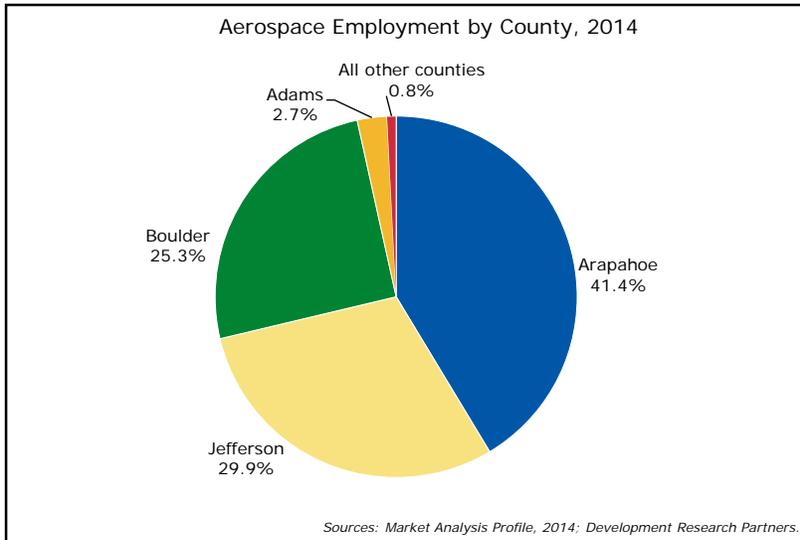
Sources: Dun & Bradstreet, Inc. Marketplace database, July-Sept. 2008-2010; Market Analysis Profile, 2011-2014; Development Research Partners.

### Aerospace Employment

The nine-county region's aerospace cluster directly employed about 19,560 workers in 2014. Employment in the region's aerospace cluster declined 0.4 percent between 2013 and 2014, compared with a 2.6 percent decrease at the national level as a result of ongoing agency consolidations and the lingering effects of government spending decreases. From 2009 to 2014, employment in the region's aerospace cluster declined 3.2 percent, compared with a 6.2 percent decline nationwide. Nearly 6 percent of the nation's aerospace employment is located in the region. Additionally, aerospace companies employed 1.1 percent of the region's total employment base, compared with a 0.2 percent employment concentration nationwide.

About 120 aerospace companies operated in the nine-county region in 2014. Approximately 54 percent of the region's aerospace companies employed fewer than 10 people, while 12 percent employed 250 or more.





## Major Aerospace Contractors

Eight of the country's major space contractors have a significant presence in the nine-county region. These companies support the U.S. Department of Defense (DoD) to procure, place, and manage national space assets for the military. They also provide manned and unmanned spacecraft, instrumentation, and ground control services for the National Aeronautics and Space Administration (NASA) and other agencies.

- **Ball Aerospace & Technologies Corp.** employs nearly 2,100 in Colorado, and supports critical missions for national agencies such as the DoD, NASA, the National Oceanic and Atmospheric Administration, and other U.S. government and commercial entities. The company develops and manufactures spacecraft, advanced instruments and sensors, components, data exploitation systems, and RF solutions for strategic, tactical, and scientific applications. [www.ballaerospace.com](http://www.ballaerospace.com)
- **The Boeing Company** has nearly 2,300 employees at several locations throughout Colorado with the largest concentrations in Arapahoe County and Colorado Springs. Core businesses include: Jeppesen, a key commercial aviation subsidiary; strategic missile defense systems, including Ground-based Midcourse Defense; space and intelligence and Global Positioning System support; and Boeing military aircraft at Fort Carson. Boeing spent \$205 million with 255 Colorado suppliers in 2013. [www.boeing.com](http://www.boeing.com)
- **Exelis** has offices in Aurora, Boulder, and Colorado Springs, altogether employing about 900 people. The **Information Systems** division provides a broad set of services including radiological, nuclear, and missile defense engineering services, space, ground and range services, as well as development and operations support to the Intelligence Community. The **Geospatial Systems** division is represented on the GPS Operational Control System program. **Exelis Visual Information Solutions (VIS)** provides software solutions and services for data and image analysis, visualization, image delivery, and rapid development for commercial, research, and government markets. [www.exelisinc.com](http://www.exelisinc.com)
- **Lockheed Martin** employs nearly 8,600 people in Colorado. Of these workers, nearly 5,100 are employed at the **Space Systems Company** unit headquartered in Jefferson County. Space Systems designs, develops, tests, and manufactures advanced technology systems for its government and commercial customers. The company also develops products ranging from human space flight systems and navigation, meteorological, and communications systems to laser radar and missile defense systems. [www.lockheedmartin.com](http://www.lockheedmartin.com)
- **Northrop Grumman** provides a diverse portfolio of products and services related to systems integration, missile systems and national security technologies, defense electronics, marine and space systems, and battle management. The company also works with advanced aircraft, unmanned aircraft vehicles, naval vessels, and space technology. Northrop Grumman employs more than 2,100 people throughout Colorado. [www.northropgrumman.com](http://www.northropgrumman.com)
- **Raytheon Company** employs about 2,500 people throughout the state, with the majority of employees located in Aurora. Raytheon Company manages spacecraft missions and analyzes post-launch data through a variety of technologies including radio frequency, GPS, communications and intelligence, and electro-optical/infrared. [www.raytheon.com](http://www.raytheon.com)
- **Sierra Nevada Corporation (SNC)** has a significant presence in Colorado, employing more than 900 people in the state. SNC's **Space Systems Group**, located in Louisville, develops small spacecraft mechanical subsystems, satellite components, and space propulsion systems for government and commercial customers. The company's **Intelligence, Surveillance and Reconnaissance Group** in Centennial provides products and services for a variety of airborne systems. [www.sncorp.com](http://www.sncorp.com)
- **United Launch Alliance (ULA)**, a joint venture between Lockheed Martin's Atlas and Boeing's Delta launch divisions, celebrated its eighth year of operation in 2014. ULA employs about 1,700 of its 3,700-person U.S. workforce at its Centennial headquarters. Most of ULA's management, engineering, and mission support functions are concentrated in Colorado, while most assembly and integration operations are concentrated in Alabama, Texas, and California. The company's Human Launch Services division supports NASA and its partners in developing capabilities to deliver U.S. astronauts to low Earth orbit and human exploration beyond Earth orbit. Since company formation in 2006, ULA has celebrated more than 75 consecutive, successful Delta II, Delta IV, and Atlas V rocket launches. [www.ulalaunch.com](http://www.ulalaunch.com)

## Additional Major Private Aerospace Companies

- ABSL Space Products  
[www.abslspaceproducts.com](http://www.abslspaceproducts.com)
- DigitalGlobe, Inc.  
[www.digitalglobe.com](http://www.digitalglobe.com)
- IHS Aerospace & Defense  
<http://aero-defense.ihs.com>
- Intrex Aerospace  
[www.intrexcorp.com](http://www.intrexcorp.com)
- Merrick & Company  
[www.merrick.com](http://www.merrick.com)
- Research Electro-Optics, Inc.  
[www.reoinc.com](http://www.reoinc.com)
- Rocky Mountain Instrument Company  
[www.rmico.com](http://www.rmico.com)
- Science Applications International Corp.  
[www.saic.com](http://www.saic.com)
- SEAKR Engineering, Inc.  
[www.seakr.com](http://www.seakr.com)
- Surrey Satellite Technology US LLC  
[www.sst-us.com](http://www.sst-us.com)
- Trimble Rockies  
[www.trimble.com](http://www.trimble.com)
- UP Aerospace Inc.  
[www.upaerospace.com](http://www.upaerospace.com)

## Military Aerospace Profile

Colorado is home to a diverse mix of U.S. Department of Defense (DoD) military installations that foster important synergies between private aerospace companies and government entities.

- **Buckley Air Force Base** in Aurora is home to the 460th Space Wing and supports more than 83 tenant organizations that represent all branches of the military. Tenants are located both on and off the base. The base also hosts the Colorado Air National Guard 120th Fighter Squadron and its F-16C fighters.
- **Air Force Bases** in Colorado Springs include Peterson Air Force Base, Cheyenne Mountain Air Force Station, and Schriever Air Force Base.
  - **Peterson Air Force Base** is the home of the 21st Space Wing as well as the North American Aerospace Defense Command (NORAD), the U.S. Northern Command (USNORTHCOM), Air Force Space Command (AFSPC), U.S. Army Space and Missile Defense Command/U.S. Army Forces Strategic Command (SMDC/ARSTRAT), and the 302nd Airlift Wing (AFRC), as well as a number of other smaller tenant units. The 21st Space Wing is responsible for worldwide missile warning, space control, and missile defense.
  - **Cheyenne Mountain Air Force Station** is owned and operated by Air Force Space Command. It hosts the NORAD and USNORTHCOM Alternate Command Center and other national security activities.
  - **Schriever Air Force Base** is the home of the 50th Space Wing (SW) as well as the Space Innovation and Development Center (SIDC), the 310th Space Wing (AFRC), the Missile Defense Integration and Operations Center (MDIOC), the Joint Functional Component Command for Integrated Missile Defense (JFCC-IMD), and numerous tenant organizations. The 50th SW is responsible for the operation and support of more than 150 DoD satellites and installation support to 16 major tenant units with a workforce of more than 8,100 personnel. The 50th SW provides space combat capability through command, control, operations, and support of communication, navigation, warning, surveillance, and weather satellite weapons systems.
- The **United States Air Force Academy** in Colorado Springs was established in 1954 as an accredited college to educate officers in the U.S. Air Force. The 10th Air Base Wing is the host wing for the Air Force Academy and provides base-level support activities including medical, engineering, base logistics, fire response services, communications, security, and other key support for more than 25,000 military and civilian personnel. The Academy has 20 research centers and institutes with more than 400 professional researchers and faculty dedicated to space, science, air, atmospheric research, modeling and simulation, and Science, Technology, Engineering, and Mathematics (STEM), exceeding \$60 million in economic impact annually.

<i>Government Installation</i>	<i>Personnel</i>
Buckley Air Force Base	8,930
Peterson Complex*	8,640
U.S. Air Force Academy	7,320
Schriever Air Force Base	3,000
<b>Total Employment</b>	<b>27,890</b>

\*Peterson Complex total includes personnel at Peterson Air Force Base and Cheyenne Mountain Air Force Station (including NORAD, USNORTHCOM, AFSPC, and SMDC/ARSTRAT).

## 2014 INDUSTRY MILESTONES

### Key Company Announcements

The nine-county region's vibrant aerospace hub is an ideal location for companies to establish and expand. In 2014, Lockheed Martin Space Systems opened a new headquarters for its commercial satellite business. The company relocated its communications and remote sensing satellite building operation from Newtown, Pa. The move includes the addition of 350 jobs at the Jefferson County location by mid-2015 and 500 jobs over the next six years. The company will fill positions in engineering and software, supply-chain management, and manufacturing.

### Research and Education Announcements

The nine-county region's leading research institutions and educational facilities make significant contributions to the state's dynamic aerospace economy.

- The University of Colorado Boulder (CU-Boulder) and the Jet Propulsion Laboratory (JPL) extended their partnership in space and Earth-science research. CU-Boulder, which began its collaboration with JPL in the 1960s, has been involved in roughly 40 sponsored research projects with JPL totaling nearly \$15 million between 2011 and 2013. Research projects include solar system exploration, star and galaxy formation, advanced telescope optics, and science outreach and climate change.
- NASA and Virgin Galactic selected a CU-Boulder payload to fly on a suborbital space plane. The payload—The Saturated Fluid Pistonless Pump Technology Demonstrator—was developed in partnership with Calif.-based Flometrics to reduce the weight, complexity, and cost of spacecraft fuel systems.
- NASA selected the Colorado Space Grant Consortium (CSGC) as a recipient of the 2014 National Space Grant and Fellowship Program to increase student and faculty engagement in science, technology, engineering, and mathematics (STEM) at community colleges and technical schools. CSGC could receive up to \$500,000 to add four new community college campuses as affiliates to the consortium, and students and faculty will participate in STEM activities by signing, building, and launching high-altitude balloon payloads.
- The Colorado Space Business Roundtable completed its first Colorado Aerospace Internship Experience—a two-week immersive program designed to bring together high school and college students from Colorado's rural areas to experience a "day in the life" of an employee at host organizations including ULA, Boeing, and Lockheed Martin. This STEM program allows students to gain valuable real-world experience as they attend meetings, perform on-the-job tasks, shadow current employees and network, all of which is fostered in a mentor capacity.

### Major Collaborations

The nine-county region is a leader in major commercial, civil, and military space missions and projects. Examples of these collaborative projects and their progress are highlighted below.

#### Dream Chaser®

Louisville-based Sierra Nevada Corporation's Space Systems Group continued to work rigorously on the [Dream Chaser®](#) spacecraft through significant collaboration with other Colorado-based aerospace companies. The [Dream Chaser®](#) is a winged, lifting-body spacecraft designed for International Space Station (ISS) crew

transportation and other human space flight operations, including international and commercial space applications. Program developments in 2014 included:

- Selection of Jefferson County-based Lockheed Martin Space Systems Company to build the composite structure of the spacecraft and to assist with certifying the vehicle for human spaceflight. Sierra Nevada and Lockheed Martin unveiled the orbital spacecraft composite airframe, which will be used to conduct the first orbital test flight in November 2016, atop a United Launch Alliance (ULA) Atlas V rocket.
- Signing three cooperative agreements—with the Japanese Aerospace Exploration Agency (JAXA), CU-Boulder's BioServe Space Technologies, and Tuskegee University—to collaborate on missions, technologies, and educational opportunities for the [Dream Chaser®](#) spacecraft. The collaboration successfully completed a series of wind tunnel tests on scale models of the spacecraft, conducted to study the spacecraft's reaction to subsonic, transonic, and supersonic conditions that will be encountered during ascent into space and re-entry from low Earth orbit.
- Unveiling plans to develop a smaller [Dream Chaser®](#) space plane to launch from a Stratolaunch plane, which could take a crew of three astronauts to low Earth orbit destinations or fly automated missions without a crew. The smaller plane could begin flight tests in 2016, with the first space mission scheduled to launch in 2018.

### GMI and GPS III

Ball Aerospace & Technologies Corp. launched its Global Precipitation Measurement-Microwave Imager (GMI) in February 2014. As a joint effort between NASA and JAXA to improve climate, weather, and rainfall predictions, the mission will play an essential role in the Earth's weather and environmental forecasting.

Lockheed Martin Space Systems Company is developing the U.S. Air Force's (USAF) next generation of Global Positioning System (GPS III) satellites, which will deliver three times better accuracy, provide up to eight times improved anti-jamming capabilities, and extend spacecraft life by 25 percent. The first satellite is scheduled for completion in 2015.

### InSight

InSight (Interior Exploration using Seismic Investigations, Geodesy and Heat Transport), a NASA Discovery-class mission to understand the processes that shaped rocky planets such as Mars and Earth, is scheduled to launch in 2016.

- Lockheed Martin Space Systems is constructing the Mars lander spacecraft for NASA's InSight mission. In addition to conducting the assembly, test, and launch operations phase for the InSight lander, Lockheed Martin is also assembling and testing the spacecraft's protective aeroshell capsule and cruise stage (which provides communications and power during the journey to Mars). Once the spacecraft has been fully assembled, it will undergo rigorous environmental testing in the summer of 2015.

### Joint Polar Satellite System

- NASA awarded Raytheon Company a \$185 million modification to its existing Joint Polar Satellite System (JPSS) Common Ground System contract, which increased the contract's total value to \$1.7 billion. The modification will allow the company to add operational capabilities to the storm- and weather-tracking satellites, the first of which is scheduled to launch in 2017.
- Ball Aerospace received the Clouds and Earth Radiant Energy Systems (CERES) instrument for JPSS-1. JPSS-1—scheduled to launch in early 2017—will assist in recognizing and monitoring environmental conditions and also provide vital near-term weather data to meteorologists. Integration of CERES into the JPSS-1 satellite began in late 2014.

### MAVEN

Mars Atmospheric and Volatile Evolution (MAVEN) is a prime example of Colorado's leadership in space exploration with the entire mission and spacecraft being built and launched by Colorado organizations including Lockheed Martin Space Systems, CU-Boulder's Laboratory for Atmospheric and Space Physics, Exelis, and ULA.

- In September, MAVEN successfully arrived in Mars' orbit. The \$485 million mission will gather data about the Martian upper atmosphere and the planet's potential for supporting life.
- Early results released by NASA and CU-Boulder indicate the probe has yielded better than expected data and images, and may have fuel reserves to last at least a decade longer than its planned one-year mission.

## Orion

Lockheed Martin Space Systems is building Orion, NASA's first spacecraft designed for long-duration, human-rated deep space exploration. Orion will transport humans to destinations beyond low Earth orbit, such as the moon, asteroids, and eventually Mars. In 2014:

- Lockheed Martin Space Systems completed construction of the spacecraft, while NASA installed the heat shield—the largest ever built—and transported Orion to the Payload Hazardous Servicing Facility at Kennedy Space Center for fueling.
- In December, Orion completed its first test flight, traveling 3,600 miles into space, and orbiting the Earth twice before a successful splashdown and recovery. The highly successful flight enabled engineers to test critical safety systems and evaluate launch and high speed re-entry systems, avionics, altitude control, parachutes, and the heat shield.

## OSIRIS-Rex

Lockheed Martin Space Systems will build the Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-Rex). OSIRIS-REx is a NASA asteroid study and sample return mission. Following launch in 2016, the mission will study and return a sample of a carbonaceous asteroid to Earth for detailed analyses in 2023.

## Aerospace Projects

### Launch Missions

- ULA launched nine national security, three space exploration missions, and two commercial missions in 2014, and twice successfully launching two separate missions from two different coasts in one week. The launch year included four Global Position Satellites for the USAF, the USAF's Defense Meteorological Satellite Program (DMSP-19) payload, and NASA's Orbiting Carbon Observatory-2 (OCO-2) payload. In addition to Orion EFT-1, other notable ULA launches included the Atlas V carrying the WorldView-3 satellite in August 2014 and the launch of CLIO—a classified communications satellite built by Lockheed Martin Space Systems—atop an Atlas V in September 2014.
- Highlands Ranch-based UP Aerospace Inc. launched its third NASA mission in 2014, with five payloads that included a sun sensor from NASA's Jet Propulsion Laboratory and a radiation-tolerant computer system from Montana State University. The company's rockets travel 75 miles into space, with about 4 minutes of time spent in zero gravity.
- NASA's Launch Services Program selected ULA's Atlas V to launch the \$173 million Solar Orbiter Collaboration mission to study the sun. The Solar Orbiter mission, scheduled to launch in 2017, will observe the sun's atmosphere with high spatial resolution lenses and will provide images and data covering the sun's polar regions.
- ULA and the Boeing Company were selected to support NASA's Commercial Crew program, sending critical cargo and the next generation of astronauts to the ISS. ULA will launch Boeing's manned CST-100 spacecraft by 2017, playing a pivotal role in advancing human spaceflight.
- ULA and Kent, Wash.-based Blue Origin partnered to develop a new rocket engine called the BE-4. The agreement includes a four-year development process with full-scale testing in 2016 and the first flight scheduled to launch in 2019. The BE-4 will be available for both companies' next generation launch systems.

### Satellite Programs

- DigitalGlobe launched WorldView-3 in 2014, the highest-resolution commercial Earth-imaging satellite ever flown, capable of taking images five times clearer than standard commercial satellites. The satellite is the first of its kind to feature short-wave, infrared bands through a CAVIS instrument—clouds, aerosols, vapors, ice, and snow—that allow accurate imaging and data even through atmospheric obstacles. Four additional Colorado companies played vital roles on WorldView-3. Ball Aerospace built the spacecraft, Lockheed Martin Commercial Launch Services organized the launch, and ULA's Atlas V delivered the satellite into orbit. Exelis Inc. constructed a telescope, shortwave infrared system, and sensor for the satellite.
- DigitalGlobe unveiled plans to accelerate the launch of WorldView-4 (formerly named GeoEye-2), built by Lockheed Martin, to mid-2016 to meet increased demand. A significant catalyst for this increased opportunity was the recent U.S. directive to allow images with a resolution up to 25 centimeters to be sold freely.

- Lockheed Martin successfully integrated the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite-R (GOES-R) system module with the propulsion module at its Littleton facility. When fully assembled, the satellite will provide accurate, real-time weather forecasts and early warning products to NOAA and other public and private organizations. The satellite is scheduled to launch in early 2016.
- Ball Aerospace was awarded a contract from Reston, Va.-based Laser Light™ Communications, LLC to provide its first global, all-optical commercial satellite system. Under the contract, Ball Aerospace will complete eight out of the 12 satellites in Laser Light's constellation operating in medium Earth orbit. When complete, the constellation will transmit data at 6 terabits per second and a service speed of 200 gigabits per second to address growing commercial bandwidth demand.
- Ball Aerospace was awarded a \$5.8 million contract from the Defense Weather System Directorate at the Space and Missile Systems Center in California to produce the Ion Velocity Meter (IVM) under the USAF Space Situational Awareness Environmental Monitoring program. The IVM will fly aboard the Constellation Observing System for Meteorology, Ionosphere and Climate-2 (COSMIC-2), a joint mission with Taiwan to launch a constellation of six satellites into low-inclination orbits in late 2015. Under the contract, Ball Aerospace will build five replicas of the IVM.
- Sierra Nevada Corporation's Space Systems Group designed and constructed 17 satellites for the ORBCOMM Generation 2 (OG2) constellation using the nation's first assembly-line specifically designed to produce a variety of small satellites. OG2 launched in late 2014 and will provide upgraded machine-to-machine communication services for all branches of industry and government, providing relay of small data packets at low latencies from mobile transmitters to ground-based terminals.
- NASA awarded Colorado State University a \$4.5 million, three-year contract to design and build a new instrument to measure ice particles in clouds and water vapor in the upper troposphere. Information collected by the Tropospheric Water and Cloud (TWICE) will be used to improve global climate models and provide data regarding ice particles in the upper atmosphere.
- Ball Aerospace is building two air-quality sensors to provide future environmental monitoring. The geostationary ultraviolet visible spectrometers include the Tropospheric Emissions: Monitoring of Pollution (TEMPO) for NASA Earth Venture and the Geostationary Environmental Monitoring Spectrometer (GEMS), which is being jointly developed with the South Korea Aerospace Research Institute. Both instruments will complete critical design in 2015 and will be delivered in 2017.

### Defense Missions

- The USAF awarded Lockheed Martin Space Systems a contract to maintain and develop systems for the nation's Minuteman III nuclear missiles through 2022. Under the initial \$109 million contract, Lockheed Martin will repair, modify, and test hardware and software components in the reentry system-reentry vehicle subsystem. The contract has options for an additional four years, totaling up to \$452 million.
- Ball Aerospace received a \$23.9 million contract from the NATO Seasparrow Project Office to develop a missile-detecting laser system for U.S. Navy ships. Under the contract, Ball Aerospace will provide fabrication test and installation and includes options for spare components, sustaining engineering, and field support.
- The USAF awarded Lockheed Martin Space Systems Company a \$1.86 billion contract to complete construction of the fifth and sixth Geosynchronous Earth Orbit (GEO) satellites for the Space-Based Infrared System (SBIRS). The SBIRS GEO satellites provide ongoing early warning of ballistic missile launches and other tactical intelligence with infrared surveillance information and will be completed by 2022.
- DigitalGlobe acquired Boulder-based Spatial Energy's digital imagery and related services. The \$37 million acquisition added to the company's position as a leading source of geospatial information and insight with new cloud-based solutions tailored to the oil and gas industry.
- Lockheed Martin Space Systems purchased Fairfax, Va.-based Zeta Associates Inc., which will become part of its Jefferson County-based division. The addition of the software company will broaden Lockheed Martin's product offerings and strengthens its ability to deliver vital ground, air, and space-based intelligence systems.

### Spaceport Colorado

In 2014, Front Range Airport continued the application process for certification from the Federal Aviation Administration (FAA) to operate as a horizontal-launch spaceport facility. The subsequent designation for Spaceport Colorado, which may be granted in 2015, fulfills a 2011 declaration by Gov. John Hickenlooper of Colorado's intent to become a spaceport state. The effort will increase Colorado's competitiveness in the aerospace industry and support new opportunities in the future growth of commercial space research and

transportation. Plans for Spaceport Colorado include the development of an aerospace and technology park to support a broad range of activities and commercial opportunities, including research and development, testing and evaluation, manufacturing, crew training, scientific research, suborbital flight, point-to-point travel, and unmanned aircraft systems (UAS). Spaceport Colorado has an abundance of surrounding land and convenient access to Denver International Airport and the Metro Denver area's sizeable aerospace industry, research universities, and talented aerospace workforce.

### Unmanned Aerial Systems (UAS)

The nine-county region is a global leader in UAS, with support from unmatched assets including a robust aerospace industry and military presence, established research institutions, and exceptional geographic and climatic diversity for testing sites. With UAS representing a growing portion of the nation's military budget, and commercial UAS operations set to expand rapidly, the U.S. Congress is encouraging the integration of UAS into the National Airspace System (NAS), which presents Colorado job growth and economic impact opportunities. The nine-county region's UAS resources and key project announcements in 2014 included:

- The Research and Engineering Center for Unmanned Vehicles (RECUV) at CU-Boulder is a university, government, and industry partnership dedicated to developing and integrating unmanned vehicle systems. RECUV engineers new mobile sensing systems, stimulates strategic discussions among leaders, increases public awareness of UAS, and educates and trains a next generation of engineers. In 2014, RECUV conducted an international research effort—the first multiple, unmanned aircraft interception of a rush of cold air, or gust front—preceding a thunderstorm across the Pawnee National Grassland. The research focuses on developing a smart, small unmanned aircraft system that can plan its own flight path to maximize endurance by combining real-time weather-radar and atmospheric-model data with measurements made from the aircraft.
- The Jonathan Merage Foundation awarded the College of Engineering and Applied Science at CU-Boulder a \$130,000 contract to design a tracker vehicle and a new lightning detection instrument for integration into a small, unmanned aircraft. The system will be designed to measure electric field changes associated with lightning strikes. This project will occur in three phases over the next year, with deployments for thunderstorms beginning in the spring of 2015.
- The University of Denver's Unmanned Systems Research Institute (DU2SRI) promotes knowledge, education, research, and development in unmanned systems, and is pushing forward the frontiers of unmanned systems to develop the next generation of fully autonomous UAS. The DU2SRI infrastructure includes five unmanned ground vehicles, one all-terrain mobile robot, more than 17 (electric and non-electric) unmanned helicopters and quadrotors, FAA-approved simulators, electronics design and fabrication capabilities, and complete UAS design and testing. In April 2014, the University of Denver signed an integrated robotics patent license agreement.
- The U.S. Geological Survey's (USGS) National Unmanned Aircraft Systems Project Office, located in Denver, leads and coordinates USGS efforts to promote and develop UAS technology for civil and domestic applications. These efforts will directly benefit the U.S. Department of the Interior and USGS missions, including access to an increased level of persistent monitoring of earth surface processes (e.g. forest health conditions, monitoring wildfires, earthquake zones, and invasive species) in previously difficult to access areas.

### Industry Infrastructure Support

The nine-county region's unique public-private partnerships support the state's thriving aerospace cluster.

- The Colorado Space Coalition (CSC), a group of industry stakeholders, works to make Colorado a center of excellence for space. The Coalition—including aerospace companies, military leaders, academic groups, and economic development organizations—promotes the state's significant aerospace assets nationally and advances legislation vital to industry growth and success.
- eSpace: The Center for Space Entrepreneurship was established in 2009 as a partnership between the University of Colorado and Sierra Nevada Space Systems. The not-for-profit business incubator develops and catalyzes new entrepreneurial space companies, commercializing aerospace technologies created within these companies, and developing the aerospace workforce to support them. Since its inception, eSpace has generated a \$7.1 million economic impact to the state and has fostered a thriving entrepreneurial aerospace industry through three successful programs: eSpace Incubator, Straight to Space workforce initiative, and the Venture Design program.
- The Center of Excellence for Commercial Space Transportation—a partnership between government, industry, the FAA, and nine academic institutions including CU-Boulder—formed in 2010 to address current and future challenges of commercial space transportation. CU-Boulder plays a key role,

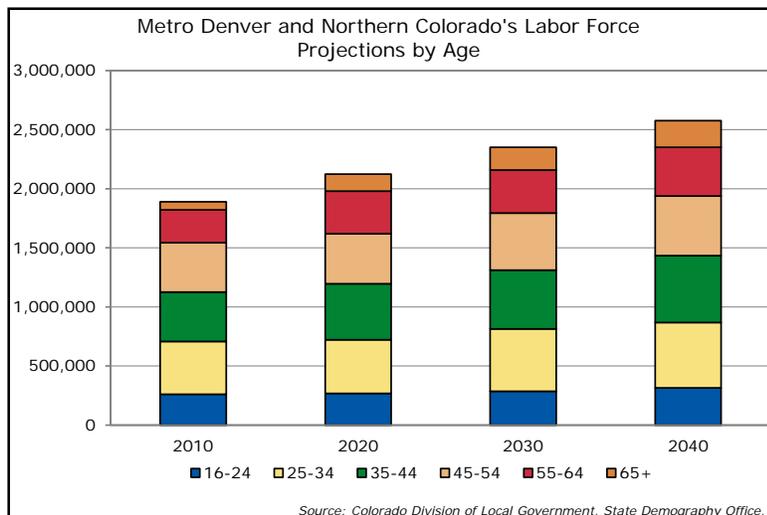
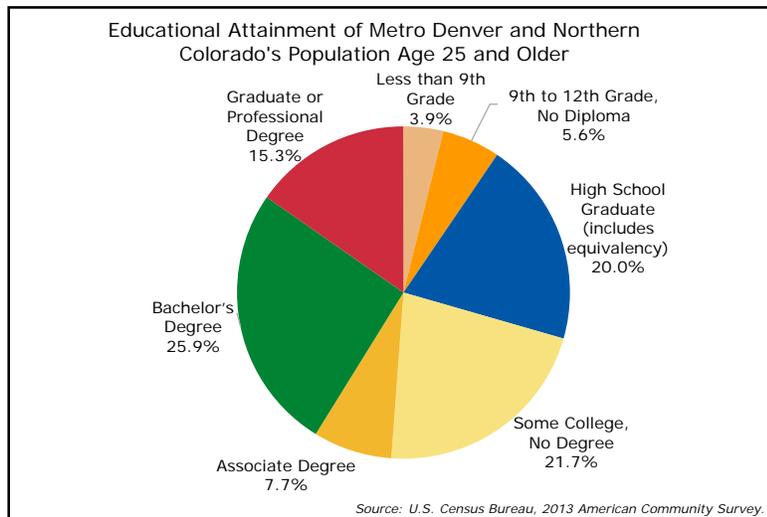
offering its experience in spacecraft life-support systems and habitat design, human factors engineering analysis, payload experiment integration, and expertise in space environment and orbital mechanics.

- The Colorado Space Business Roundtable (CSBR) is an independent, nonprofit organization promoting the growth of space and space-related industry in Colorado, with particular focus on small space businesses. CSBR members include a broad cross-section of the Colorado space community including industry, government, and academia that support the space industry with services, advocacy, and procurement. In 2013, the CSBR sponsored a week-long networking road trip to help connect major space contractors along the Front Range with smaller aerospace subcontractors, suppliers, and businesses in Pueblo, Durango, Rifle, Grand Junction, and Alamosa.

## Private Aerospace Workforce Profile

Many companies choose locations because of the available workforce. With nearly half of the nine-county region's 3.6 million residents under the age of 35, employers can draw from a large, young, highly educated, and productive workforce. Of the region's adult population, 41.2 percent are college graduates and 90.5 percent have graduated from high school. The state has the nation's second-most highly educated workforce as measured by the percentage of residents with a bachelor's degree or higher.

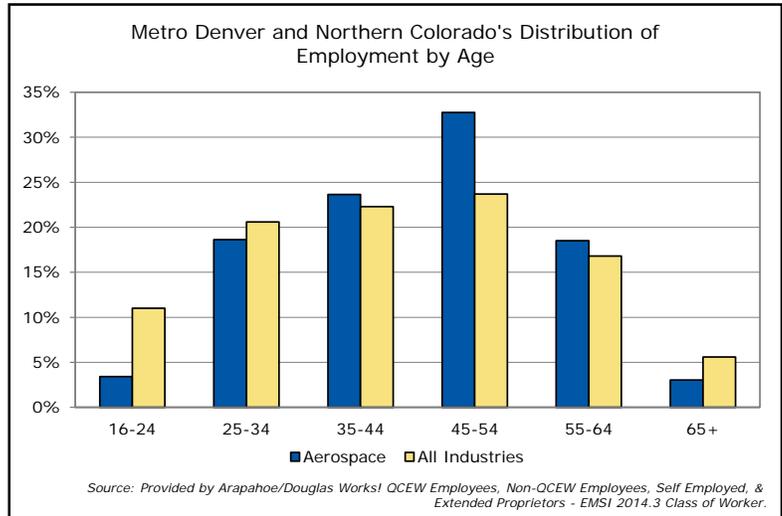
The attractiveness of the region draws new residents through migration. The region's population is expected to grow 53.3 percent from 2010 to 2040, driving a 36.3 percent increase in the region's labor force over the same period. It is important to note the changing composition of the workforce supply as the baby boomers begin to retire, which will pose implications for businesses whose employee pool includes significant numbers of these workers.



# AEROSPACE: Metro Denver and Northern Colorado Industry Cluster Profile

The nine-county region's aerospace industry employs 19,560 people and includes a large pool of talented, well-educated, and highly skilled workers. Compared with the age distribution across all industries, the aerospace cluster has a larger share of employees that are between the ages of 35 and 64 years old.

The aerospace workforce supply consists of four main components: those currently working in the industry; those doing a similar type of job in some other industry; the unemployed; and those currently in the education pipeline. The Metro Denver and Northern Colorado Occupation & Salary Profile below includes the 10 largest aerospace occupations in the region. For these 10 largest occupations, the chart details the total number of workers employed in that occupation across all industries, the number of available applicants that would like to be working in that occupation, the number of recent graduates that are qualified for that occupation, and the median and sample percentile annual salaries.



## Wages

Wages in the aerospace cluster are among the highest across all industry clusters. The 2013 average annual salary for an aerospace worker in the nine-county region was \$124,380, compared with the national average of \$100,200. Total nine-county payroll in the aerospace cluster exceeded \$2.4 billion in 2013.

## Metro Denver and Northern Colorado Aerospace Occupation & Salary Profile, 2014

10 Largest Aerospace Occupations in Metro Denver and Northern Colorado	Total Working Across All Industries (2014)	Number of Available Applicants (2014)	Number of Graduates (2013)	Median Salary	10th Percentile Salary	25th Percentile Salary	75th Percentile Salary	90th Percentile Salary
1. Aerospace engineers	2,350	119	138	\$104,728	\$64,106	\$80,558	\$126,214	\$159,203
2. Business operations specialists, all other	31,368	776	77	\$65,707	\$33,654	\$46,446	\$88,296	\$113,381
3. Software developers, systems software	10,390	174	630	\$98,238	\$63,419	\$79,373	\$119,267	\$139,443
4. Mechanical engineers	4,654	215	454	\$82,618	\$48,901	\$63,627	\$105,747	\$131,560
5. Software developers, applications	18,702	345	585	\$87,963	\$52,125	\$67,434	\$108,597	\$130,749
6. Biological technicians	2,206	108	0	\$42,702	\$30,264	\$34,632	\$55,182	\$67,517
7. General & operations managers	33,235	1,528	5,881	\$105,706	\$54,226	\$72,467	\$158,683	\$230,630
8. Industrial engineers	2,629	102	11	\$85,904	\$58,136	\$70,117	\$103,917	\$124,342
9. Atmospheric & space scientists	1,216	9	49	\$104,000	\$62,795	\$83,117	\$129,314	\$145,184
10. Secretaries & administrative assistants, except legal, medical, & executive	49,103	678	71	\$35,381	\$23,005	\$28,558	\$43,139	\$50,773

Notes: The number of available applicants is a point-in-time measurement of the number of people who have registered in Colorado's workforce development system's statewide database, Connecting Colorado, as being able and available to work in a particular occupation. Results should be interpreted with caution since registration in Connecting Colorado is self-reported. In addition, the skills rubric may assign up to four occupation codes for each registrant. Therefore, the number of available applicants could be inflated. Source: Provided by Arapahoe/Douglas Works!; QCEW Employees, Non-QCEW Employees, Self Employed, & Extended Proprietors - EMSI 2014.3 Class of Worker.

## Education & Training

Colorado's higher education system provides an excellent support system for businesses in the region. There are 28 public higher education institutions in Colorado, of which seven four-year and six two-year public institutions offering comprehensive curricula are located in the nine-county region. In addition, there are more



than 100 private and religious accredited institutions and nearly 340 private occupational and technical schools offering courses in dozens of program areas throughout the state. Although not exhaustive, a list of the major, accredited educational institutions with the greatest number of graduates for each of the 10 largest aerospace occupations in the nine-county region are included below. A directory of all higher education institutions with corresponding websites may be accessed via <http://higher.ed.colorado.gov>.

- Colorado School of Mines  
[www.mines.edu](http://www.mines.edu)
- Metropolitan State University of Denver  
[www.msudenver.edu](http://www.msudenver.edu)
- University of Denver  
[www.du.edu](http://www.du.edu)
- Colorado State University  
[www.colostate.edu](http://www.colostate.edu)
- Regis University  
[www.regis.edu](http://www.regis.edu)
- University of Northern Colorado  
[www.unco.edu](http://www.unco.edu)
- Colorado State University Global Campus  
[www.colostate.edu](http://www.colostate.edu)
- University of Colorado Boulder  
[www.colorado.edu](http://www.colorado.edu)
- Jones International University  
[www.jiu.edu](http://www.jiu.edu)
- University of Colorado Denver  
[www.ucdenver.edu](http://www.ucdenver.edu)

## Key Reasons for Aerospace Companies to Locate in the Nine-County Region

The region is a top aerospace location offering:

- 1. The ability to recruit and retain technical and scientific employees and entrepreneurial talent**
  - Of Colorado's adult population, nearly 38 percent has completed a bachelor's or higher-level degree, making Colorado the second-most highly educated state in the nation behind Massachusetts. (U.S. Census Bureau, 2013 American Community Survey)
  - Colorado ranked ninth in the number of science and engineering graduate students per 1,000 individuals ages 25 to 34 years old in 2011. (National Science Foundation, 2014)
  - Colorado ranked fourth in the number of scientists and engineers as a share of all occupations in 2012. (National Science Foundation, 2014)
  - Colorado ranked 10th in the number of patents issued per 1 million people in 2013. (U.S. Patent and Trademark Office, 2014; U.S. Bureau of Economic Analysis, 2014)
  - The U.S. Department of Commerce's United States Patent and Trademark Office located one of four new satellite offices in Denver due to the state's expansive culture of innovation and entrepreneurship. (U.S. Patent and Trademark Office, 2014)
  - Metro Denver ranked as the ninth-best metro area for science, technology, engineering, and mathematics (STEM) graduates in 2014. STEM jobs in Metro Denver represented 8.2 percent of all occupations and the area's annual mean wage for STEM jobs was \$84,380. (NerdWallet, 2014)
  - Denver ranked as the seventh-best city for millennials (ages 25-34) out of 25 major cities with a population over 1 million in 2014. (Niche.com, 2014)
  - Denver ranked among the top five "Best Cities for New College Grads" in 2014. (*Kiplinger's Personal Finance*, 2014)
- 2. Proximity to vendors and customers**
  - Colorado received the nation's fourth-highest National Aeronautics and Space Administration (NASA) prime contract awards in 2013, receiving more than \$1.7 billion. The University of Colorado ranked fifth and Colorado State University ranked 58th among the top 100 public educational institutions for NASA research awards in 2013. (NASA, 2014)
  - The nine-county region's aerospace cluster is anchored by eight large prime contractors: Ball Aerospace, The Boeing Company, Exelis, Lockheed Martin, Northrop Grumman, Raytheon, Sierra Nevada Corporation, and United Launch Alliance.
  - Colorado is home to major military operations including Buckley AFB, Peterson AFB, Schriever AFB, and Cheyenne Mountain Air Force Station. In addition, the U.S. Air Force Academy is located just outside of Colorado Springs.
  - Cheyenne Mountain Complex serves as NORAD and USNORTHCOM's Alternate Command Center and as a training site for crew qualification.

- The U.S. Department of Defense (DoD) awarded Colorado a Procurement Technical Assistance Center (PTAC) in 2009, which assists Colorado businesses do business with prime contractors and federal, state, and local governments at nominal or no cost. The central office for Colorado's PTAC is located in Colorado Springs and satellite offices in Aurora, Golden, and Westminster.

### 3. Business organizations and public policy programs designed to encourage industry growth

- In 2013, Gov. Hickenlooper named Maj. Gen. Jay Lindell to be Colorado's Aerospace and Defense Industry Champion, whose role is to oversee implementation of the state's aerospace strategic plan and assist aerospace businesses, defense installations, and research institutions.
- The Advanced Industries (AI) Accelerator Programs were created in 2013 to promote growth and sustainability in Colorado's advanced industries including advanced manufacturing, aerospace, bioscience, electronics, energy and natural resources, infrastructure engineering, and technology and information. The Colorado Office of Economic Development and International Trade offers Proof of Concept, Early-Stage Capital & Retention, Infrastructure Funding, and AI Exports grants. Since inception, the programs have awarded 67 grants totaling \$8.2 million to support these critical industries in their various phases of growth. (The Colorado Office of Economic Development and International Trade, 2014)
- To further encourage investment in Colorado's aerospace industry, legislation passed in 2014 will help support the state's growing aerospace economy. House Bill 1178 (2014) exempted personal property used in an orbital space facility, a space propulsion system, satellite, or space station from sales and use taxes. The exemption will encourage capital investment in aerospace manufacturing supplies.
- President Obama signed into law the Bipartisan Budget Act of 2013, which includes more than \$2.7 billion in funding for Colorado's space projects and initiatives. The funding includes \$1.2 billion for Orion, \$824 million for the Joint Polar Satellite System, and \$2 million for the Boulder-based COSMIC-2 satellite program. These projects are all being partially built in Colorado.
- To further pave the way for Spaceport Colorado, legislation passed in 2012 will help expand the state's aerospace economy. Senate Bill 035 (2012) limited the liability for public and private entities holding a Federal Aviation Administration license for spaceflight activities. The legislation is an important first step in initiating commercial spaceflight activities in the state.

### 4. Proximity to colleges/universities

- Two academic institutions in Colorado offer nationally ranked aerospace programs or degrees:
  - The University of Colorado Boulder's (CU-Boulder) aerospace engineering sciences graduate program ranked among the top 10 in the nation. (*U.S. News & World Report*, 2014)
  - The National Research Council ranked CU-Boulder's aerospace engineering sciences graduate program among the top four in the country. (National Research Council, 2010)
  - The U.S. Air Force Academy in Colorado Springs ranked second among schools that do not offer doctoral degrees for its undergraduate aerospace engineering program for the 13th consecutive year. (*U.S. News & World Report*, 2013)
- The University of Colorado system ranked 10th among the nation's public institutions for science and engineering research and development expenditures totaling \$800 million in fiscal year 2012. The university also ranked fourth for federally funded research expenditures. (National Science Foundation, 2014)
- CU-Boulder's Laboratory for Atmospheric and Space Physics is the only research institution that has designed and built space instruments for NASA that have launched to every planet in the solar system.
- CU-Boulder is the only university outside of the Naval Postgraduate School to have two astronaut alumni on its faculty. Thirteen of CU-Boulder's astronaut alumni are affiliates of the College of Engineering and Applied Science. (University of Colorado, 2014)
- The University of Colorado is among the top-five U.S. universities, excluding military academies, in the number of astronaut alumni. Of the 20 astronaut alumni, 19 have flown in space as of 2014. (University of Colorado, 2014)

### 5. Low to moderate costs of doing business

- Colorado's simplified corporate income tax structure based on single-factor apportionment allows companies to pay taxes based solely on their sales in the state. Along with few regulatory burdens, Colorado's corporate income tax rate of 4.63 percent is one of the lowest and most competitive tax structures in the nation. (State of Colorado; The Tax Foundation)
- Colorado has the nation's ninth-best tax climate for entrepreneurship and small business. (Small Business & Entrepreneurship Council, 2014)

- Metro Denver office rental rates averaged \$28.83 per square foot in the fourth quarter of 2014, making the region's office market highly competitive with other major markets in the U.S. (CoStar Realty Information, The CoStar Office Report, Q4 2014)

## 6. Pro-business and flexible state and local governments

- *Forbes* ranked Metro Denver fourth among the "Best Places for Business and Careers" in 2014. Four other Colorado metropolitan areas were included on the list. The Fort Collins metro area ranked fifth overall, Greeley ranked 20th, Boulder ranked 23rd, and Colorado Springs ranked 29th. (*Forbes*, 2014)
- Colorado tied with Virginia as the eighth-best state for business in 2014 and the state earned top-10 rankings in the categories that measure access to capital (first), workforce (fifth), economy (eighth), and technology and innovation (ninth). (*CNBC*, 2014)
- Colorado ranked second in innovation and entrepreneurship and was among the top 10 states for infrastructure, business climate, and talent pipeline. (National Chamber Foundation, 2014)
- Colorado ranked as the No. 8 small-business-friendly state in the nation. Fort Collins (24th) and Denver (28th) ranked among 84 cities in the country. (Thumbtack.com, 2014; Ewing Marion Kauffman Foundation, 2014)

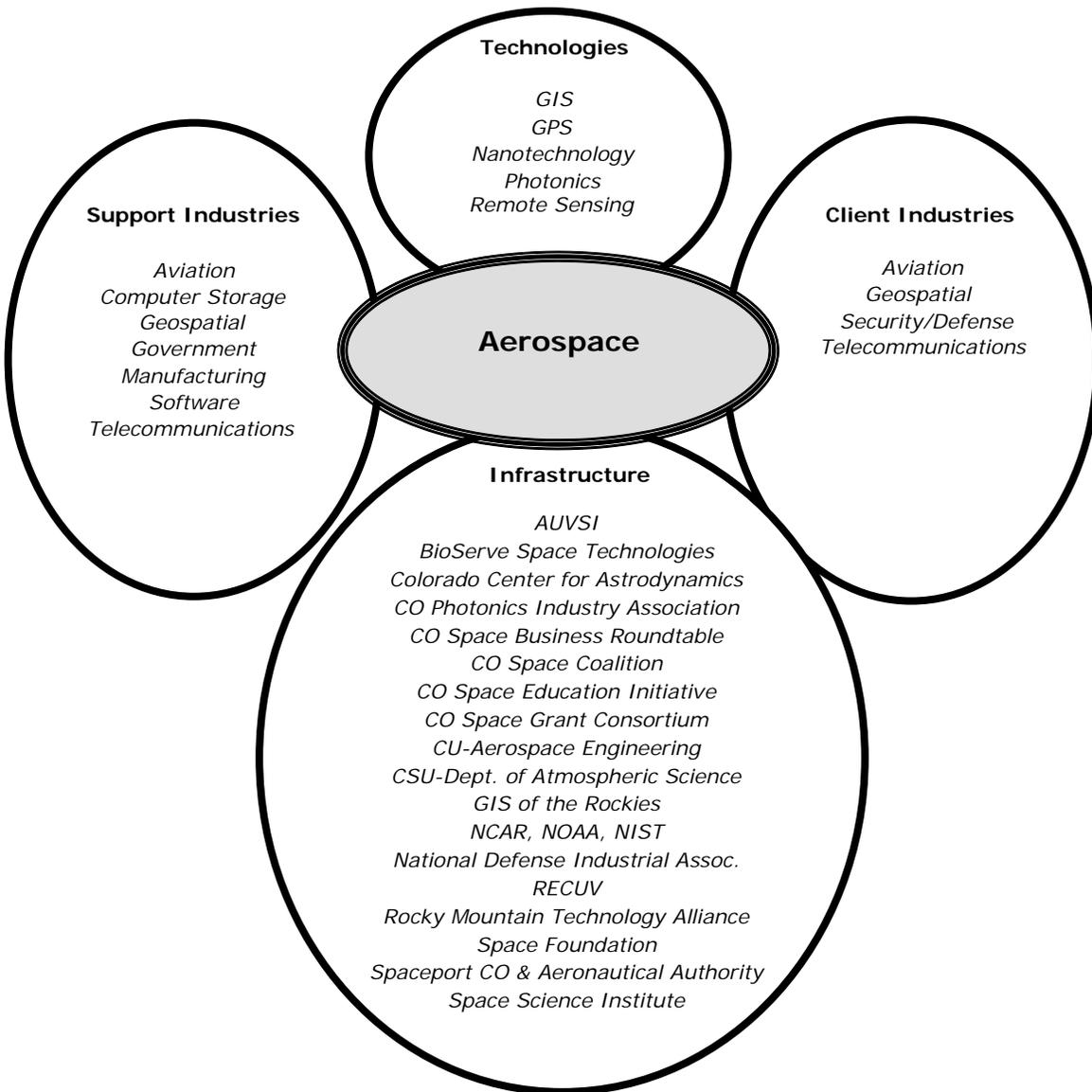
## Aerospace Industry Cluster Definition

NAICS Code*	NAICS Description	SIC Code	SIC Description
331512 (P)	Steel investment foundries	3324-9901	Aerospace investment castings, ferrous mfg.
331524 (P)	Aluminum foundries (except die-casting)	3365-0201	Aerospace castings, aluminum mfg.
331529 (P)	Other nonferrous metal foundries (except die-casting)	3369-9901	Aerospace castings, nonferrous: except aluminum mfg.
332111 (P)	Iron & steel forging	3462-05	Missile & ordnance forgings mfg.
332112 (P)	Nonferrous Forging	3463-02	Nonferrous missile & ordnance forgings mfg.
332313 (P)	Plate work mfg.	3443-1104	Space simulation chambers, metal plate mfg.
332813 (P)	Electroplating, plating, polishing, anodizing & coloring	3471-0204	Decontaminating & cleaning of missile or satellite parts mfg.
332993 (P)	Ammunition (except small arms) mfg.	3483-0101	Arming & fusing devices for missiles mfg.
332993 (P)	Ammunition (except small arms) mfg.	3483-9910	Missile warheads mfg.
333314 (P)	Optical instrument & lens mfg.	3827	Optical instruments & lenses
334220 (P)	Radio & television broadcasting & wireless communications equipment mfg.	3663-9910	Space satellite communications equipment mfg.
334511	Search, detection, navigation, guidance, aeronautical, & nautical system & instrument mfg.	3812	Search, detection, navigation, guidance
336414	Guided missile & space vehicle mfg.	3761	Guided missiles & space vehicles
336415	Guided missile & space vehicle propulsion unit & propulsion unit parts mfg.	3764	Space propulsion units & parts
336419	Other guided missile & space vehicle parts & aux. equipment mfg.	3769	Space vehicle equipment NEC
339113 (P)	Surgical appliance & supplies mfg.	3842-0113	Space suits mfg.
423860 (P)	Transportation equipment & supplies (except motor vehicle) merchant wholesalers	5088-0300	Aircraft & space vehicle supplies & parts - wholesale trade
423860 (P)	Transportation equipment & supplies (except motor vehicle) merchant wholesalers	5088-0305	Guided missiles & space vehicles – wholesale trade
423860 (P)	Transportation equipment & supplies (except motor vehicle) merchant wholesalers	5088-0307	Space propulsion units & parts – wholesale trade
517919 (P)	All other telecommunications	4899-9902	Missile tracking by telemetry or photography
541712 (P)	Research and development in the physical, engineering, and life sciences (except biotechnology)	3761	Guided missiles and space vehicles
927110	Space research and technology	9661	Space research and technology
927110	Space research and technology	4789-9902	Space flight operations, except government

\*(P) indicates that only part of the NAICS industry category is represented in the industry cluster definition.

Note: NEC indicates "not elsewhere classified."

## Aerospace Industry Cluster Relationships



For additional information, contact us:



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