VIRGINIA AVIATION AND SPACE WORKFORCE ANALYSIS AND STRATEGY DEVELOPMENT

APRIL 2012

Courtesy National Business Aviation Association

Courtesy of Rolls-Royce

Courtesy Washington Airports Task Force

Courtesy of Virginia Department of Aviation

PMG@VCU

Virginia Commonwealth University

VIRGINIA SATSLab

ACKNOWLEDGEMENTS

The Performance Management Group (PMG) in the L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University would like to acknowledge the following for their advice and consultation:

Virginia SATSLab, Inc.

ACT Workforce Development Division

Chmura Economics & Analytics

Community College Workforce Alliance

ECPI College of Technology

Federal Aviation Administration

MathScience Innovation Center

NASA Langley Research Center

National Association of Manufacturers Institute

Office of the Secretary of Education

Opportunity, Inc.

Virginia Aerospace Advisory Council

Virginia Aviation Board

Virginia Center for Innovative Technology

Virginia Community College System

Virginia Department of Aviation

Virginia Department of Education

Virginia Economic Development Partnership

Virginia Space Grant Consortium

Virginia Tech

Note: The opinions stated in this report are those of the Performance Management Group and do not necessarily reflect those of all entities and individuals who contributed to the report.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Virginia's aviation and space industry has a significant economic impact in the Commonwealth. The space industry in Virginia directly employs approximately 9,000 people with 19,000 additional employees supporting related areas. These approximately 28,000 employees contribute $7.6 billion in annual economic output (direct, indirect, and induced). Virginia's airports account for 4.4% of the state's total economic output through their direct and indirect support of 259,000 jobs, contributing to $28.8 billion in overall annual economic activity.

In June 2011, Boeing announced a forecasted global need for 460,000 new commercial airline pilots and 650,000 commercial airline maintenance technicians over the next 20 years. Boeing estimated that North America will need 82,800 pilots and 134,800 technicians. According to the Federal Aviation Administration's (FAA) more conservative aerospace forecast for 2011-2031, the United States will need 12,595 new commercial pilots over the same period. The FAA also projects that total revenue passenger miles (RPM) will increase at an annual rate of 3.8% and that air cargo revenue ton miles (RTM) will increase at an average rate of 4.8% per year. General aviation is also projected to grow at a 0.9% annual rate over the next 20 years.

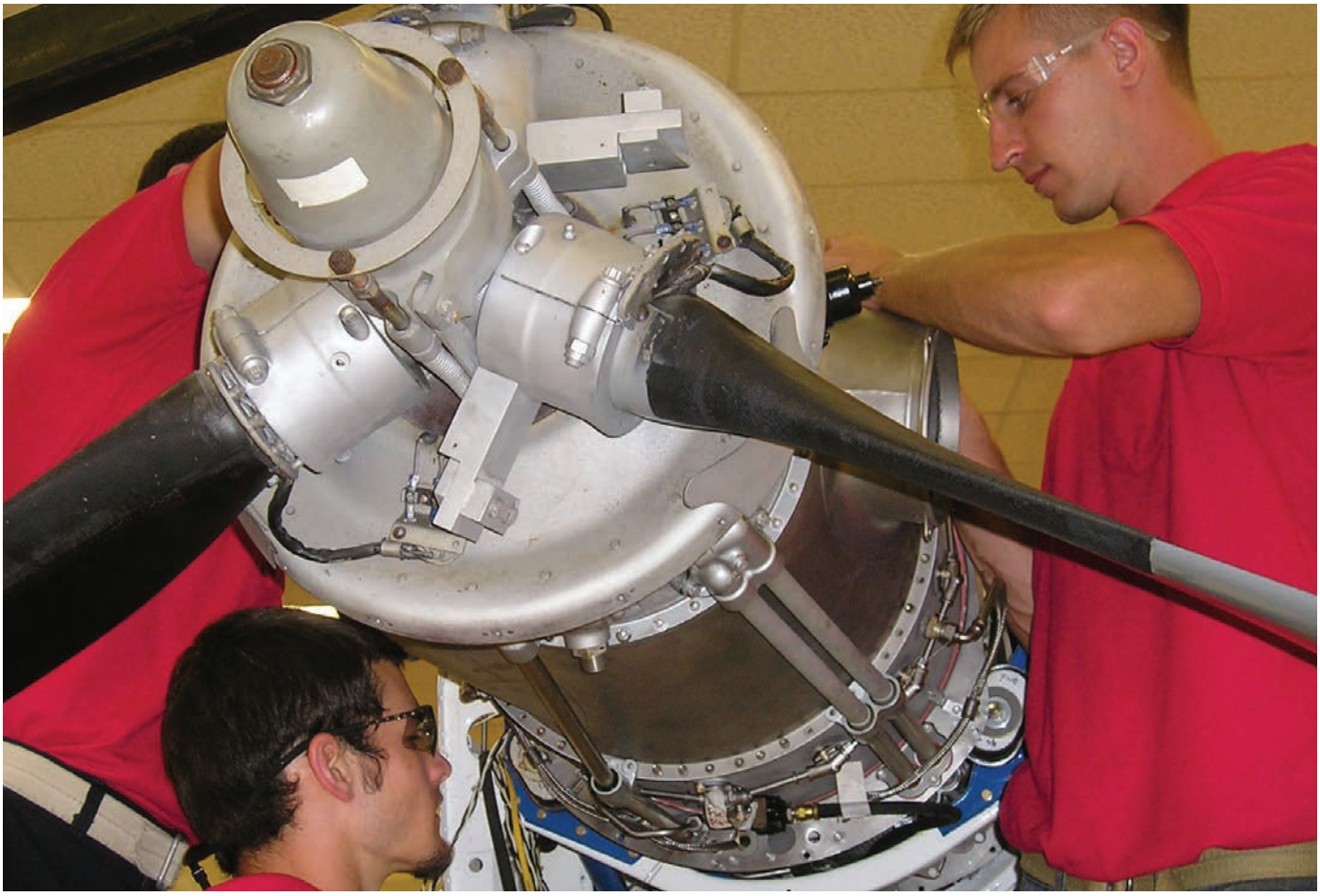
However, projections for Virginia's share of this growing industry, based upon an analysis conducted for this report by Chmura Economics & Analytics, are for a mere 12,283 new workers over the next decade. Of these 12,283 workers, 10,398 would fill retiree roles. This suggests that, given the current approach, Virginia could lose out on a burgeoning industry. Given the tremendous historical legacy of aviation and space and the high concentration of relevant intellectual strength and strong military presence in Virginia, the Commonwealth could position itself to gain a greater share of the workforce in this industry. For Virginia to be successful in this, the Commonwealth would do well to ensure that a skilled workforce is there to anticipate industry needs and draw business more and more to Virginia. A more aggressive approach to training and development, investment in science, technology, engineering, and mathematics (STEM) education, and marketing Virginia's assets will be significant aspects of a comprehensive approach to workforce strength in aviation and space in Virginia.

Courtesy of National Business Aviation Association

As a result of this study, PMG recommends nine action steps to make Virginia more of a competitive leader in the aviation and space industry.

Recommendations:

1. **Enhance interest in STEM-related careers by focusing on the educational pipeline.**
2. **Enhance STEM opportunities in secondary education.**
3. **Increase aviation and space industry visibility through marketing and industry promotion.**
4. **Identify advanced technology skills and work with colleges (including universities, technical, and community colleges) to equip schools with the latest industry technology.**
5. **Utilize internet-based tools that provide snapshots of the industry, jobs, and wages to attract new employees.**
6. **Develop a statewide strategic plan to address pipeline strategies for informing and engaging the skills of the future, incumbent, and transitioning workforce.**
7. **Develop mentorship programs to transfer institutional knowledge from the senior generation to the younger generation of the workforce.**
8. **Place ex-military with defense contractors to facilitate the pipeline between the military exits and the aviation and space workforce.**
9. **Capitalize on the workforce recruitment opportunity resulting from the termination of NASA's Space Shuttle Program.**



Courtesy of Liberty University

1. PROJECT OVERVIEW

The Virginia SATSLab, Inc., a public-private venture dedicated to fostering collaboration between Virginia companies and universities to support general aviation, commissioned the Performance Management Group (PMG) in the L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University to coordinate a workforce report and propose recommendations to enhance Virginia's aviation and space workforce availability and readiness. PMG partnered with Chmura Economics & Analytics to produce the extensive workforce technical study required for this project. Chmura's report, *Virginia's Aviation and Aerospace State of the Workforce: 2011*, is available for access on the Virginia Department of Aviation (DOAV) website.

The goals of this project were as follows:

1. Determine the current size and impact of the aviation and space industry.
2. Project the aviation and space industry growth within Virginia.
3. Identify core workforce support entities within Virginia related to this industry.
4. Isolate the gaps in the current supply and the projected workforce demand.
5. Develop a set of recommendations that will lead Virginia to capture a larger share of the industry's growth.

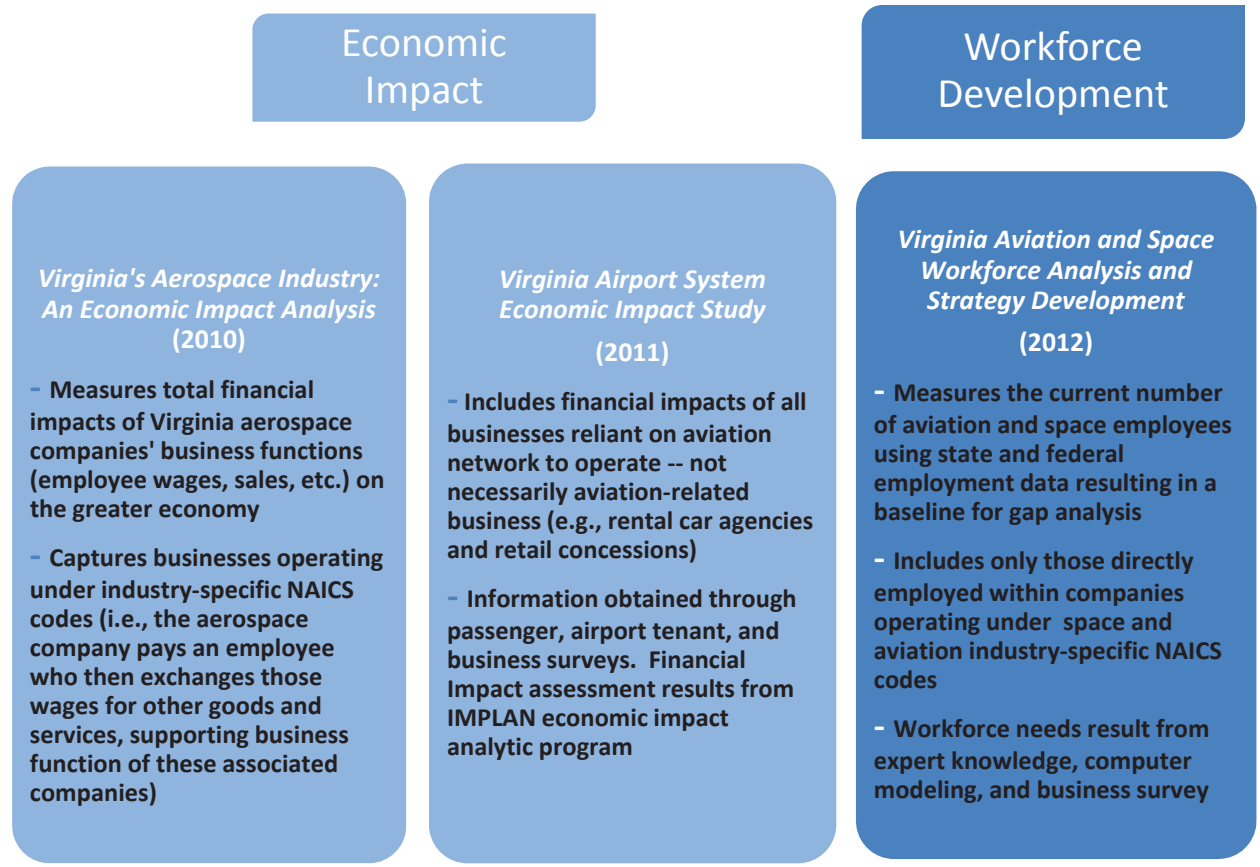
Courtesy of Liberty University

2. BACKGROUND AND CONTEXT

Virginia's aviation and space industry has a significant economic impact in the Commonwealth.

Figure 1 provides information about the recent economic impact studies of the aviation and space industry and provide context for this workforce development report.

Figure 1: Methodological Overview



The reports highlight the significance of the aviation and space industry to the Commonwealth. The space industry in Virginia directly employs approximately 9,000 people with about 19,000 additional employees supporting related areas of the industry. These 28,000 employees contribute $7.6 billion in annual economic output (direct, indirect, and induced).[1] Additionally, Virginia's airports account for 4.4% of the state's total economic output through their direct and indirect support of 259,000 jobs, contributing to $28.8 billion in overall annual economic activity.[2] Highlights from both reports are shown in the figures 2, 3, and 4.

1 Performance Management Group (PMG) at Virginia Commonwealth University, *Virginia's Aerospace Industry: An Economic Impact Analysis,* November 2010, p. 2.

2 ICF SH&E, *Virginia Airport System Economic Impact Study*, August 2011. Figures include airport-dependent business, on-airport tenants, and visitor spending.

Virginia's Aerospace Industry: An Economic Impact Analysis (2010)

Virginia's Aerospace Industry: An Economic Impact Analysis examines the economic impact of the aerospace industry in Virginia. Figure 2 highlights the major findings:

Figure 2: *Virginia's Aerospace Industry: An Economic Impact Analysis*: Key Findings

- Virginia ranks 16th in the nation in aerospace employment, supporting 28,110 jobs
- Virginia's six military installations support an additional 26,000 aerospace workers.
- Aerospace contributes $7.6 billion in annual economic output to the Commonwealth
- Virginia has one of the highest concentrations of research and technology companies – four times the national average

Source: Chmura Economics & Analytics, 2010

Virginia Airport System Economic Impact Study (2011)

In early 2010, DOAV partnered with an independent consulting firm, ICF SH&E, to study the economic impact of Virginia's airports and airport-dependent businesses. Major findings from the *Virginia Airport System Economic Impact Study* are listed in Figure 3.

Figure 3: *Virginia Airport System Economic Impact Study*: Key Findings

- Virginia's airports contribute $28.8 billion in economic activity—representing 4.4% of the state's total economic output
- Virginia airports create and sustain approximately 259,000 jobs (5.5% of total jobs in the state) and contribute $11.1 billion in payroll
- Approximately 23,000 visitors arrive by commercial or general aviation aircraft per day in Virginia

Source: ICF SH&E, 2011

Figure 4: Virginia Summary Snapshot

Economic Impact Study	Annual Economic Impact	Employment
Virginia's Aerospace Industry: An Economic Impact Analysis (2009 data)	$7.6 billion	28,110 jobs
Virginia Airport System Economic Impact Study (2010 data)	$28.8 billion	259,000 jobs

3. STATE OF THE COMMONWEALTH'S AVIATION AND SPACE WORKFORCE

Virginia's Aviation and Aerospace State of the Workforce: 2011

The study by Chmura Economics & Analytics, *Virginia's Aviation and Aerospace State of the Workforce: 2011* (available on the DOAV website), provides a comprehensive snapshot of Virginia's aviation and space industry. It highlights areas in which the industry currently excels (i.e., average wage per employee and worker productivity), while highlighting a number of projected gaps in the workforce that may present potential challenges to sustained industry growth. Among the factors affecting the industry's workforce development efforts are:

- An aging workforce
- Waning interest in science, technology, engineering, and mathematics (STEM) careers among K-12 and college students
- Average wages
- Educational attainment
- Productivity
- Shortage of skilled workers

An Aging Workforce

A 2010 *Aviation Week* workforce study found that within the larger U.S. aviation and space defense companies surveyed, 19% of employees are at retirement age, a number that is projected to increase to 40% by 2014.[3] Chmura's numbers echo this trend and indicate that no age categories are projected to grow at a percentage rate equal to or greater than those aged 65 years or older.

Workers 65 years or older accounted for roughly 4.3% of Virginia's aviation and space workforce in the second quarter of 2010. This percentage is expected is grow to 7.3% by 2020. These numbers indicate growth in eventual retirements that may weaken the industry if not replaced by qualified workers. Coupled with the fact that those in the workforce who are 25 years and younger are projected to decline over the same period, these figures represent a potential risk to the development of aviation and space industry assets in Virginia.

Waning Interest in STEM Careers

Chmura's report shows that interest in aviation and space careers may be waning in Virginia. Its findings echo those of similar surveys designed to gauge students' interest in STEM careers. One survey found that nearly 49% of a nationwide sample group of high school students (N = 533) stated that they had no interest in STEM careers.[4] Similarly, a survey of 270,000 college students revealed that only 7.5% stated that they intended to major in engineering, despite the fact that the wages in the aviation and space industry are, on average, higher than the mean salary of all industries.[5] [6]

Average Wages

The average wage for aviation and space workers in 2009 was $65,579 per year, 38% higher than the Commonwealth's average wage of $47,672. Four aviation and space sub-industry wages averaged over $100,000 in 2009. They are:

- Air traffic control
- Guided missile and space vehicle manufacturing
- Satellite telecommunications
- Search, detection, navigation, guidance, aeronautical, and nautical system and instrument manufacturing.

Wages in the Commonwealth's aviation and space industry have been increasing by an average of 3.0% each year from 2000 to 2009, which is close to the national rate of 3.4%.

3 Carole Rickard Hedden, "Demand for Talent Grows Despite Shrinking Economy," *Aviation Week,* 13 August 2010, *http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=defense&id=news/talgrow_wkf10.xml* (accessed November 29, 2011).

4 Brian Burnsed, "Combating Students' Disinterest in the Sciences," *U.S. News*, 23 May 2011, *http://www.usnews.com/education/best-colleges/articles/2011/05/23/combating-students-disinterest-in-the-sciences?PageNr=1* (accessed November 29, 2011).

5 Aerospace Industries Association (AIA), *Launch into Aerospace: Industry's Response to the Workforce Challenge* (PDF file). 2008, p. 4, http://www.aia-aerospace.org/assets/workforce_report_1_sept08.pdf (accessed November 29, 2011).

6 Chmura Economics & Analytics, Virginia's Aviation and Aerospace State of the Workforce: 2011. (2011) .

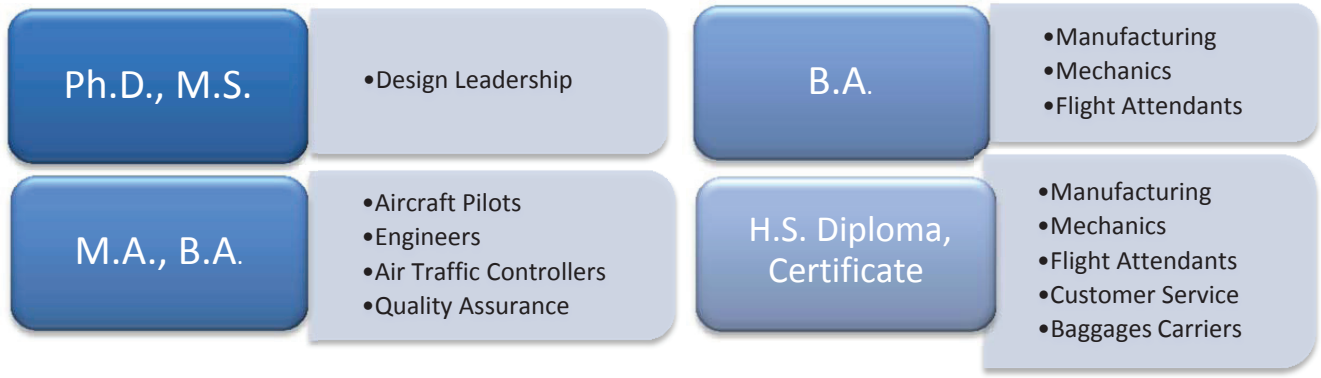
Educational Attainment

The higher wages in this industry are partially driven by an increase in the workforce's average educational attainment. Nearly 75% of all aviation and space occupations currently require some level of college education, and according to Chmura's analysis, this trend is going to increase over the next ten years.[7] The percentage change of Virginia's workforce by level of educational attainment is shown in Figure 5. Figure 6 pairs aviation and space industry occupations with their common corresponding educational requirements:

Figure 5: Educational Attainment in Virginia's Aviation and Space Industry: Ten Year Projections (2011 - 2021)

High School Diploma or Less	(4.4)%
Associate's Degrees	36%
Bachelor's Degrees	17%
Graduate Degrees	34%

Figure 6: Education and Occupations in the Aviation and Space Industry



Productivity

Using a common methodology for determining worker productivity, Chmura Economics & Analytics determined that the sales per aviation and space employee figure was higher than Virginia's industry average, and is growing at a faster than average rate. In 2009, the average sales per employee in all Virginia industries was $116,105, roughly 63% of the aviation and space industry's $194,144. These elevated levels of productivity affect industry workforce in several ways. Although higher productivity often equates to higher wages, it also allows companies to expand without a corresponding increase in workforce.[8] Higher than average productivity may also have an effect on the conservative projections in workforce growth as firms become better equipped to do more with fewer employees.

7 Chmura Economics & Analytics, *Virginia's Aviation and Aerospace State of the Workforce: 2011*. (2011)
8 Ibid.

4. IDENTIFYING FUTURE NEEDS

Workforce Projections

In June 2011, Boeing announced an estimated global need for 460,000 new commercial airline pilots and 650,000 commercial airline maintenance technicians over the next 20 years. Boeing indicated that North America will need 82,800 pilots and 134,800 technicians.[9] According to the Federal Aviation Administration's (FAA) more conservative aerospace forecast for 2011-2031, the United States will need 12,595 new commercial pilots over the same period. The report forecasts a 3.8% average annual increase in total revenue passenger miles (RPM), and a 4.8% annual increase in air cargo revenue ton miles (RTM). General aviation is also projected to grow at a 0.9% annual rate over the next 20 years.[10]

Despite these notable projections for growth, however, industry forecasts by Chmura Economics & Analytics indicate that Virginia's aviation and space industry will need a mere 12,283 more workers over the next 10 years with each job supporting an additional 1.12 jobs elsewhere in Virginia. More specifically, Chmura notes that 10,398 individuals will be needed to replace those who have either retired or left the aviation and space workforce and another 2,000 jobs will be needed as the industry expands.[11]

The more conservative numbers put forward by Chmura may, to a degree, reflect the increased efficiencies that will be part of the industry's future. For example, the growth in total RPM and RTM may not directly translate into similar growth in employment numbers since increasing the aircraft occupancy rate by 5% can result in a 5% growth in total RPM with little need for additional workforce. Also, an airline can optimize flight schedules to reduce the idle time of aircraft and their crews. In addition, greater reliance on self-directed check-in systems significantly reduces the demand for ticket brokers at airport terminals and increased automation in luggage handling can enhance potential capacity dramatically without adding more employees. The improvement in efficiency in the aviation industry implies that the growth in workforce could lag behind the growth in total passenger or cargo miles.

At the same time, Virginia may be able to seize a higher percentage of the potential growth in this industry with a more aggressive approach to pull strategies designed to draw talent pools to the Commonwealth.

Aviation and Space Skills

Projections indicate that potential skill shortages may occur for mechanics, maintenance workers, pilots, and engineering occupations within the aviation and space industry. With the exception of pilots and engineers, the projected shortage focuses on individuals with little or no college experience. While some positions, such as mechanics, may have a certificate validating competency level, employer judgment is usually the only standard for determining if a worker has the skill set required to fulfill the role.

The industry supports a high threshold of jobs that require an understanding of technical STEM subjects. Appendix 4 shows the top thirty occupations by employment in Virginia's aviation and space industry and their correlation to STEM competencies. Nearly half of the top thirty space occupations require employees to exhibit strong STEM skills and competencies. Although Virginia supports a strong network of higher level learning institutions with renowned programs in STEM-related subjects, those wishing to enter the industry out of high school may have difficulty finding

9 "Boeing Challenges Industry to Meet Unprecedented Demand for Aviation Personnel," Boeing press release, June 22, 2011, retrieved from *http://boeing.mediaroom.com/index.php?s=43&item=1809.*

10 "FAA Forecast Fiscal Years 2011-2031," Retrieved from http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/aerospace_forecasts/2011-2031/media/2011%20Forecast%20Doc.pdf

11 Chmura Economics & Analytics, *Virginia's Aviation and Aerospace State of the Workforce: 2011*. (2011).

employment. Unless they attend advanced programs, these students may be lacking the competencies that qualify them for industry employment.

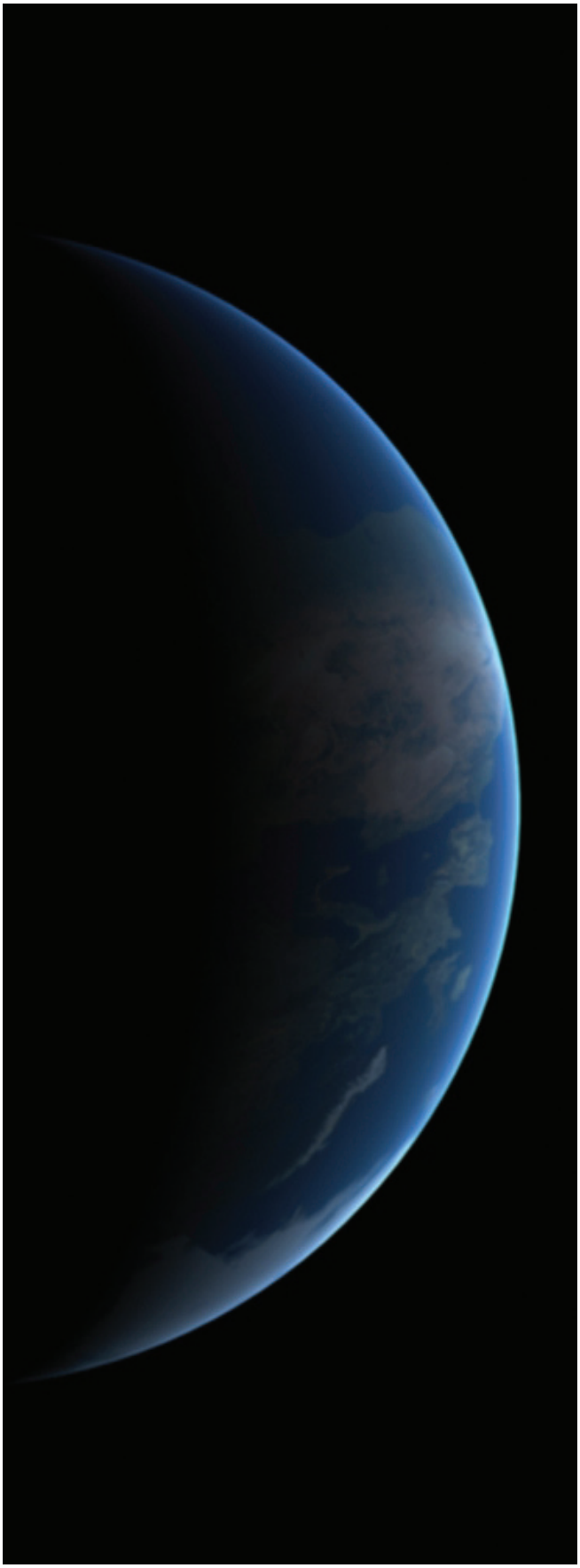
Survey results from the technical analysis suggest that Virginia's aviation and space executives are experiencing a range of issues in attracting and retaining a qualified workforce. Respondents to the survey included human resource representatives and business executives within Virginia's aviation and space industry. Highlights include:

- 57% of space-related respondents reported a lack of qualified candidates for job openings, but only 23% of aviation-related respondents reported this as a problem.
- 67% of space-related respondents cited regulatory trends as having a negative effect on hiring. The point was echoed by 35% of aviation-related participants.[12]

In a similar survey conducted in 2009, commissioned by DOAV, results showed:

- Respondents most frequently cited Airframe and Powerplant (A&P) mechanics and flight line technicians or line service technicians as the most difficult positions to find qualified candidates.
- 59% of respondents mentioned having problems locating a qualified pool of candidates.[13]

Other non-technical but important skills found to be in short supply within the aviation and space workforce include program management, critical-thinking, and decision-making skills. Differing sectors naturally require job-specific training; however, skills such as critical thinking and problem solving are transferable to all positions and allow the workforce to easily adapt, within the Commonwealth's job market.



12 Chmura Economics & Analytics, *Virginia's Aviation and Aerospace State of the Workforce: 2011*. (2011), p. 67

13 Survey and Evaluation Research Laboratory, "Virginia Department of Aviation: Aviation/Aerospace Workforce Survey," Center for Public Policy, L. Douglas Wilder School of Government and Public Affairs VCU, (2009).

5. AVIATION AND SPACE ASSETS

A review of Virginia's aviation and space assets highlights why it makes sense for the Commonwealth to take a more assertive stance on potential job growth in the industry. Virginia has been a pioneer in aviation research since the 1917 establishment of Langley Aeronautical Laboratory, the United States' first civilian lab devoted to aviation and space research and development. In the 94 years since Langley's beginning, Virginia has taken great strides to expand its presence within the aviation and space landscape. The Commonwealth is now home to many space-related organizations advancing a range of missions, including research and development, launch, and commercial space operations. Virginia also boasts an aviation system consisting of 66 public-use airports, 12 aviation/technical schools, and 53 flight schools. The Commonwealth's educational network has provided the foundation for the development of these assets and will be fundamental in fueling growth in the industry.

Education

Virginia's strong aviation-oriented educational network began in 1932 with the establishment of a flight school at the College of William and Mary, the first in the United States to be included within an institution of higher learning.[14] The tradition set by the William and Mary Flight School is continued today through Liberty University's School of Aeronautics. Additionally, Liberty offers degrees with concentrations in flight attendance and in Airframe and Powerplant (A&P) Certification.[15] Other universities, such as Old Dominion University, University of Virginia, and Virginia Tech, offer education and training in a myriad of aviation and space-related engineering fields.

In recent years, Virginia Tech has ranked among the top three universities for recruiting prospective space industry employees as reported through an annual workforce survey conducted by Hitachi Consulting for the industry magazine, *Aviation Week & Space Technology*.[16] In addition, Virginia Tech's Aerospace and Ocean Engineering program ranked 11th in the nation according to the 2011 survey of America's best colleges by *U.S. News and World Report*, with 200 additional students admitted to the undergraduate class for the 2011 academic year.[17] Virginia Tech is also one of the few schools in Virginia to offer a specific aerospace engineering degree that provides hands-on learning opportunities through numerous experimental aerodynamics labs, an aerospace structures and materials laboratory, and a space systems simulation laboratory.[18] The presence of strong universities and research programs in Virginia has resulted in a highly educated and skilled workforce that is the foundation of the aviation and space industry. At the heart of this are programs within the Commonwealth that assist in identifying and building the skills that students can apply in their efforts to seek and maintain employment in the aviation and space industry.

Aviation Magnet School

The FAA reports that 24 states support high school level aviation magnet schools in the United States. Of these, Arizona, California, Florida, Illinois, Maryland, New York, Texas, and Virginia have the highest concentration of schools when compared to the remainder of the United States.[19] Virginia has 8 aviation and

14 B.J. Pryor, "Here Today, Gone Tomorrow: The Remarkable History of the First College Flight School," *Virginia Aeronautical Historical Society* (2010), *http://www.vahsonline.org/Websites/vahsonline/Images/History Project/The Remarkable History of the 1st College Flight School.pdf* (accessed 29 November 2011).

15 Liberty University, "School Of Aeronautics, Aeronautics Program," http://www.liberty.edu/index.cfm?PID=17356 (accessed 29 November 2011).

16 Hitachi Consulting, *2010 Workforce Study* (PDF file), Aviation Week, 20 July 2010. *http://www.okaero.com/wp-content/uploads/2010/08/2010-Aviation-Week-Work-Force-Study-FINAL.pdf* (accessed December 29, 2011).

17 Steven D. Mackay, "'U.S. News' gives high marks to Virginia Tech's undergraduate engineering, business programs," Virginia Tech Website (2010), http://www.vtnews.vt.edu/articles/2010/08/081710-engusnewsrankings.html (accessed 29 November 2011).

18 Virginia Tech, College of Engineering, "Aerospace and Ocean Engineering Research Facilities," *http://www.aoe.vt.edu/research/facilities/index.html* (accessed 29 November 2011).

19 Federal Aviation Administration, "Education, National Aviation Magnet Schools Survey," *http://www.faa.gov/education/educator_resources/magnet_schools/index.cfm?magnet_schools=2010_magnet_schools_summary* (accessed 29 November 2011).

space-related magnet schools. One example is the Newport News Public Schools' "Aviation Academy" at Denbigh High School. Denbigh's "Aviation Academy" is designed to offer students the opportunity to enroll in an advanced STEM curriculum, educating students in the high-tech aviation and space and related engineering fields. Graduates of the program are awarded the Advanced Math and Technology seal on their diplomas to denote successful completion of the advanced coursework. This coursework includes classes in physics, electricity, materials and fluids, pneumatics, and aircraft design. Students also attend courses held at the Newport News-Williamsburg International airport, which include an FAA Pilot Ground School course.[20] The experience gained at the "Aviation Academy" magnet school puts graduates on course to become valuable assets to Virginia's aviation and space industry.

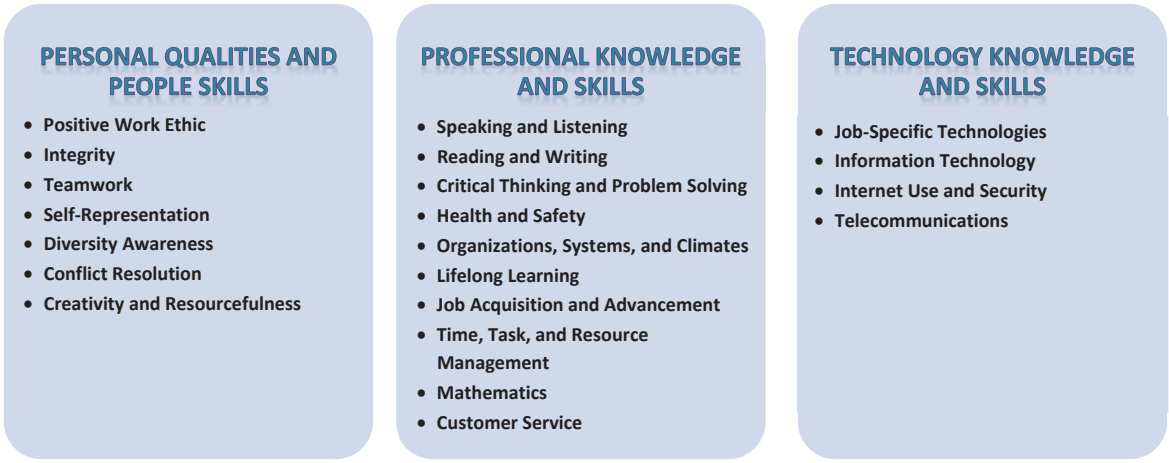
Workplace Readiness Skills for the Commonwealth

The 21 Workplace Readiness Skills encompass attributes that are identified by Virginia employers as essential for individual workplace success and critical to Virginia's economic competitiveness. These skills were developed through research and in close collaboration with business representatives and are a required component of all secondary Career and Technical Education (CTE) courses. Students learn workplace competencies while they develop occupational expertise. These skills and a corresponding assessment are used in the secondary education system, creating a model that addresses a broad range of careers, including professions within the aviation and space industry. The Workplace Readiness Skills for the Commonwealth are listed in Figure 7:

The Virginia College and Career Readiness Initiative

The Virginia College and Career Readiness Initiative (CCRI) prepares high school students for college and the workforce. The CCRI is designed to ensure that college- and career-ready academic expectations are present in the secondary education system and to ensure that students are equipped with the skills and knowledge needed to succeed in college and the workforce. This has been achieved through the CCRI's efforts to identify and define performance expectations for college and career readiness, as agreed upon by the Virginia Department of Education (VDOE), the Virginia Community College System (VCCS), and the State Council of Higher Education (SCHEV). Four institutions of higher education have provided technical assistance and teacher professional development on these performance expectations.[21]

Figure 7: Workplace Readiness Skills for the Commonwealth



**Source: Virginia Department of Education in collaboration with Virginia's CTE Resource Center; Demographics & Workforce Group, University of Virginia; and Career and Technical Education Consortium of States*

20 Newport News Public Schools, "High School Magnet Programs, Aviation Academy Aviation," *http://sbo.nn.k12.va.us/magnet/high.html* (accessed 29 November 2011)

21 Virginia Department of Education, "College and Career Readiness," *http://www.doe.virginia.gov/instruction/college_career_readiness/index.shtml* (accessed 29 November 2011).

Virginia Education Wizard

The Virginia Education Wizard (www.VaWizard.org) is a one-stop online resource used to assist students in secondary education course planning, as well as to inform postsecondary education and career decisions. Aligning with recent state legislation that requires students to create an academic and career plan beginning in the 7th grade, the Wizard is utilized in many school divisions to guide K-12 students in developing such plans. The Wizard program facilitates the career development process from initial coursework choices through postsecondary and career decision-making. Student users align their interests, skills, and values to plan courses that lead to high-wage, high-skill, and high-demand careers. To date, the career planning section of the Wizard remains the most popular feature, accounting for more than half of the over 12 million page views. Utilizing this tool early on to pique interest in aviation and space careers can provide a comprehensive approach in attracting a larger pool of qualified employees.

Courtesy of Roanoke Regional Airport

Virginia Space Grant Consortium

Operating in support of the state's educational assets, the Virginia Space Grant Consortium (VSGC) fosters a collaborative atmosphere among the Commonwealth's colleges and universities, NASA, state agencies, and many museum and research institutions. Every year, the VSGC offers approximately 100 scholarships and fellowships to STEM students enrolled at VSGC partner institutions, as well as internships to students statewide. VSGC's Virginia Aerospace Science and Technology Scholars program provides an interactive learning experience in partnership with NASA Langley Research Center to educate high school juniors to the inner workings of the space industry. Finally, VSGC offers students access to spaceflight-oriented programs and promotes communication between the education system and the aviation and space field to foster interest on a broad scale.

Virginia Career Readiness Certificate

The Virginia Career Readiness Certificate (CRC) is based on ACT's WorkKeys® assessments – Applied Mathematics, Locating Information, and Reading for Information – that provide individuals with a workplace skills certification that employers can use to inform decisions on hiring and training. With support from the Virginia Workforce Council (VWC), the number of CRC recipients continues to grow among Virginia's postsecondary students and transitioning workforce. Community colleges, paired with their local One-Stops, improved partnerships with businesses, enhanced outreach efforts, and saw increases in the number of CRCs. In FY 2011, Virginia awarded approximately 7,500 CRCs, a 30% increase over the previous year. Virginia has awarded about 25,000 CRCs to postsecondary individuals over the past four years.

State and National Promotion

In the summer of 2011, Virginia Lieutenant Governor Bill Bolling co-sponsored a resolution of the National Lieutenant Governor's Association (NLGA) supporting STEM education throughout the U.S. The initiative was a boost to the nation's effort to be more competitive in a global economy that is "knowledge-based, innovation-driven and dependent upon a STEM-education workforce."[22]

Virginia's Lt. Governor Bolling offered the Commonwealth's schools the opportunity to participate in the "Real World Challenge," an aircraft design engineering competition. The program allows aviation industry experts to pose challenges to high school students giving them access to real tools and resources to develop solutions. Students also receive mentoring from industry, government, and the education community. Virginia was one of the ten original states to endorse the competition in 2008 and sanctioned the Real World Challenge as a bridge to meet the needs of the industry and the future of education. Table 1 shows Virginia schools that competed in the Real World Challenge in 2011-2012.

The FAA has also promoted STEM programs in the Commonwealth by hosting or participating in several special events. The Virginia aviation and space industry benefited from national promotion in September 2011 when DOAV received an invitation from U.S. Secretary of Transportation Ray LaHood to participate in the first Semi-Annual Aviation Workforce Management Conference in Washington, D.C. This event was highlighted by the signing of a memorandum of understanding (MOU) among the U.S. Department of Transportation, U.S. Department of Education, and U.S. Department of Labor to promote aviation and space education and workforce development.

The MOU created a means for collaborating agency missions to include:

"...ensuring a fast, safe, efficient, accessible and convenient aerospace system that meets vital national interests and enhances the quality of life of the American people today and into the future; promotes student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access; and fostering, promoting and developing the welfare of the wage earners, job seekers and retirees of the United States while advancing opportunities for profitable employment." [23]

Table 1: 2011-2012 Real World Challenge Virginia Participants

School Name	Number of Teams	Division
Gloucester High School	1	Gloucester County Public Schools
Kecoughtan High School	1	Hampton City Public Schools
Loudoun Valley High School	3	Loudon County Public Schools
Governor's School at Innovation Park	1	Manassas City Public Schools, Manassas Park City Public Schools, and Prince William County Public Schools
Warwick High School	1	Newport News City Public Schools
Heritage High School	1	Newport News City Public Schools
Granby High School	1	Norfolk City Public Schools
Poquoson High School	3	Poquoson City Public Schools
Brentsville District High School	1	Prince William County Public Schools
Forest Park High School	1	Prince William County Public Schools
Richmond Technical Center	1	Richmond City Public Schools
North Stafford High School	1	Stafford County Public Schools
Surry County High School	1	Surry County Public Schools
Blue Ridge Technical Center	1	Warren County Public Schools
West Point High School	2	West Point City Public Schools

22 The resolution can be viewed in its entirety in "Appendix 1: Resolution in Support of STEM Education Initiative."

23 The MOU can be viewed in its entirety in "Appendix 2: Memorandum of Understanding."

Commercial Aviation and Space

Virginia's educational assets play a pivotal role in attracting aviation and space business and research to the Commonwealth. Virginia bolstered its legacy of world-class, university-based research with the recent addition of a public-private research and development enterprise. The Commonwealth Center for Advanced Manufacturing (CCAM) is designed to bring innovation to the aviation and space industry, while advancing the research efforts of Virginia's university system. CCAM is intended to foster research and development through public-private partnerships. CCAM facilities will house research and development to provide private enterprise with access to academia's intellectual capital in return for funding to advance university-affiliated research. CCAM is currently within its first year of operation and plans to provide Virginia with a sustainable source of jobs and avenues for economic development throughout the coming years.

Due to the proactive measures of the Virginia Commercial Space Flight Authority (VCSFA), it and NASA's presence in Virginia has quickly expanded in the last two decades. In 1995, the General Assembly created the VCSFA with the task of advancing Virginia's capacity to support commercial launches, further space-related research, and increase other economic development opportunities associated with the space industry. To accomplish these tasks, the VCSFA, in conjunction with NASA, founded the Virginia Space Flight Center at Wallops Island. In 2004, Virginia governor Mark Warner and Maryland governor Robert Ehrlich forged an agreement to bring the two states into an economic development partnership renaming the Virginia Space Flight Center, the Mid-Atlantic Regional Spaceport (MARS). In its short history, MARS has experienced success in attracting commercial launch missions to the Wallops Flight Facility. MARS has completed three series of launches contracted by the United States Air Force lending it and the Wallops national credibility within the defense and space communities. This national attention helped the VCSFA obtain a contract with the Dulles-based Orbital Sciences Corporation to orchestrate the upcoming International Space Station resupply missions.[24]

24 Mid-Atlantic Regional Spaceport (MARS), "History of Mars," http://www.marsspaceport.com/mid-atlantic-spaceport-history (accessed 29 November 2011).

6. INDUSTRY TRENDS

Next Generation Air Transportation System (NextGen)

The Next Generation Air Transportation System (NextGen) is poised to bring widespread change to the National Airspace System (NAS). According to the FAA's NextGen Implementation Plan released in March 2011, NextGen implementation has begun and is scheduled to be completed incrementally over the coming decades. Its implementation is likely to cause significant changes in the United States' workforce needs.[25]

The NextGen system will revolutionize aviation operations, including air traffic control procedures to provide pilots with real-time weather, flight path, GPS, and aircraft proximity data. Precision GPS will allow pilots to fly more direct routes to destinations in lieu of the conventional, indirect routes designed to ensure constant communication with ground-based control. Multiple aircraft will also be able to fly safer at closer distances due to technology that provides pilots with information on their proximity to other aircraft. More efficient air traffic control procedures will allow aircraft to engage in direct descents with engines idling, thus reducing the noise and environmental impact of aviation operations.

Currently, NextGen implementation is at a critical crossroads. The FAA is seeking to install advanced technology on a large scale to facilitate navigation at higher capacities accommodating air traffic growth; however, budgetary restrictions have hindered progress. As NextGen implementation continues, it becomes necessary to develop a workforce with the manpower, knowledge, and capabilities to both administer the changes from an air traffic control standpoint, as well as to install, use, and repair the new systems.

An example of an area where the NextGen system will produce great change and opportunity is in the mandated use of Automatic Dependent Surveillance-Broadcast (ADS-B) radios in general aviation aircraft. ADS-B is a satellite transmission system which has two components, ADS-B In and ADS-B Out, relaying information between properly equipped aircraft, ground control stations, and other ground locations to assist in air traffic control and coordination. The FAA has mandated that all aircraft must be ADS-B compliant by January 2020. More specifically, the rule mandates ADS-B avionics equipage when operating in certain designated airspace (FAA 14 CFR § 2.225). While most of the commercial aircraft are already in compliance, smaller general aviation aircraft have not yet fully complied. This gap in the industry can be a significant opportunity for Virginia's workforce to excel.

Although the NextGen initiative will influence the future development of the aviation and space industry, there are a number of challenges to ensuring its timely implementation. Certain incentive measures to encourage aircraft operators to invest in NextGen technologies were determined to be either beyond the FAA's current enforcement capacity or too costly to implement at the present time.

A 2010 report from the U.S. Department of Transportation discusses the challenges in safely administering incentive policies to install NextGen compatible systems in the early and middle stages of implementation.

Courtesy of Rolls-Royce

25 Federal Aviation Administration, *"NextGen Implementation Plan,"* March 2011, *http://www.faa.gov/nextgen/media/ng2011_implementation_plan.pdf* (accessed 29 December 2011).

Figure 8: General statistics from FAA's Controller Workforce Plan:

- General aviation operations are expected to grow by 1.5% annually
- FAA plans to hire 11,000 controllers by fiscal year 2019
- NextGen training is anticipated to take approximately 2 ½ years to complete
- FY 2011 Air Traffic Controller staffing for Virginia's 6 largest airports range from 125 (low) – 154 (high)

*Source: Federal Aviation Administration. "A Plan for the Future: 10-Year Strategy for the Air Traffic Control Workforce 2011-2020."

Additionally, questions regarding the elevated implementation costs have yet to be answered. Although challenges continue to present themselves throughout the NextGen implementation process, it will be important for Virginia to remain a close partner with the FAA throughout the course of completion.

DOAV has made an attempt to reinforce this partnership in its *Virginia's Flight to 2025: An Aviation Vision for the Commonwealth* (2011), a strategic plan for the future development of the Commonwealth's Air Transportation System. The document discusses Virginia's goal to be a leader in testing and implementing mature NextGen technologies.[26] Efforts to advance aviation workforce development will strengthen Virginia's partnership with the FAA and favorably position the Commonwealth for workforce training resources and implementation grants.

Evolving Space Policy

On July 21st, 2011, the safe return of the Space Shuttle *Atlantis* essentially marked the end of NASA's Space Shuttle program. It is projected that the effect on the space workforce has and will continue to be significant. Due to NASA's substantial presence along Florida's "Space Coast," shuttle-related layoffs will disproportionately affect Florida's space industry. Estimates place layoffs at nearly 9,000 employees in Florida's Brevard County alone, the site of the John F. Kennedy Space Center.[27] Additionally, the Obama Administration's cancellation of the 2010 Constellation Program and its commitment to fostering the commercial spaceflight industry reinforces the evolution away from government-managed space operations.

In 2008, the FAA qualified Virginia as the most advanced state in its commercial space incentive policies.[28] Virginia has offered several measures to ensure that Wallops Flight Facility remains a serious competitor for commercial launches. One example includes a $26 million bond to fund a series of infrastructure enhancements to the Wallops launch facilities. Virginia's regulatory incentive measures further evoked interest in the capabilities of MARS at the Wallops Flight Facility. Recent legislation, such as the Virginia Space Liability and Immunity Act of 2007 and the Zero Gravity, Zero Tax Act of 2008, is particularly important. The Virginia Space Liability and Immunity Act of 2007 reformed tort law regarding human spaceflight transportation companies and was designed to reduce the liability associ-

26 Virginia Department of Aviation, *Virginia's Flight to 2025: An Aviation Vision for the Commonwealth* (PDF file), 2011, available online at *http://www.doav.virginia.gov/Downloads/Studies/Vision%202025/Vision%202025.pdf* (accessed 29 November 2011).

27 Judith Smelser,. "Space Jobs Scarce for Laid-Off Shuttle Workers." *WMFE*, 11 July 2011, *http://www.wmfe.org/site/News2?page=NewsArticle&id=11719&news_iv_ctrl=2041* (accessed 29 November 2011).

28 Office of Commercial Space Transportation Federal Aviation Administration, State Support for Commercial Space Activities (PDF file),http://www.faa.gov/about/office_org/headquarters_offices/ast/media/State Support for Commercial Space Activities.pdf (accessed 29 November 2011).

Courtesy of Virginia Department of Aviation

ated with commercial spaceflight. By reducing liability, this act protects commercial space companies interested in utilizing MARS. The Zero Gravity, Zero Tax Act of 2008 provides a state tax exemption to space transportation companies interested in launching payloads from MARS or in conducting spaceflight training within the Commonwealth. These legislative incentives help enhance Virginia's competitive standing in the aviation and space industry and set the Commonwealth apart from other states.

7. CASE STUDIES

The case studies highlighted in this section are a sample of national and state workforce development programs that have proven successful in preparing individuals for employment in industries similar to aviation and space. In many ways they resemble the efforts of Virginia's successful workforce and skill development programs, and are meant to assist in developing future programs.

ACT Work Readiness Systems

On a national level, the ACT Work Readiness Systems provide a model for skill identification. The concept driving this system and its respective programs focuses on assessing, developing, and strengthening skills of students, job applicants, and skilled workers. The Work Readiness System is comprised of several integrated tools that assist employers in meeting workforce needs, which include job analysis, various assessments, training and curriculum, certification programs, and research and analytics. Central to the Work Readiness Program is the WorkKeys® assessment, which is a job skill assessment that assists employers in selecting job candidates with the skillsets needed for specific positions.

The WorkKeys® assessment is used in several of ACT's Work Readiness Programs. Various certificates are offered which reflect different levels and types of skills. One specific certificate program that has had great success is the National Career Readiness Certificate program. This program measures important cognitive skills and work-related behaviors to predict the success of an individual in the work environment. To earn this certificate, individuals complete three WorkKeys® assessments that measure "real world skills" critical to workplace success.[29] Upon completion, students receive a certificate that serves as a validation tool of the level of measurable skills acquired by the certificate holder. A sample of measurable skills from the National Career Readiness Certificate program is listed below:

- Problem solving
- Critical thinking
- Reading and using written, work-related text
- Applying information from workplace documents to solve problems
- Applying mathematical reasoning to work-related problems
- Setting up and performing work-related mathematical calculations
- Locating, synthesizing, and applying information that is presented graphically
- Comparing, summarizing, and analyzing information presented in multiple and related graphics

*bulleted information obtained from ACT website: http://www.act.org/certificate/about.html

The ACT National Career Readiness Certificate is an example of a certification process assisting in educating the labor force and skilled workers in aviation and space-related fields. Using the ACT Work Readiness System as a guideline, agencies can address workforce challenges that may plague industry expansion.

Georgia Work Ready Program

The Georgia Work Ready program, initiated in 2006, is an example of the ACT model applied on a state level. The Work Ready workforce program was designed and implemented to assess the current skills of Georgia's workers, offer job training and placement, and ensure job growth while demonstrating to companies that Georgia's labor market is certified to provide high-performance workers on a long-term basis. The Work

29 ACT, "National Career Readiness Certificate," *http://www.act.org/certificate/about.html* (accessed 29 November 2011).

Ready program encourages individual counties within Georgia to increase high school graduation rates through the *College and Career Readiness System*. This system is used to correctly match certified applicants with the proper job-placement opportunities and to allow future employers to match applicants to the positions to which they are best suited.

The Work Ready program has had success and, according to the *Georgia Workforce Investment Act Annual* report, achieved its 2010 goals, including an initiative to aid 10,000 citizens in finding employment. The Work Ready's long-term plan is to increase the amount of certified job applicants and students as well as continue job placement and increase training for skill gaps.

Ohio STEM Learning Network (OLSN)

Ohio has taken significant steps toward improving STEM skill attainment in the education system. In a partnership with the Bill and Melinda Gates Foundation, it created the Ohio STEM Learning Network (OSLN) that is described as:

> *"…an initiative that connects and unites the STEM education assets in the state and provides a forum to share the work. Its overarching goal is to provide a STEM innovation and knowledge network engaging all of Ohio's formal and informal educational assets, from preschool learning through college, to continuously improve STEM curriculum, instruction, assessment, teacher quality, leadership and community engagement."*[30]

This initiative has created seven STEM hubs that serve as regional facilitators between the community, industries, and STEM schools located in Ohio. Currently, Ohio also has 26 K-8 STEM Programs of Excellence and 10 STEM schools. The model works by coordinating four groups of stakeholders around education and skill attainment:

1. **Investors**: Individuals and organizations committing financial support, in-kind resources, and/or political capital to enable the OSLN to carry out the work.

2. **Core Team**: Individuals and organizations providing statewide consistency and coherence to manage the ambiguity of the OSLN during its emergence phase and adaptation to real-world experiences from other stakeholders.

3. **Early Adopters**: Individuals and organizations committed to serve as a proving ground for new approaches to STEM and simultaneously participating in coordinated work.

4. **Capacity Builders**: Individuals and organizations focusing on the infrastructure necessary for sustaining and growing critical STEM education, teaching, and learning ability across a region of interest. [31]

The OSLN network is an excellent example of a coordinated, multifaceted approach to improving STEM skills in the future workforce and is a model of excellence for similar programs.

Employ Florida Banner Center for Aviation and Aerospace

The Employ Florida Banner Center for Aviation and Aerospace is another example of a coordinated workforce development effort. This space industry resource center is designed to assist with current and future workforce training needs by crafting curricula and providing a one-stop shop for training and workforce needs. The resource center's mission is as follows:

> *The Employ Florida Banner Center for Aviation and Aerospace provides training, certification, and support for the continuation and expansion of Florida's aviation and space industries. Besides crafting relevant curricula that address technological advances and changing workforce skills requirements, the Banner Center engages in business incubation initiatives, skills identification and credentialing, industry pipeline development, and the current as well as future economic development of the aerospace industry. Towards these ends, this collaborative system serves as a resource center*

30 Ohio STEM Learning Network, "FAQ," *http://www.osln.org/about-osln/faq/index.php* (accessed 29 November 2011).

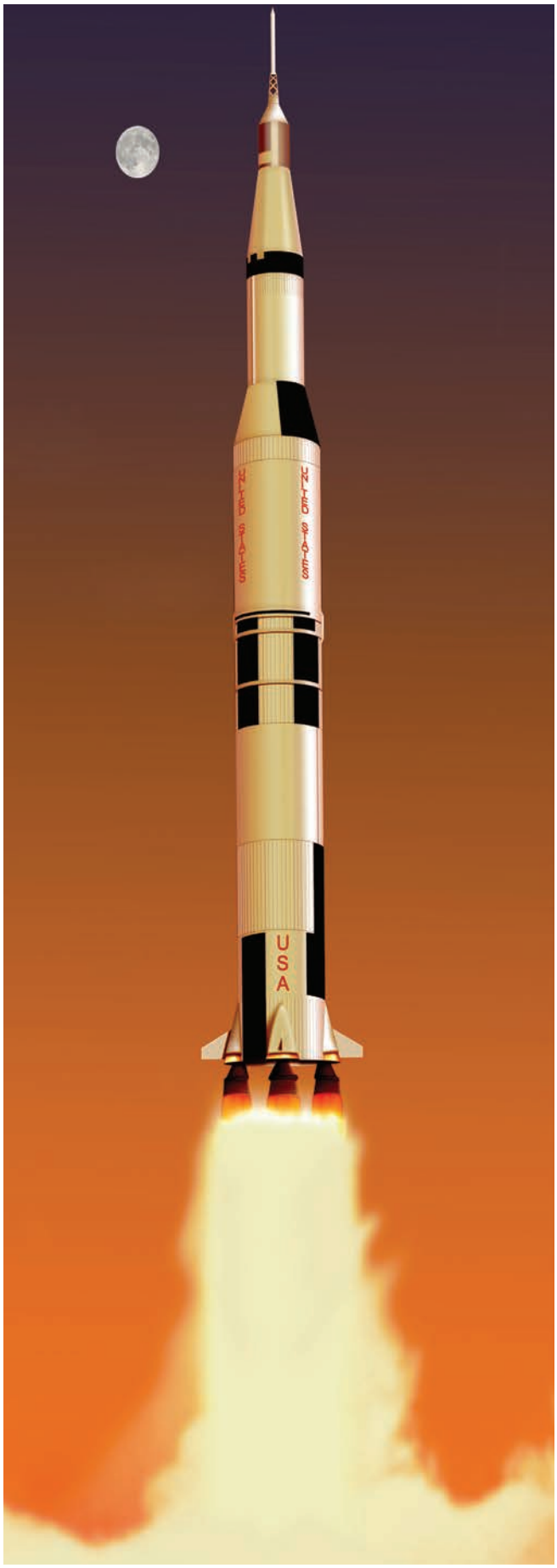
31 Ibid.

for creating a unified workforce education and training system to meet the needs of Florida's aerospace industry.[32]

The resource center currently offers ten training curricula for the aviation and space industry which range from job-specific training such as "Aviation Sheet Metal Technician" to more general knowledge courses such as "Introduction to the Aerospace Industry." In addition to providing comprehensive training programs for the aviation and space industry, the Banner Center also brings together top industry leaders from Florida's major geographic regions, workforce and economic development, and public and private institutions. This resource center is an exemplary model of a coordinated approach to workforce skill development that accounts for the present and looks toward the future.

32 Employ Florida Banner Center, Aerospace Resource Center, "About Us," *http://aerocenter.org/aout-aerospace-resource-center/* (accessed 29 November 2011).

Courtesy of Liberty University



8. RECOMMENDATIONS: VIRGINIA'S ROADMAP TO THE FUTURE

The recommendations included in this report reference STEM-related careers and competencies. They are grounded in the belief that students should develop a core set of skills and aptitudes, including critical thinking and problem solving, through participation in STEM subjects to equip them for success in a range of highly technical career fields. In this way, STEM skills go beyond proficiency in particular facets of science, technology, engineering, and mathematics to reference the core competencies in highest demand among those hiring within the industry.

The Chmura study indicates three themes for enhancing the Commonwealth's aviation and space workforce pipeline:

1) Increase focus on STEM skills in the education pipeline;
2) Develop more advanced technology training;
3) Address the short supply of critical job skills.

These recommendations are designed to equip Virginia with a workforce that has the skills to support a progressive approach to aviation and space industry expansion. This workforce will provide Virginia the logistical support to take the lead in implementing the technological and policy innovations that are reshaping the industry. It is through innovation that Virginia will find the greatest potential for growth. An overview of areas of need, the current status, existing gaps, and recommendations is based upon Chmura's technical report and survey and is available in Appendix 3.

Courtesy of Roanoke Regional Airport

Increasing Focus on STEM skills in the Education Pipeline

Recommendation 1: Enhance interest in STEM-related careers by focusing on the educational pipeline.

The aviation and space industry has a unique opportunity to enhance interest in STEM careers by opening a new learning and teaching lab to increase exposure to the industry. This lab would serve as a gateway to various STEM-based careers in aviation and space. It could be a community effort guided by partnerships with educational entities such as the Science Museum of Virginia, the Virginia Air and Space Center, the National Air and Space Museum (including the Udvar-Hazy Air and Space Center), the Governor's STEM Academies, and other organizations that support informal aerospace education programs. VDOE advisement will be critical to the development and implementation of this initiative. This learning and teaching lab would offer information about the aviation and space industry, providing participants the opportunity to experience hands-on work that is similar to the work that is completed within the industry. These real-world experiences would stress the importance of STEM competencies, with an emphasis on critical thinking, problem solving, and teamwork. Industry and pipeline experts would be available to answer questions and walk students through the types of training and preparation that are necessary for success in aviation and space careers. The laboratory should apply the following methods:

1) A written skill assessment—The assessment would reveal the skill strengths, weaknesses, and interests of the participant as they relate to the aviation and space industry.

2) Problem solving exercise—Participants might engage in a short activity, based on their skill assessment and areas of interest that mimics a daily task, and emphasizes solving common problems associated with an employee's work in the aviation and space field.

3) Education pipeline—Participants would learn about the educational requirements necessary to follow their career path. Students would receive informational packets about Virginia's higher level learning institutions offering degrees in fields most pertinent to their career path of choice.

4) Occupations—Participants would be provided information about different occupations, including written or video narratives from those employed in the industry, including discussion concerning the benefits and disadvantages of the occupations.

5) Real-time job information—Participants could be given the opportunity to map their "Aviation and Aerospace Career Path," to then examine information from JobsEQ® software about real-time job openings, educational requirements, and salaries in the particular aviation and space careers.[33]

Recommendation 2: Enhance STEM opportunities in secondary education.

Industry leaders and survey participants note that STEM competencies are in short supply within the workforce.[34] An effort should be made to increase student involvement in courses that advance a core STEM body of knowledge. VDOE has begun these efforts with several established and successful Career and Technical Education (CTE) programs that include courses in transportation, aerospace engineering and technology, aviation maintenance, pilot training, and air traffic control training. DOAV should continue to promote these, advocating that they be available to high school students throughout the state.

In order to leverage VDOE and the Virginia Community College System's work and to ensure that students are able to apply a core STEM body of knowledge toward a career in the aviation and space industry, we recommend the following:

1) *Advanced training for teachers:* Improving teacher training in STEM-related competencies is critical to ensure that students receive the most up-to-date and relevant knowledge, using the latest teaching techniques. Special attention should be given to training teachers on pedagogical techniques regarding the technical skills for the jobs and industries in highest demand.

2) *Utilize student skill assessments:* High schools should utilize student skill assessments to guide and focus a student's effort in particular subject areas. Special attention should be directed at students with interest in, or skillsets most inclined for entry-level, trade and technical careers in the aviation and space industry.

Recommendation 3: Increase aviation and space industry visibility through marketing and industry promotion.

Virginia's aviation and space industry could greatly benefit from a state-level, cohesive marketing and promotion plan that targets youth in elementary and middle school. Designed to pique interest and provide basic aviation and space exposure, a coordinated partnership between DOAV and VDOE should focus on educating students and promoting aviation- and space-related careers. These promotional efforts might be centralized in the Commonwealth's aviation and space education resources, perhaps as a main component of the learning and skills laboratory mission discussed in the first recommendation.

33 JobsEQ is a software program developed by Chmura Economics & Analytics.

34 Chmura Economics & Analytics, *Virginia's Aviation and Aerospace State of the Workforce: 2011*.

Efforts to increase industry visibility should also extend beyond the educational system to attract the transitional workforce within Virginia and elsewhere around the nation. This might be accomplished through continued industry promotion from a collaborative state and federal perspective, much like the recent efforts described in Section 5. Virginia can harness STEM skills, increase awareness of aviation and space, and bolster its position within the national landscape under a concerted marketing strategy.

Advancing the Workforce Through Technology

Recommendation 4: Identify advanced technology skills and work with colleges (including universities, technical, and community colleges) to equip schools with the latest industry technology.

The educational pipeline should incorporate the latest technologies and training curricula to support the development of a workforce that is responsive to industry trends. Community colleges and universities, with the support of and in collaboration with industry representatives, should focus specific classes or modules toward education in how to install and maintain advanced technology. This should include investment in the latest training tools to match the work being completed within the industry. Classes and modules might also be offered to existing workers to ensure that the workforce remains versed in the latest practices, possessing the necessary skills to facilitate a successful transition to the more technologically-advanced system. A certification process that includes classroom education, as well as technical hands-on instruction would help the industry quickly assess the skill level of those entering or transitioning jobs within the workforce. Updating training materials and curricula will provide Virginia with new opportunities to take a leadership role in evolving the aviation and space industry.

Recommendation 5: Utilize internet-based tools that provide snapshots of the industry, jobs, and wages to attract new employees.

In this era, the majority of individuals seeking new jobs will utilize the internet to research types of jobs, wages, industries, and current job openings. The development, maintenance, and usage of such a tool should serve as a one-stop shop for individuals interested in working in the Virginia aviation and space industry. The application of this tool should be leveraged against computer-based, career development tools already in successful operation within the Commonwealth. From a demand perspective, employers can also utilize this internet-based resource to view résumés, industry projections, and applicant interest levels. Providing a single stop for access to applicant résumés allows businesses to greatly reduce the time it takes to find a qualified employee. The digital nature of the career development tool also allows the user to track industry trends, providing the ability to tailor data to better understand the state of the workforce.

Addressing the Short Supply of Critical Job Skills

Recommendation 6: Develop a statewide strategic plan to address pipeline strategies for informing and engaging the skills of the future, incumbent, and transitioning workforce.

Virginia would benefit from the development and implementation of a statewide strategic plan designed to bring all workforce development organizations together to forge a common path for innovating the aviation and space workforce pipeline. It might include action strategies designed to increase interest in aviation and space employment early in students' education. These strategies might also include ways to better market trade and technical positions in the industry to those students interested in aviation and space, but not interested in seeking a bachelor's or graduate degree to

enter the field. The Commonwealth might also look toward ways to best incorporate more web-based development tools in boosting participation in the workforce pipeline. The development of a strategic plan will insure the most efficient and effective implementation of these strategies from a statewide perspective.

Recommendation 7: Develop mentorship programs to transfer institutional knowledge from the senior generation to the younger generation of the workforce.

The aviation and space industry faces a significant challenge in the retirement of senior workers. A mentorship program could be established by which senior workers are able to educate junior workers to the inner workings of the industry, offering them valuable institutional knowledge and helping to facilitate a smoother transition from junior to senior-level roles. These senior employees have valuable knowledge regarding aviation and space industry standards, procedures, and institutional norms that the junior employees may not yet have acquired when they transition to senior positions. Mentorship programs can provide the means for transferring this knowledge to junior employees. By adequately preparing employees to replace the retiring workforce, the industry can sustain productivity, even in the face of elevated retirement rates.

Recommendation 8: Place ex-military with defense contractors to facilitate the pipeline between the military exits and the aviation and space workforce.

The highly skilled military population in Virginia represents a significant competitive advantage to the aviation and space workforce. In many cases, exiting military personnel hold the security clearances and industry-specific experience that make them well-suited for employment within the field. Virginia's aviation and space industry may benefit from allocating the state's resources in ways that supplement the current federal and industry-based military transition pipeline. Recommendations include grant funding for economic development marketing programs to be administered at job fairs or within Virginia's transition assistance offices. In addition, exploratory efforts should determine the feasibility of motivating Virginia's government contractors to focus recruitment efforts at military installations within the state.

Recommendation 9: Capitalize on the workforce recruitment opportunity resulting from the termination of NASA's Space Shuttle Program.

Virginia's capacity to support commercial space launch activities provides the Commonwealth with a unique opportunity to attract NASA's displaced employees and contractors. The depth of training and experience achieved during employment with NASA's Shuttle Program equips these employees with skill sets that are immediately transferable to private sector spaceflight operations. According to the Brevard Workforce, *Aerospace Workforce Outlook Report*, "The culture of safety and quality in the STS [Space Transportation System] workforce is one that industries nationwide expend significant expense to achieve."[35] Virginia should extend marketing efforts to attract these displaced STS employees in support of pending commercial space-

Courtesy of Liberty University

35 Brevard Workforce, *Aerospace Workforce Outlook Report: Phase III* (PDF file), 2010, p. 17, *http://www.bwdb.org/DownloadDocuments/Misc Documents/AWO Phase III Report.pdf* (accessed 29 November 2011).

BIBLIOGRAPHY AND WORKS CITED

Aerospace Industries Association (AIA). *Launch into Aerospace: Industry's Response to the Workforce Challenge* (PDF file). N.d. <*http://www.aia-aerospace.org/assets/workforce_report_1_sept08.pdf*> [accessed December 2011]

Atkinson, Robert D. and Scott Andes. *The 2010 State New Economy Index: Benchmarking Economic Transformation in the States.* Information Technology and Innovation Foundation: November 2010. <*http://www.itif.org/files/2010-state-new-economy-index.pdf*>

Boeing. "Boeing Challenges Industry to Meet Unprecedented Demand for Aviation Personnel." Boeing Press Release, June 22, 2011. <*http://boeing.mediaroom.com/index.php?s=43&item=1809*>

Brevard Workforce. *Aerospace Workforce Outlook Report – Phase III* (PDF file). January 2010. <*http://www.bwdb.org/DownloadDocuments/Misc Documents/AWO Phase III Report.pdf*>

Burnsed, Brian. "Combating Students' Disinterest in the Sciences." *U.S. News,* May 23, 2011. <*http://www.usnews.com/education/best-colleges/articles/2011/05/23/combating-students-disinterest-in-the-sciences?PageNr=1*>

Carrier, Achsah & Meredith Gunter. *Critical Workplace Skills for Virginia's Economic Vitality* (PDF file*).* November 2010. University of Virginia: Weldon Cooper Center.

Chmura Economics & Analytics. *Virginia's Aerospace and Aviation Industry: State of the Workforce 2011*.

Employ Florida Banner Center for Aviation and Aerospace. "About Us." <*http://aerocenter.org/aout-aerospace-resource-center/*> [accessed December 2011]

Federal Aviation Administration (FAA). "National Aviation Magnet Schools Survey." <*http://www.faa.gov/education/educator_resources/magnet_schools/index.cfm?magnet_schools=2010_magnet_schools_summary*> [accessed December 2011]

Federal Aviation Administration. *FAA Aerospace Forecast: 2011-2031* (PDF file). N.d. Available at <*http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/aerospace_forecasts/2011-2031/media/2011%20Forecast%20Doc.pdf*> [accessed December 2011]

Federal Aviation Administration's Office of Commercial Space Transportation. *State Support for Commercial State Activities* (PDF file). N.d. <*http://www.faa.gov/about/office_org/headquarters_offices/ast/media/State%20Support%20for%20Commercial%20Space%20Activities.pdf*> [accessed December 2011]

Liberty University. "School of Aeronautics." <*http://www.liberty.edu/index.cfm?PID=17356*> [accessed December 2011]

Long, Emily. "FAA planner size up workforce demands with new air traffic control system." *Nextgov*, April 2, 2011. <*http://www.nextgov.com/nextgov/ng_20100402_4134.php*>

Mid-Atlantic Regional Spaceport (MARS). "History of MARS." <*http://www.marsspaceport.com/mid-atlantic-spaceport-history*> [accessed December 2011]

Newport News Public Schools. “High School Magnet Schools.” <*http://sbo.nn.k12.va.us/magnet/high.html*> [accessed December 2011]

Ohio Stem Learning Network (OSLN). “Our Promise.” <*http://www.osln.org/about-osln/our-promise.php*> [accessed December 2011]

OSLN. “Frequently Asked Questions.” <*http://www.osln.org/about-osln/faq/index.php*> [accessed December 2011]

Pryor, B.J. “Here Today, Gone Tomorrow: The Remarkable History of the First College Flight School.” Prepared for Virginia Aviation History Project. N.d. Available at <*http://www.vahsonline.org/Websites/vahsonline/Images/History Project/The Remarkable History of the 1st College Flight School.pdf*> [accessed December 2011]

“Space Jobs Scarce for Laid-Off Shuttle Workers.” Judith Smelser. *Fresh Perspectives,* WMFE, July 8, 2011. Audio and Transcription available at <*http://www.wmfe.org/site/News2?page=NewsArticle&id=11719&news_iv_ctrl=2041*> [accessed December 2011]

Survey and Evaluation Research Laboratory. “Virginia Department of Aviation: Aviation/Aerospace Workforce Survey.” 2009. Center for Public Policy, L. Douglas Wilder School of Government and Public Affairs VCU.

Virginia Department of Aviation. *Virginia Airport System Economic Impact Study: Executive Summary.* 2011. Summary prepared by ICF SH&E, et al. Available online at <*http://tinyurl.com/7ajws6a*> [accessed December 2, 2011]

Virginia Department of Education. “Virginia College & Career Readiness Initiative.” <*http://www.doe.virginia.gov/instruction/college_career_readiness/index.shtml*> [accessed December 2011]

Virginia Tech College of Engineering. *Aerospace & Ocean Engineering.* “Research Facilities.” <*http://www.aoe.vt.edu/research/facilities/index.html*> [accessed December 2011]

GLOSSARY OF ACRONYMS

ADS-B – Automatic Dependent Surveillance-Broadcast

CCAM – Commonwealth Center for Advanced Manufacturing

CCRI – College and Career Readiness Initiative

CRC – Career Readiness Certificate

CTE – Career and Technical Education

DOAV – Virginia Department of Aviation

FAA – Federal Aviation Administration

MARS – Mid-Atlantic Regional Spaceport

MOU – Memorandum of Understanding

NAICS – North American Industry Classification System

NAS – National Airspace System

NextGen – Next Generation Air Transportation System

NLGA – National Lieutenant Governor's Association

OSLN – Ohio STEM Learning Network

RPM – Revenue Passenger Miles

RTM – Revenue Ton Miles

SCHEV – State Council of Higher Education

STEM – Science, Technology, Engineering, Mathematics

STS – Space Transportation System

VCCS – Virginia Community College System

VCSFA – Virginia Commercial Space Flight Authority

VDOE – Virginia Department of Education

VSGC – Virginia Space Grant Consortium

VWC – Virginia Workforce Council

Appendix 1

Resolution in Support of STEM Education Initiative

RESOLUTION IN SUPPORT OF STEM EDUCATION INITIATIVE

WHEREAS, the foundation of America's leadership in the 21st century knowledge based, innovation-driven global economy is built upon a Science, Technology, Engineering and Mathematics (STEM) literate workforce;

WHEREAS, the U.S has one of the lowest rates of STEM degree production in an international comparison; the international average is 26.4% of all degrees; the US rate is 16.8%, while Japan's rate is 64.0%, China's rate is 52.1% and India's rate is 32.5%; [1]

WHEREAS, the number of STEM-qualified, new entrants into the aerospace workforce is projected to be insufficient to fill the workforce pipeline creating a gap; 54% of the aerospace and defense STEM workers are 45 years old or older and 1/3 are eligible to retire today and only 7.5% of students enter baccalaureate programs in STEM fields such as engineering and only 50% of those graduate; [2]

WHEREAS, the vitality of the aerospace industry in the United States is essential to the national security, war on terror, and the economic competitiveness of the nation and the aerospace industry relies upon a highly-skilled, technically qualified workforce to accomplish its mission; the aerospace workforce declined from 800,000 in 1993 to 624,200 in 2010; aerospace industry sales are forecast to be $219.2 billion in 2011; [3]

WHEREAS, key STEM stakeholders have indicated that they want people in the workforce with 7-10 years of real world experience; and that significant real world experience can be provided at the secondary level;

WHEREAS, the Real World Design Challenge provides real world STEM experience for secondary students by providing a real problem, real tools and resources, real roles for students, and an opportunity for students to make real contributions;

[1] Jeffrey J. Kuenz, *CRS Report for Congress: Science, Technology, Engineering and Mathematics (STEM) Education; Background Federal Policy and Legislative Action*, March 2008.
[2] Druyun, *Defense Reform 2001, A Blueprint for Action: Final Report, DFI International* 2001; *Occupational Outlook Handbook*, 2002-03; Chubin, *National Action Council for Minorities in Engineering Testimony to the Government-University-Industry Research Roundtable*, 2002.
[3] *Aerospace Industries Association Year-End Review and Forecast*, AIA Research Center, 2011.

WHEREAS, the Real World Design Challenge has involved 7,672 students from 29 states over the last three years;

WHEREAS, the Real World Design Challenge provides a quality STEM education experience that is *FREE* to students, is provided at no cost to the taxpayers of the states, and brings millions of dollars of STEM education resources to the states;

NOW LET IT BE RESOLVED, that the NLGA encourages member states to investigate partnership with the Real World Design Challenge;

NOW LET IT BE FURTHER RESOLVED, that the NLGA encourages interested states to publicize the Real World Design Challenge, encouraging educators to take advantage of this partnership;

NOW LET IT BE FURTHER RESOLVED, that the NLGA would support, as possible, members and their state departments of education in involving teachers in the Real World Design Challenge.

As introduced on this 24th day of June, 2011.

Sponsored by: Lt. Governor Mead Treadwell (AK)
Lt. Governor Brian Schatz (HI)
Co-Sponsors: Lt. Governor Kim Reynolds (IA)
Lt. Governor Yvonne Prettner Solon (MN)
Lt. Governor Tim Murray (MA)
Lt. Governor Todd Lamb (OK)
Lt. Governor Matt Michels (SD)
Lt. Governor Gregory Francis (USVI)
Lt. Governor Kay Ivey (AL)
Lt. Governor Bill Bolling (VA)
Lt. Governor Greg Bell (UT)

Appendix 2

Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING
Among the
UNITED STATES DEPARTMENT OF TRANSPORTATION
And
UNITED STATES DEPARTMENT OF EDUCATION
And
UNITED STATES DEPARTMENT OF LABOR
To
PROMOTE AVIATION AND SPACE EDUCATION AND AEROSPACE WORKFORCE DEVELOPMENT

Purpose:
This Memorandum of Understanding (MOU) establishes a collaborative effort between and among the Department of Transportation (DOT), the Department of Education (ED), and the Department of Labor (DOL) to foster the development of a skilled workforce through science, technology, engineering, and mathematics (STEM) programs and initiatives relating to aerospace workforce development. DOT, ED, and DOL share a common goal of promoting and developing a skilled workforce that can meet the Nation's demands for the 21st century. The purpose of this MOU is to improve collaboration and inter-departmental support among DOT, ED, and DOL in furtherance of that goal and in accordance with the following department missions:

- DOT:
  - Serve the United States by ensuring a fast, safe, efficient, accessible, and convenient aerospace system that meets our vital national interests and enhances the quality of life of the American people, today and into the future;
- ED:
  - Promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access;
- DOL:
  - Foster, promote, and develop the welfare of the wage earners, job seekers, and retirees of the United States; and
  - Advance opportunities for profitable employment.

This MOU establishes a mechanism for inter-departmental collaboration for the purpose of developing and implementing strategies and activities for using STEM education to develop a workforce that is highly qualified to work in the aerospace industry. Under this MOU, each department will seek to leverage existing resources and increase coordination of activities in support of aerospace workforce development, including through industry collaboration and by increasing internship, apprenticeship, mentoring, and volunteering opportunities in STEM fields. This MOU will support programs promoting learning, workforce development, and teacher training relating to skill development for STEM fields, including mathematical reasoning, scientific inquiry, and problem-solving skills. This MOU promotes joint endeavors by the departments that motivate students and help

them develop STEM skills leading to careers that benefit the Nation's workforce and address growing needs within the aerospace industry.

Background:
In April 2010, the Future of Aviation Advisory Committee (FAAC) was established by DOT to provide information, advice, and recommendations to the Secretary of Transportation on ensuring the competitiveness of the U.S. aviation industry and its capability to address the evolving transportation needs, challenges, and opportunities of the global economy. The FAAC's final report contained the following:

> "The Secretary of Transportation should work with the Secretary of Labor … to implement a national strategy focused on recruiting, training, and cultivating the aerospace workforce…. Additionally, the Secretary of Transportation should work with the Department of Education to provide resources that would create state-of-the-art STEM elementary and secondary educational facilities."

This recommendation followed up on the finding of DOL's Interagency Aerospace Revitalization Task Force, in February 2008, (*Report of Interagency Aerospace Revitalization Task Force)* on the importance of STEM education. In that report, the Task Force found that "… there is significant concern that students who are participating in K-12, postsecondary, apprenticeships, and/or career and technical education are not adequately prepared for employment in STEM careers."

In September 2010, the President's Council of Advisors on Science and Technology published a report (*Prepare and Inspire, K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future).* The committee concluded:

> "To meet our needs for a STEM-capable citizenry, a STEM-proficient workforce, and future STEM experts, the Nation must focus on two complementary goals: We must prepare all students, including girls and minorities who are underrepresented in these fields, to be proficient in STEM subjects. In addition, we must inspire all students to learn STEM and, in the process, motivate many of them to pursue STEM careers."

The report went on to state:

> "Over the past few decades, a diversity of Federal projects and approaches to K-12 STEM education across multiple agencies appears to have emerged largely without a coherent vision and without careful oversight of goals and outcomes. In addition, relatively little Federal funding has historically been targeted toward catalytic efforts with the potential to transform STEM education, too little attention has been paid to replication and scale-up to disseminate proven programs widely, and too little capacity at key agencies has been devoted to strategy and coordination."

DOT's strategic plan notes that developing human capital through workforce planning is important to identifying mission and workforce trends, to assessing mission-critical core competencies, and to implementing plans to close workforce gaps through vigorous learning and knowledge management approaches, targeted recruitment, and succession planning. The DOT/FAA's Aviation and Space Education (AVSED) program is uniquely situated to provide resources and expertise to address the concern about the future workforce needs of the aerospace community. With DOT's mission in mind, the AVSED program is committed to ensuring a dependable supply of qualified workforce professionals by supporting educators and engaging students through exciting and high-quality aerospace thematic STEM programs, including many aspects of STEM education, in order to ensure a dependable supply of qualified workforce professionals. The AVSED program strives to ensure a steady entrance of diverse, qualified STEM experts into our country's air transportation and aerospace industry.

Intent:

The aim of this MOU is to facilitate increased collaboration and coordination of information by and among DOT, ED, and DOL in order to share information more efficiently and more effectively target the appropriate audience. By informing decisions on each Department's allocation of resources in the development of a skilled professional workforce through quality STEM programs, the three departments can better fulfill our Nation's aerospace workforce needs.

As a key part of this effort, DOT, through the AVSED program, will provide training and support for educators, work with local educational agencies and state educational agencies to thoughtfully connect aviation and aerospace-related instructional materials to existing curriculum, and disseminate information about activities, projects, youth events, and aviation career guidance. To the extent possible, ED will assist with the collection of information relating to STEM education and its dissemination to state and local educational agencies, provide information regarding internships, apprenticeships, and grant opportunities, and promote educator development opportunities as they relate to this MOU. DOL will support the public workforce system's efforts to coordinate with industry, share grant information related to STEM career pathways initiatives with partner agencies and their stakeholders, and disseminate information on educational initiatives and workforce development as it relates to this agreement.

It is understood and agreed by DOT, ED, and DOL that the intent of this MOU is to state shared goals and to establish and maintain cooperation and collaboration towards meeting these shared goals. This MOU does not create any binding obligation, contractual, financial, or otherwise, for any party. This MOU also does not serve to obligate any funds of the participating agencies nor to authorize the transfer of funds between the participating agencies of this agreement. Each department agrees to conduct its respective activities in a coordinated and mutually beneficial manner. DOT, ED, and DOL will evaluate their respective participation in any specific event on a case-by-case basis, in accordance with relevant law and regulations. Pursuant to this MOU, DOT, ED, and DOL agree to establish a partnership that will develop and coordinate activities that address, but not necessarily be limited to addressing, the following objectives:

1. *Collaboration*
    - Participating jointly in the Administration's strategic planning and design of projects and activities that advance transportation workforce development in STEM fields;
    - Serving as a resource for communities exploring alternative methods for the delivery of aerospace educational services; and
    - Continuing to encourage department personnel to support existing internship, apprenticeship, mentoring, and volunteering opportunities in order to create a consistent national effort.
2. *Focal Areas*
    - Reviewing new and existing programs to identify opportunities for collaboration in instances where programs directly complement or supplement one another;
    - Involving or partnering with non-federal stakeholders, including schools and state and local decision-makers;
    - Working with educational organizations, both formal and informal, to provide support and assistance where practical, beneficial, and applicable to the focus of this MOU;
    - Engaging industry partners and workforce stakeholders to align Federal efforts with industry's projected needs;
    - Designing program collaboration in a manner that capitalizes on the relative strengths and expertise of each department and reflects department missions; and
    - Aligning program collaboration to capitalize on the relative strengths, expertise, and mission of each department.
3. *Coordination*
    - Sharing information and/or supporting joint efforts in the following areas: K-12 program partnerships; workforce services, including training for workers (both incumbent and unemployed); and leveraging internet resources, including social media;
    - Setting program priorities and ensuring alignment to achieve common goals and objectives; and
    - Promoting mentoring and volunteering opportunities.
4. *Strengthening the knowledge base by sharing intellectual expertise*
    - Exchanging information on pending legislation related to STEM education;
    - Sharing information on legislative initiatives, regulatory and non-regulatory issues, and administrative actions originating from DOT, ED, and DOL that may affect aerospace workforce development;
    - Reviewing proposed legislation to identify common issues, as well as to assess the potential impact on department programs and the relationship of proposed initiatives to department strategies and priorities;
    - Sharing of information relating to aerospace workforce development and STEM education; and

- Identifying common issues and strategies to maximize allocation of resources and attainment of common goals.

5. *Leadership Support and Accountability*
   - Developing a formal process to improve communication and coordination between departments regarding aerospace workforce development efforts;
   - Exploring and developing a collaborative communications strategy designed to increase public awareness and visibility regarding STEM education and aerospace workforce development;
   - Supporting designated staff as points of contact to enable them to carry out the purposes and scope of the MOU;
   - Identifying the highest-priority joint actions along with timelines for implementation; and
   - Developing performance measures to track progress of this MOU.

Effective Date and Termination:
This MOU takes effect when signed below and shall remain in effect for a period of three (3) years. DOT, ED, and DOL agree to review this MOU annually to determine whether it should be revised, renewed, or terminated. Notice of termination shall be served on all other parties at least ninety (90) days prior to the effective date of that termination unless all parties consent to an earlier termination date. Only the signatories or their successors and designees may terminate this MOU.

DOT enters into this agreement pursuant to its authority under 49 U.S.C. § 301 and § 322(c).

ED enters into this MOU under the authority to enter into agreements in section 415 of the Department of Education Organization Act (DEOA) (20 U.S.C. § 3475), and consistent with the purposes set forth in section 102(4), (5), and (6) of the DEOA (20 U.S.C. § 3402(4), (5), and (6).

DOL enters into this MOU under the authority under 29 U.S.C. § 551 and also under the Workforce Investment Act, section 189(c) [29 U.S.C. § 2939(c)].

Agreed By:

Sept 20, 2011
Date

Secretary of Transportation

Sept 21, 2011
Date

Secretary of Education

Sept 21, 2011
Date

Secretary of Labor

Appendix 3

Recommendations Summary

Recommendations Summary				
Area	**Current**	**Need**	**Gap**	**Recommendation**
Aviation/Space Workforce Pipeline	28,110 employees	12,000-13,000 employees needed by 2020	Individuals will soon be needed for new hire and retiree replacement	Industry Visibility: Recommendation #3 Jobs Listing and Industry Snapshot Tool: Recommendation #5 Military Pipeline: Recommendation #8 Displaced NASA contractor/employee recruitment: Recommendation #9
Critical Skills in Short Supply	33% of survey respondents say lack of qualified employees for job openings is a critical issue	Survey respondents stated that employees and recruits lack project management skills (49%), critical thinking skills (48%), and decision making skills (46%)	Skills need to be identified so that employers hire adequately skilled workers	Statewide Strategic Plan: Recommendation #6 Industry Mentorship: Recommendation #7
STEM Skills and the Educational Pipeline	Half of all space occupations in Virginia are STEM related	86% of space and 15% of aviation survey respondents stated STEM skills were lacking	Virginia will benefit from better training in STEM skill alignment from P-20 pipeline and aviation and space industry	Enhance interest in STEM early in students' education: Recommendation #1 Enhance STEM Opportunities in Secondary Education: Recommendation #2
Advanced Technology Training	71% of survey respondents offer employee training programs	33% of space and 21% of aviation survey respondents indicated that technology will impact workforce planning	Current and future employees need training for new advanced technologies	Advanced Technology Training: Recommendation #4

Appendix 4

Top Thirty Occupations - Virginia Aviation Industries					
SOC	Title	2010Q2 Employment	10-Year Growth Demand	Minimum 10-Year Replacement Demand	STEM
43-4181	Reservation and Transportation Ticket Agents and Travel Clerks	2,899	379	647	
39-6031	Flight Attendants	2,874	412	639	
49-3011	Aircraft Mechanics and Service Technicians	2,073	315	400	✓
53-2011	Airline Pilots, Copilots, and Flight Engineers	2,067	287	699	✓
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	845	5	271	
53-6099	Transportation Workers, All Other	669	125	239	
43-5011	Cargo and Freight Agents	628	184	143	
39-6011	Baggage Porters and Bellhops	592	100	153	
43-4051	Customer Service Representatives	583	128	183	
43-1011	First-Line Supervisors/Managers of Office and Administrative Support Workers	493	69	111	
53-2012	Commercial Pilots	361	91	122	✓
49-9042	Maintenance and Repair Workers, General	274	37	42	
39-6032	Transportation Attendants, Except Flight Attendants and Baggage Porters	246	37	55	
49-2091	Avionics Technicians	228	52	38	✓
49-1011	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	223	16	58	
53-7199	Material Moving Workers, All Other	220	(1)	25	
43-5081	Stock Clerks and Order Fillers	202	18	46	
43-9061	Office Clerks, General	169	26	23	
11-1021	General and Operations Managers	168	8	49	
53-7061	Cleaners of Vehicles and Equipment	163	4	58	
13-1199	Business Operations Specialists, All Other	153	24	34	
43-3031	Bookkeeping, Accounting, and Auditing Clerks	134	18	16	
53-2021	Air Traffic Controllers	132	15	45	✓
43-5061	Production, Planning, and Expediting Clerks	132	9	32	
33-9032	Security Guards	131	18	27	
43-6011	Executive Secretaries and Administrative Assistants	118	20	16	
37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	117	8	22	
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	108	32	23	
53-6051	Transportation Inspectors	105	22	25	
53-2022	Airfield Operations Specialists	100	18	34	
Source: Chmura Economics & Analytics, 2011					

Top Thirty Occupations - Virginia Aerospace Industries					
SOC	Title	2010Q2 Employment	10-Year Growth Demand	Minimum 10-Year Replacement Demand	STEM
17-2011	Aerospace Engineers	746	131	154	✓
17-2199	Engineers, All Other	507	80	105	✓
17-2072	Electronics Engineers, Except Computer	283	34	65	✓
17-3029	Engineering Technicians, Except Drafters, All	264	31	50	✓
51-2092	Team Assemblers	251	(0)	56	
15-1032	Computer Software Engineers, Systems	226	103	19	✓
51-2011	Aircraft Structure, Surfaces, Rigging, and	223	67	47	
17-2112	Industrial Engineers	221	61	56	✓
13-1199	Business Operations Specialists, All Other	217	34	48	
51-2022	Electrical and Electronic Equipment Assemblers	210	(18)	32	
15-1031	Computer Software Engineers, Applications	201	93	17	✓
51-9061	Inspectors, Testers, Sorters, Samplers, and	184	6	30	
51-4041	Machinists	183	(6)	24	
17-2141	Mechanical Engineers	173	20	44	✓
17-3023	Electrical and Electronic Engineering	170	16	32	✓
17-2071	Electrical Engineers	159	21	36	✓
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	147	31	38	
11-9041	Engineering Managers	138	23	28	✓
49-3011	Aircraft Mechanics and Service Technicians	134	20	26	✓
11-1021	General and Operations Managers	130	6	37	
51-1011	First-Line Supervisors/Managers of Production and Operating Workers	121	(5)	16	
13-1111	Management Analysts	115	40	20	
43-4051	Customer Service Representatives	110	24	35	
19-2099	Physical Scientists, All Other	109	10	28	✓
43-6011	Executive Secretaries and Administrative	109	19	15	
11-9199	Managers, All Other	107	12	28	
51-2023	Electromechanical Equipment Assemblers	106	(11)	16	
13-1041	Compliance Officers, Except Agriculture, Construction, Health and Safety, and Transportation	101	33	11	
43-5061	Production, Planning, and Expediting Clerks	100	7	24	
13-2011	Accountants and Auditors	80	20	14	✓
Source: Chmura Economics & Analytics, 2011					

Virginia SATSLab, Inc.
Virginia Department of Aviation
5702 Gulfstream Road
Richmond, Virginia 23250-2422
www.doav.virginia.gov