2011

Aerospace and Aviation Workforce Strategy

Kristy Rochon

Center for Urban and Public Affairs, Wright State University

Ohio

Ohio Board of Regents

AEROSPACE AND AVIATION WORKFORCE STRATEGY

JUNE 30, 2011

ACKNOWLEDGMENTS

Prepared for.....**Ohio Board of Regents**

Prepared by.....**Kristy Rochon**
Dayton Development Coalition

Employer survey implementation and analytics provided by.....**Wright State University**
Center for Urban and Public Affairs

dayton development coalition
WWW.DAYTONREGION.COM
900 Kettering Tower Dayton, OH 45423

Workforce Challenges in the Aerospace and Aviation Industry

TABLE OF CONTENTS

INTRODUCTION

Despite the struggling economy and the challenges that have plagued the commercial aviation market, the national Aerospace and Aviation industry has experienced growth from 2005 to 2009. U.S. Aerospace sales increased by 21 percent and profits increased by 29 percent. However, at the same time, aircraft production lines have contracted as a result of decreased defense spending over the past 15 years. This contraction has limited production surge capacity, an event that is looming as a result of aging aircraft in both the commercial and defense fleets.

There is a window of opportunity for the State of Ohio to emerge as a global industry leader. In order to capitalize on this opportunity, the State must address critical gaps in workforce and economic development. The talent development pipeline must focus not only on meeting the current business demand, but also on anticipating future national demand. This forward reaching strategy could position the state to receive aircraft production lines as the industry strains to meet increasing commercial and defense demands.

The following strategy provides a view toward the industry, documented business demand—known supply side issues—and recommendations.

Industry and Outlook

INDUSTRY AND OUTLOOK

DEFINING THE INDUSTRY

The State of Ohio's Aerospace and Aviation industry has a direct workforce of 85,215 across 3,280 establishments. The defense industry also drives advances in Aerospace, and due to the missions moving to Ohio under the 2005 Defense Base Realignment and Closure process (BRAC), Sensors and Human Factors are expected to grow in the private sector. These support fields account for an additional 193,959 jobs and 8,025 establishments; they should be included in workforce strategies to measure growth from the baseline year of 2011.

For consistency of data and to ensure outcomes can be measured by the baseline data presented in this strategy, the following outlines recommendations for defining the Aerospace and Aviation Industry.

CHART 1: DEFINING THE AEROSPACE AND AVIATION INDUSTRY

Core Occupations

NAICS	DESCRIPTION
AEROSPACE MANUFACTURING	
333314	Optical Instrument and Lens Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
335931	Current-Carrying Wiring Device Manufacturing
336411	Aircraft Manufacturing
336412	Aircraft Engine and Engine Parts Manufacturing
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing
336414	Guided Missile and Space Vehicle Manufacturing
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
AVIATION	
481111	Scheduled Passenger Air Transportation
481112	Scheduled Freight Air Transportation
481211	Nonscheduled Chartered Passenger Air Transportation
481212	Nonscheduled Chartered Freight Air Transportation
481219	Other Nonscheduled Air Transportation
488111	Air Traffic Control
488119	Other Airport Operations
488190	Other Support Activities for Air Transportation
611512	Flight Training
RESEARCH AND DEVELOPMENT	
541330	Engineering Services
541380	Testing Laboratories
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)
FEDERAL GOVERNMENT/MILITARY	
911000	Federal Government, Civilian, Except Postal Service
912000	Federal Government, Military

CHART 1: DEFINING THE AEROSPACE AND AVIATION INDUSTRY *CONTINUED*

Support Occupations

NAICS	DESCRIPTION
HUMAN FACTORS	
334119	Other Computer Peripheral Equipment Manufacturing
511210	Software Publishers
541330	Engineering Services
541380	Testing Laboratories
541519	Other Computer Related Services
541611	Administrative Management and General Management Consulting Services
541618	Other Management Consulting Services
541620	Environmental Consulting Services
541690	Other Scientific and Technical Consulting Services
541720	Research and Development in the Social Sciences and Humanities
SENSORS	
333314	Optical Instrument and Lens Manufacturing
334411	Electron Tube Manufacturing
334412	Bare Printed Circuit Board Manufacturing
334413	Semiconductor and Related Device Manufacturing
334414	Electronic Capacitor Manufacturing
334415	Electronic Resistor Manufacturing
334416	Electronic Coil, Transformer, and Other Inductor Manufacturing
334417	Electronic Connector Manufacturing
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing
334419	Other Electronic Component Manufacturing
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables
334514	Totalizing Fluid Meter and Counting Device Manufacturing
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
334516	Analytical Laboratory Instrument Manufacturing
334517	Irradiation Apparatus Manufacturing
334518	Watch, Clock, and Part Manufacturing
334519	Other Measuring and Controlling Device Manufacturing
335314	Relay and Industrial Control Manufacturing

INDUSTRY OUTLOOK

The U.S. Aerospace and Aviation industry is fractured, with research and development (R&D) located mainly in the Eastern United States and the majority of the manufacturing workforce on the West Coast. However, there are areas in the country that have been successful in gaining traction with Aerospace and Aviation manufacturing jobs, like Kansas and South Carolina.

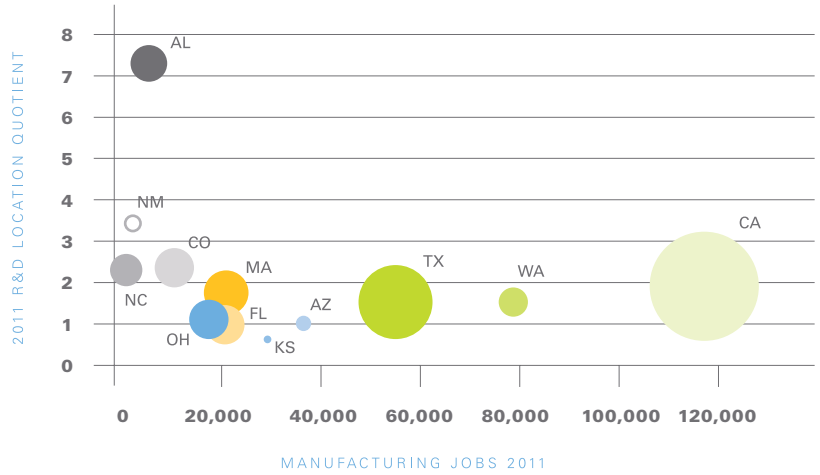
From a talent development perspective, over the past few decades, the major Aerospace prime contractors have developed talent recruitment practices that are hard to change. Specific skill sets are recruited from targeted programs, and often times, those manufacturing and R&D functions are located where the talent is produced.

South Carolina recently broke the trend, winning Boeing's second 787 Dreamliner production line. Boeing cited South Carolina's lower costs compared to Washington, and its world-class port as a strategic asset to gaining access to western countries. Another factor that has been implied by the National Labor Relations Board is that Boeing looked to expand into a non-union/right-to-work state due in part to a 58-day strike in Washington.

The union issue aside, South Carolina's win proves major manufacturing decisions are not predetermined. The State of Ohio's value proposition is the concentration and projected growth in R&D, its current manufacturing workforce and existing Aerospace and Aviation parts manufacturing, the capacity to grow due to its pool of skilled unemployed manufacturing workforce, billions of dollars in R&D conducted at Wright-Patterson Air Force Base (WPAFB), and a vast university system willing to respond to business demand.

CHART 2: AEROSPACE AND AVIATION MANUFACTURING AND R&D STRENGTHS

Statistical Area Comparison to State Industry Strength



Alabama
New Mexico
North Carolina
Colorado
Massachusetts
Florida
Ohio
Kansas
Arizona
Texas
Washington
California

Size of bubble represents growth in R&D over next five years

Chart 2 methodology: States having a high location quotient, and workforce were identified for comparison purposes. Within each state, MSAs (Metropolitan Statistical Area) were evaluated for industry concentration. The state numbers represented in the chart include only those MSAs that were identified as industry strengths for each state.

The State of Ohio is better positioned to attract a prime manufacturing operation than locations, such as Kansas and Arizona. Though both Kansas and Arizona have a large Aerospace and Aviation manufacturing workforce, their R&D workforce growth and location quotient are very low. Ohio competes well when compared with strongholds like Florida and Massachusetts. In fact, not only is Ohio's Aerospace and Aviation industry competitive with states boasting similar capabilities, but also the statewide industry has the potential to surpass strongholds like Colorado and Alabama.

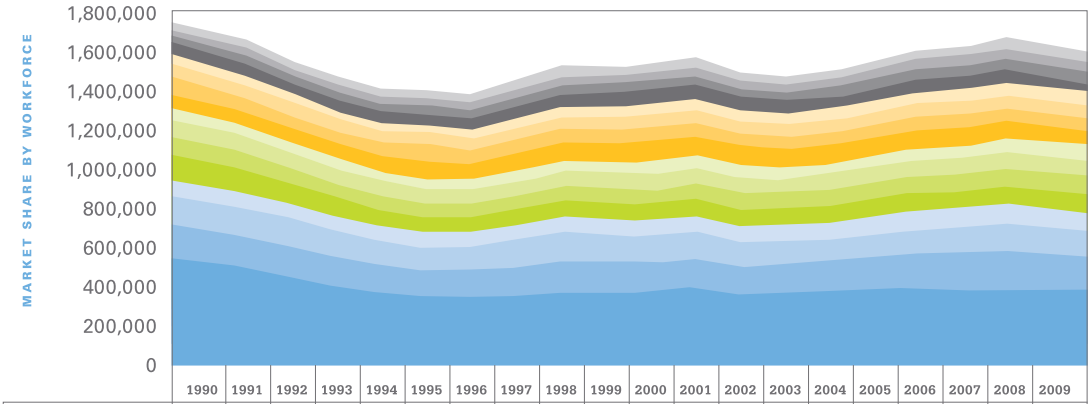
MARKET SHARE BY INDUSTRY MANUFACTURING WORKFORCE

A survey of trends across the Aerospace and Aviation industry revealed a concentration of the industry market share. The industry job numbers across the nation have fluctuated over the past 20 years. Despite those shifts, Ohio has maintained a steady share of the jobs. While the industry jobs have come and gone, percentages have remained fairly stable across the top 16 states, particularly among the small market shares. Ohio has an opportunity to upset the concentration as the industry surges by attracting major Aerospace and Aviation companies before the industry peaks again.

The following analysis illustrates the industry changes from 1991 to 2009 in the states with more than 50,000 jobs in 2009.

CHART 3: AEROSPACE AND AVIATION WORKFORCE ECONOMIC INDICATOR

Aerospace and Aviation Manufacturing Market Share



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Kansas	49.3	48.9	48.2	45.3	42.3	42.5	47.3	55.3	60.4	60.8	58.6	59.4	51.5	44.7	44.5	47.2	49.7	54.0	56.8	50.9
Georgia	27.2	26.4	25.9	38.2	38.5	39.3	40.4	44.5	37.7	39.3	39.7	39.7	38.2	44.8	47.3	49.6	52.2	53.9	55.7	53.9
Colorado	26.4	43.9	42.9	41.6	38.3	40.0	42.9	47.1	49.0	50.0	48.8	50.0	48.3	47.8	49.5	54.5	56.0	57.6	58.8	57.5
Illinois	61.0	60.6	59.9	60.5	60.3	59.9	59.7	61.8	63.6	68.0	71.0	72.5	67.4	63.4	59.9	61.7	63.9	64.1	64.6	62.2
Arizona	46.3	44.6	41.1	39.5	38.5	42.4	44.7	46.8	50.5	52.0	54.3	56.3	55.7	54.3	56.1	58.8	61.8	64.4	63.5	62.5
Ohio	79.5	76.4	74.3	68.2	64.6	63.9	64.7	66.7	67.4	66.6	66.7	66.7	63.9	62.4	62.4	63.9	66.4	67.5	69.3	66.1
New Jersey	72.1	68.3	66.3	65.6	65.3	93.1	67.1	65.9	71.4	74.2	76.5	77.5	73.4	69.2	70.1	70.3	72.7	72.9	71.6	70.8
Michigan	70.6	74.4	72.4	74.7	76.9	80.9	83.8	86.0	92.1	98.3	103.0	97.1	96.6	94.6	91.4	91.2	89.1	87.2	83.7	73.8
Maryland	69.0	64.0	60.5	57.8	56.3	55.8	54.9	57.4	59.1	61.5	65.2	67.1	69.1	60.2	64.0	66.5	68.6	70.8	71.9	82.7
Pennsylvania	92.9	90.5	81.9	79.1	78.2	77.6	76.1	78.2	79.8	78.9	79.3	81.3	76.2	73.7	78.6	83.2	83.7	84.9	87.7	86.4
Massachusetts	86.7	82.3	78.5	77.0	74.3	71.8	72.4	74.6	77.2	77.1	78.1	80.7	80.5	79.1	81.3	84.3	87.9	88.3	93.2	93.1
New York	123.2	113.6	102.7	95.5	88.5	82.7	78.6	80.4	83.0	84.4	86.8	88.4	89.4	87.4	88.2	90.9	91.8	93.8	96.8	96.3
Florida	91.5	85.5	82.6	79.9	76.7	78.0	77.2	80.2	84.9	86.9	87.8	88.3	87.0	87.7	94.2	100.9	106.9	106.6	107.0	100.8
Washington	146.5	146.8	143.1	129.6	124.4	113.5	119.0	138.4	147.8	135.8	124.9	127.4	118.0	108.2	105.9	111.7	119.2	128.9	134.6	133.5
Texas	166.7	162.1	157.5	152.6	140.0	139.7	143.6	148.8	159.5	157.2	158.7	159.9	155.8	157.6	158.7	170.2	180.1	187.5	195.7	190.6
California	521.9	469.8	424.6	376.9	346.9	323.9	320.8	331.0	349.4	350.4	350.3	369.4	337.8	350.0	356.1	366.3	371.1	361.6	370.6	355.8

This chart includes only Aerospace and Aviation manufacturing workforce numbers due to voids in historical data. Numbers in thousands.

MANUFACTURING

A cornerstone of increasing the market share of the Aerospace and Aviation workforce is to ensure the pipeline is full of highly skilled manufacturing workers. As the Aerospace and Aviation industry contracts, each job will become more competitive. However, when the industry surges, locations with the needed workforce will be better positioned to win a prime manufacturer.

Capturing employer demand in manufacturing has been a challenge across Ohio. Though employers report the need for high-skilled workers, Labor Market Information (LMI) shows losses in manufacturing, even though demand can be demonstrated in high-skill fields. Ohio Department of Job and Family Services (ODJFS) One-Stop

offices are designed to assist job seekers and employers with workforce related services. One-Stop representatives across the state report that dislocated workers cannot get training dollars for education and training within the manufacturing industry due to these overall losses. Exceptions are sometimes given if the One-Stop offices receive documentation from employers.

Another challenge in the manufacturing industry is one of image. With the loss of nearly 200,000 manufacturing jobs in Ohio over the past five years, many dislocated workers believe the industry is not hiring, or they choose to find something more stable that cannot be outsourced. These workers have the industry experience that Aerospace and Aviation businesses seek, but they lack the education businesses require.

With the downsizing of traditional manufacturing demands, defining growth areas in advanced manufacturing has been challenging and recruiting a workforce willing to enter high-skilled manufacturing positions has been difficult.

Ohio's employers report the need to up-skill workers across all production industries—Aerospace, Chemicals, Polymers, Plastics, Energy, Pharmaceuticals, Medical devices, and many other industries. Many unemployed manufacturing workers have skills that are out-of-date in a manufacturing environment; most have an educational foundation with skills required for postsecondary education.

However, colleges in Ohio do not have a mechanism to consistently assess workers, document their skills, or provide credit for experiential learning that would assist students in preparation for accelerated programs or short-term technical training that could help them fill high-demand manufacturing positions.

The following high-wage manufacturing fields demonstrated growth after the departure of General Motors (GM) from the Dayton Region and are projected to continue to grow over the next five years. The Dayton MSA and Montgomery County were the hardest hit in Ohio by the Automotive decline. It is critical to note, according to ODJFS, the majority of manufacturing jobs open in the first quarter of 2011 require a bachelors degree to qualify.

CHART 4: ADVANCED MANUFACTURING OCCUPATIONS REPORTING GROWTH

Dayton Region Growth

NAICS CODE	DESCRIPTION	GROWTH 01–07	GROWTH 08–10	GROWTH 11–16	2010 TOTAL EPW
336992	Military Armored Vehicle, Tank, and Component Manufacturing	507	409	1,377	$75,272
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	615	259	1,284	$83,439
325412	Pharmaceutical Preparation Manufacturing	213	52	951	$112,320
331491	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding	383	48	738	$58,194
336412	Aircraft Engine and Engine Parts Manufacturing	50	346	405	$91,789
339112	Surgical and Medical Instrument Manufacturing	160	5	373	$83,948
325211	Plastics Material and Resin Manufacturing	66	66	365	$83,399
333993	Packaging Machinery Manufacturing	99	21	274	$85,874

INDUSTRY CONTRACTION AND LONG-TERM WORKFORCE REQUIREMENTS

The Aerospace and Aviation industry has been contracting for several years. As defense demand for new aircraft declined, smaller companies merged with the larger primes. This has left a void in the Aerospace and Aviation industry and has resulted in few integrating prime contractors capable of competing for future defense aircraft—for example: Lockheed Martin, Boeing, Alenia North America, Airbus America, and Northrop Grumman. Other primes such as Raytheon, General Atomics, General Dynamics, and General Electric provide either unmanned air vehicles or systems that support the aircraft production. International companies can compete if they have a U.S. prime partner and a U.S. production facility. With this consolidation, the opportunities for innovation can be hampered, and the nation's surge capacity for aircraft manufacturing has been compromised.

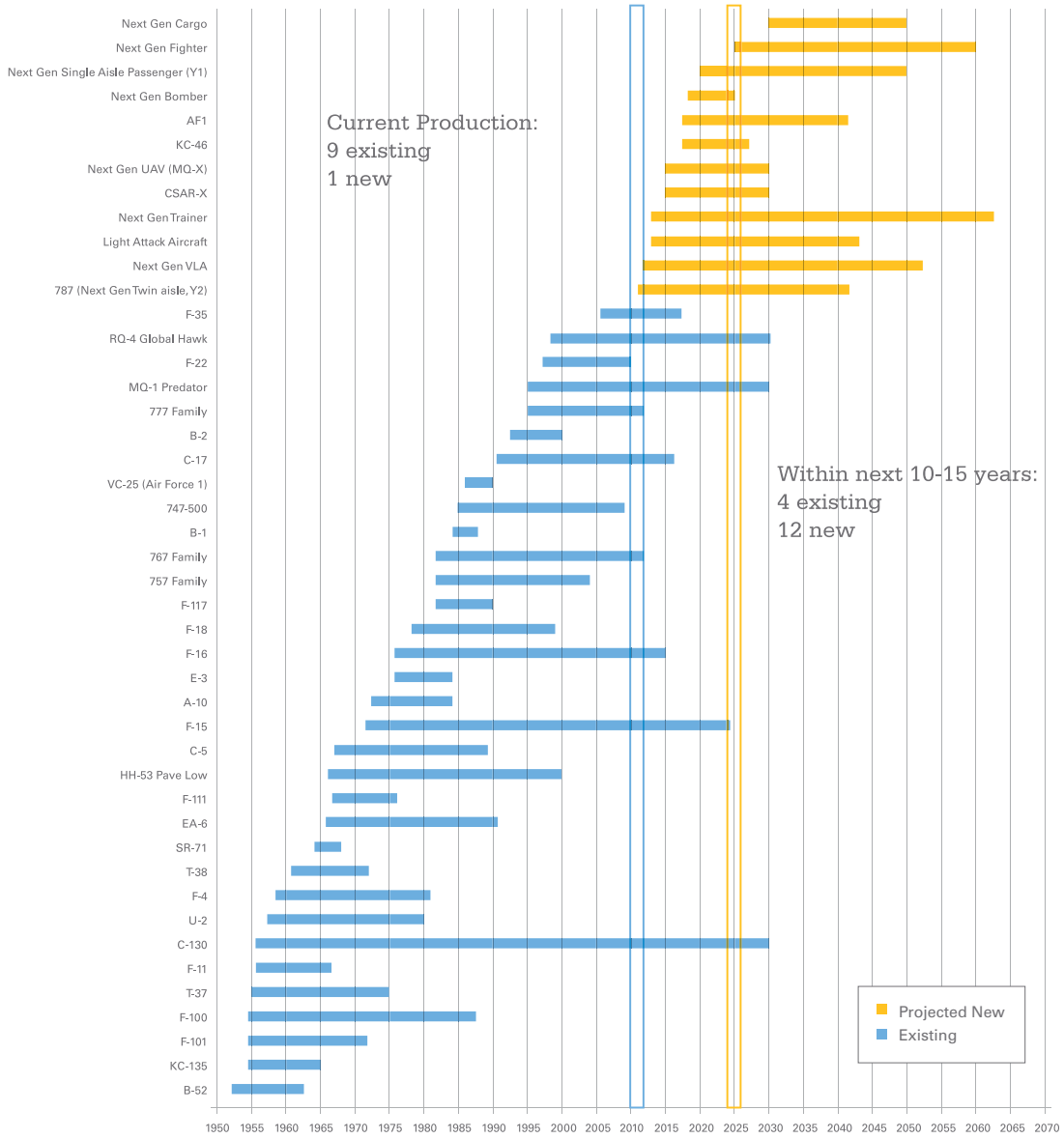
The average ages of both the military and commercial fleets are 28 years old, and both sectors are making long-term plans for their next generation replacements. It is anticipated that many of these new production lines will ramp up at roughly the same time, straining existing production capacity and could hit a critical mass within the next 10 to 15 years.

While current and near-term workforce requirements must be addressed, any Aerospace and Aviation workforce strategy must have a view toward the mid- and long-term demand. It is with that demand that the Ohio Board of Regents (OBOR) can effectively impact state success. Most recommendations contained in this document that address current and near-term demand are stop-gap measures that should be implemented in order to find best practices for long-term solutions.

With at least 12 new aircraft requirements on the horizon *(illustrated in chart 5)* and shortfall of production lines and available workforce, states must position themselves now to capitalize on the growing capacity. Producing the right quality and quantity of graduates will be critical to any value proposition proposed to the prime contractors. Not since World War II has there been such a surge in new aircraft production lines.

CHART 5: AIRCRAFT PRODUCTION LINES *(data from open source materials, some dates are speculative)*

Aircraft Production Lines Trends and Projections



Business Demand

BUSINESS DEMAND

CURRENT AND FIVE-YEAR BUSINESS DEMAND

More than 120 private Aerospace and Aviation companies in the State of Ohio participated in a workforce survey to define Aerospace and Aviation workforce requirements over the next five years. Even though this timeframe is limited compared to the long-term growth in the Aerospace and Aviation industry, most businesses struggled to define these short-term needs as their workforce demand depends on the company's success in winning defense contracts.

In these results, a nearly equal number of companies are represented in Aviation, Aerospace, and Defense sectors. The most common industrial classification of these companies is in the R&D classification (NAICS 541712), representing 39 of the 126 companies responding to the survey.

AEROSPACE AND AVIATION DEMAND

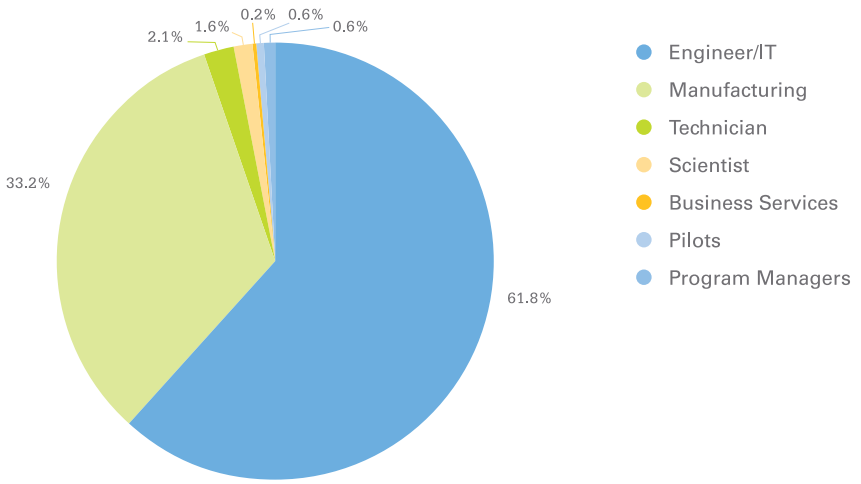
One-third of the companies anticipate future shortages of qualified candidates over the next five years. The most common reasons for this are due to specific occupation or skills that are already perceived to be difficult to recruit/attract and due to education and training programmatic issues.

Ninety occupations were specified by the 126 private sector companies surveyed as critical occupations of the Aerospace and Aviation Industries. Engineering and Information Technology emerged as the most critical and complicated. In these two fields, little standardization of occupation titles and experience is required; as a result, the focused analysis shifted to degrees required for the occupations. The top five common degrees were defined as: Mechanical Engineering, Aerospace Engineering, Electrical Engineering, Computer Science, and Computer Engineering. The study also looked at secondary degrees that would be considered by the businesses if the primary degrees were unavailable.

ENGINEERING AND INFORMATION TECHNOLOGY

CHART 6: AEROSPACE AND AVIATION DEMAND BASED ON SURVEYED BUSINESS RESPONSE

Business Anticipated Shortfalls for Aerospace and Aviation Occupations



The Engineering and Information Technology group emerged as the most critical and complicated group. For this reason, greater analysis will be provided.

The following chart outlines the more flexible degrees, the occupation titles supplied by surveyed businesses, the projected demand for the occupational titles provided by surveyed businesses, and the statewide demand for the degrees regardless of the industry. Double counting is expected in each of the projected jobs due to the cross cutting nature of the degrees.

CHART 7: MOST FLEXIBLE DEGREES IN THE AEROSPACE AND AVIATION INDUSTRY

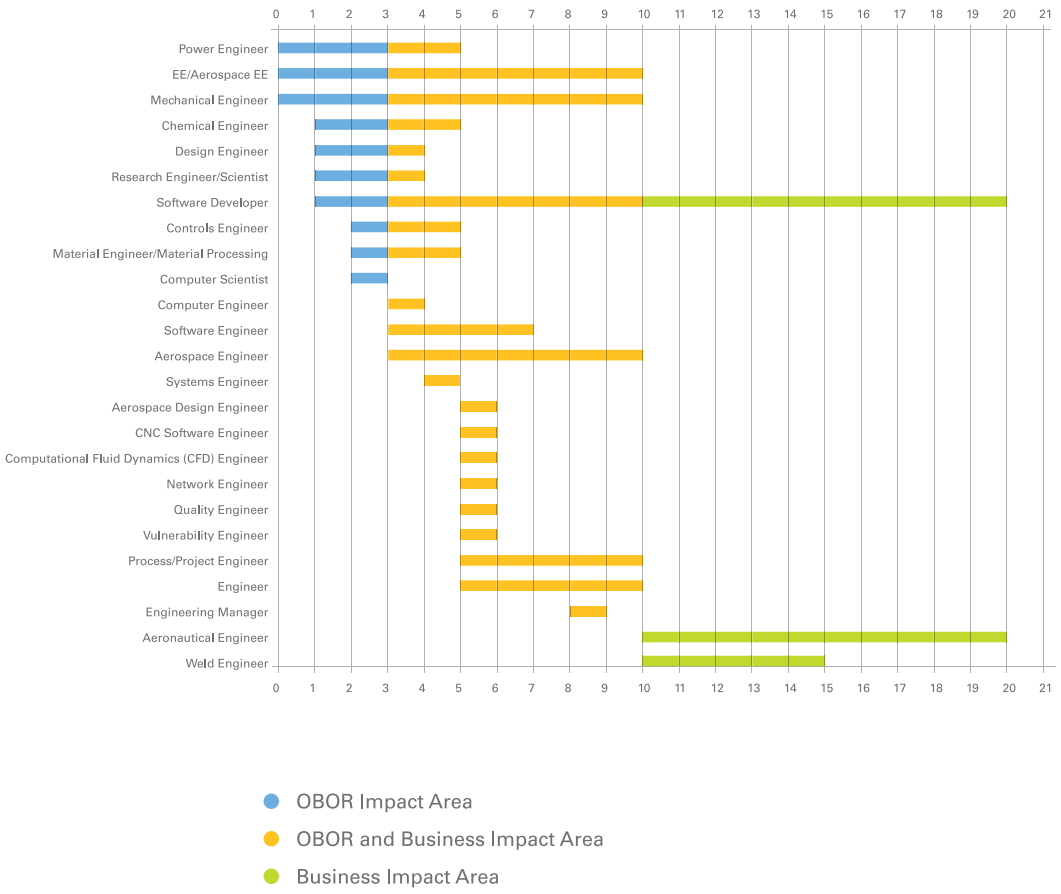
Occupations Matched to Primary Degrees

PRIMARY DEGREE IN...	CAN MEET OCCUPATIONAL REQUIREMENTS OF...	DEMAND FROM SURVEYED COMPANIES	STATEWIDE ANNUAL DEMAND FOR DEGREE
Mechanical Engineering	Aerospace Engineer, Design Engineer, Manufacturing Engineer, Mechanical Engineer, Process/Project Engineer, Quality Engineer, Research Engineer/Research Scientist, Vulnerability Engineer	191	383
Aerospace Engineering	Aerospace Engineer, Electrical Engineer, Manufacturing Engineer, Mechanical Engineer, Process/Project Engineer Vulnerability Engineer	156	95
Electrical Engineering	Design Engineer, Electrical Engineer, Power Engineer, Research Engineer, Software Engineer, Vulnerability Engineer	171	225
Computer Science	Computer Scientist, Computer Engineer, Software Developer, Software Engineer, Systems Engineer	266	2,583
Computer Engineering	CNC Software Engineer, Computer Engineer, Network Engineer	15	1,254

In total, the number of specialists employed by private companies in Engineering and IT occupations among sampled firms is currently 538, while the projected employment for specialists in 3 to 5 years grows 60 percent to 863. A strong growth rate is not applicable to all occupations. High growth occupations include Aerospace Engineering (AE), Computer Science (CS), and Systems Engineering (SE).

The years of experience required by occupation varies by employer. For instance, some companies stated that they require three years of experience for their Aerospace Engineers, while others require ten years. Several initiatives are needed to address the complexity of the problem. OBOR can have a greater affect on the positions, requiring zero to three years of experience through a robust internship program and strengthening co-op programs. The other areas will require a combination of programs targeting experienced technicians (primarily at WPAFB), the development of Bachelors of Applied Science degrees, and increasing retention rates of masters and doctorate graduates. These initiatives are addressed in the Recommendations section of this document.

CHART 8: YEARS OF EXPERIENCE NEEDED FOR SELECT OCCUPATIONS BASED ON SURVEYED BUSINESS RESPONSE



SECONDARY DEGREES

In addition to identifying flexible primary degrees, the survey respondents were also asked to identify secondary degrees that would be accepted for the critical occupations. When citing secondary degrees, companies were asked what competencies those degrees typically lack compared to the primary degree. Though physics was not identified as a primary degree for any of the occupations, it emerged as a flexible secondary degree. Mechanical Engineering (ME) and Electrical Engineering (EE) also demonstrated their abilities to be cross-cutting with the appropriate supplemental training. Suggestions on how to take advantage of this data is explored in the Recommendations section of this document.

CHART 9: SECONDARY DEGREES BASED ON BUSINESSES SURVEYED

Occupations Matched to Secondary Degrees and Skill Gaps

SECONDARY DEGREE IN...	CAN MEET OCCUPATIONAL REQUIREMENTS OF...	LISTED SKILLS LACKING	STATEWIDE ANNUAL DEMAND FOR DEGREE
Physics	Aerospace Engineer, Electrical Engineer, Engineering Manager, Software Developer, Software Engineer, Systems Engineer, Vulnerability Engineer	Occupation Specific Programs Radio Frequency MBA Programming Skills Java Programming Programming Skills Not Specified	47
Electrical Engineering	Controls Engineer, Design Engineer, Engineering Manager, Manufacturing Engineer, Network Engineer, Research Engineer	Not Specified Not Specified MBA Materials Background Not Specified Experience with mechanical & electronic hardware	225
Mechanical Engineering	Aerospace Engineer, Engineering Manager Power Engineer Research Engineer/Research Scientist Software Developer	Aerospace Systems MBA Electrical Skills Experience with mechanical & electronic hardware Programming Skills	383
Chemistry	Engineering Manager Mechanical Engineer	MBA Mechanic Skills, Materials Processing and knowledge	130

SCIENTISTS AND BUSINESSES SERVICES

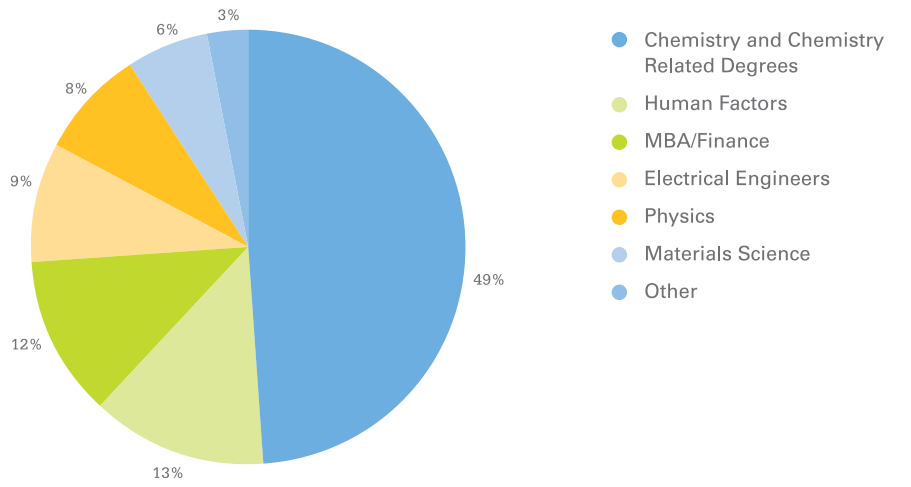
In addition to Engineering and Information Technology, Business Services and other Science occupations were identified as critical, hard-to-fill occupations. These occupations account for a total of 116 jobs. Though this group accounts for 16% of the occupations, these business demands should be monitored.

Three companies reported employing 33 research scientists, and these scientists were presented in the Engineering Group rather than in the list of scientists. The degrees desired for those research scientists were PhD level MEs and AEs.

The analysis of the other scientist occupations and the financial service occupations is outlined in the chart below.

CHART 10: SCIENCE AND BUSINESS SERVICES

Business Anticipated Shortfalls for Science and Business Services



Federal Demand

Federal Demand

WRIGHT-PATTERSON AIR FORCE BASE

Though not included in the survey, the workforce requirements at Wright-Patterson Air Force Base (WPAFB) and NASA Glenn impact, and at times drive, the Aerospace and Aviation workforce requirements for Ohio.

AERONAUTICAL SYSTEMS CENTER

Located at WPAFB, the Aeronautical Systems Center (ASC) is the largest of three product centers within the Air Force Materiel Command (AFMC). ASC manages more than 500 Air Force, joint and international aircraft acquisition programs and related projects; executes an annual budget of $23 billion; and employs a workforce of more than 10,000 people located at the base and 38 other locations worldwide. Approximately 9,000 ASC employees are assigned to WPAFB.

The acquisition and logistic workforce needed to maintain ASC's portfolio programs is a fast-growing workforce, and in acquisition alone, WPAFB leadership is expecting to hire more than 750 highly-skilled program managers and logisticians over the next five years. A large percentage of ASC's current workforce is also eligible to retire in the next five years, and an equally large percentage still needs a graduate degree and could potentially benefit from a program focused on Program Management. On top of the new jobs and replacement jobs due to retirements, ASC operates with a standard attrition rate of 3 percent. Though the future impacts of these statistics is largely unpredictable, all likely outcomes lead to an environment where the Dayton Region could see considerable promotion opportunities for those who are currently employed with advanced degrees, as well as a significant portion of entry level/journeyman positions becoming available for new hires.

The current training options available to ASC's civilian employees are meeting their initial hiring needs, but they are facing a gap in availability and content of specialized training needed for natural career progression of their incumbent workers. In particular, ASC is interested in providing risk management training for more of its civilian workers.

AIR FORCE RESEARCH LABORATORY

Also located at WPAFB is the Air Force Research Laboratory (AFRL). AFRL is headquarters for ten directorates dedicated to leading the discovery, development, and integration of warfighting technologies. Five of its ten directorates operate from WPAFB—sensors, human factors, air vehicles, power and propulsion, and materials. These directorates account for 53 percent of AFRL's total R&D budget or nearly $2 billion in R&D funding. Under the 2005 BRAC, more than 1,000 scientists and engineering positions will move from other U.S. locations to serve at AFRL in Dayton. The burden of supplying a workforce for the future positions will partially fall on the Dayton Region.

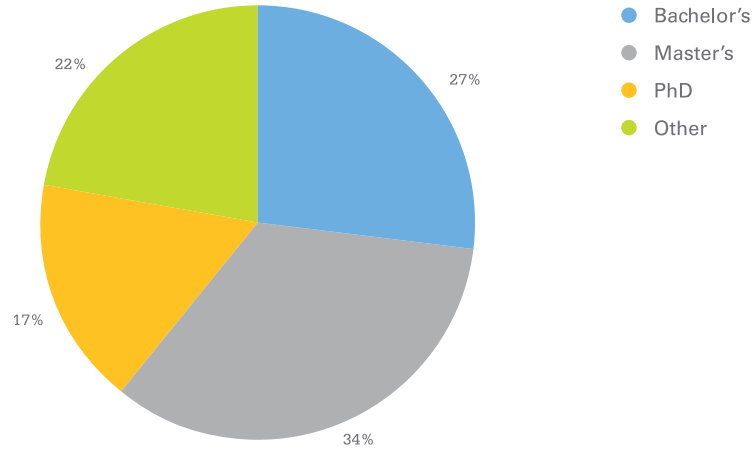
According to one company surveyed, WPAFB has used EEs for years to do the work of CSs. This no longer works as system architecture and infrastructure for high performance computing are paramount, and EEs do not have this training. Demand for CS will go up, and there's already a shortage.

NASA GLENN

NASA Glenn Research Center has very specialized workforce requirements. In Fiscal Year 2009, 78 percent of its workforce had a bachelor's degree or higher. More than 1,200 of its 1,650 employees are scientists, engineers and technicians. While its overall workforce numbers have been declining, its average percentage of scientists and engineers have remained steady with an increase of 33 jobs over the last four years, 26 of which were added in FY09. These numbers do not include the 1,895 contractors employed by the center.

CHART 11: NASA GLENN WORKFORCE

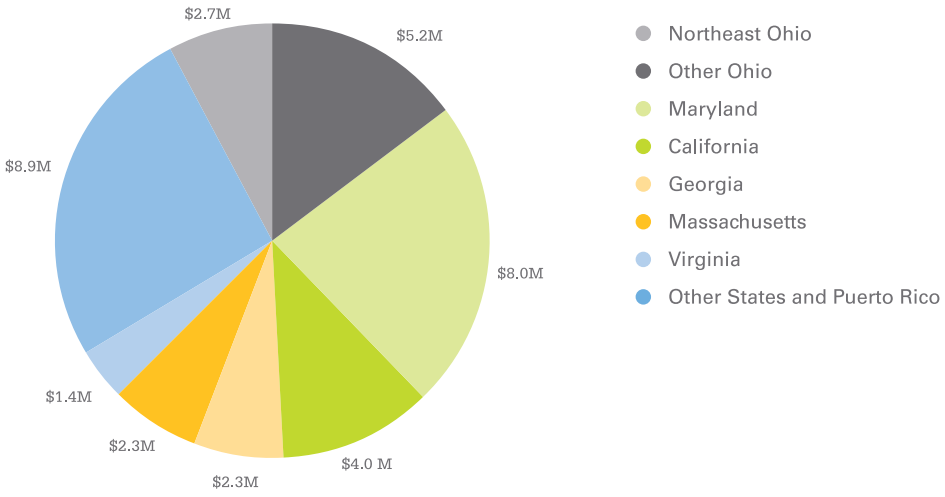
Education Attainment Levels



NASA Glenn is also closely tied to the University System of Ohio. $8 million was awarded to Ohio colleges and universities in FY09 for R&D contracts and grants, assisting research and development activities. With $34.8 million academic awards in FY09, NASA Glenn presents a unique opportunity for the OBOR specifically. Developing a stronger partnership with NASA Glenn would provide a better understanding of their R&D needs and how OBOR can increase its involvement. The amount of funding budgeted for academia is determined annually based on its goals and mission for each year.

CHART 12: NASA GLENN ACADEMIC AWARDS

State University Systems Receiving Awards in FY09



Supply Issues

SUPPLY ISSUES

Much of what the University System of Ohio has to offer is unknown within the state and the nation. The vastness of the system and the quality of the programs are an asset that should be proclaimed on a national stage. Education should be one of Ohio's greatest commodities to recruit and retain Ohio's best and brightest and actively draft national talent.

INTERNSHIPS AND COLLEGE RECRUITMENT

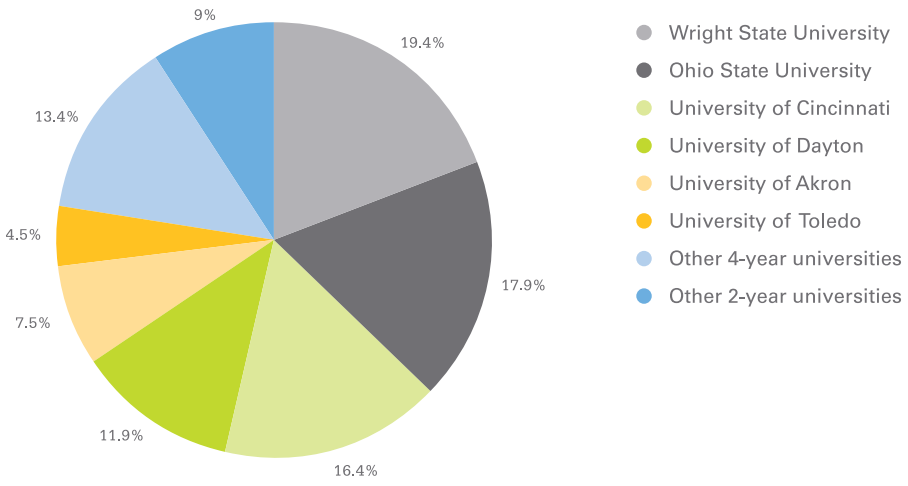
The survey queried businesses on the use of internships and their recruitment of students from in-state and out-of-state universities and colleges as a means of meeting employer demand.

More than one third of the Aerospace and Aviation companies offer internship and/or cooperative education opportunities to college students. Another 17 companies are pursuing or are interested in pursuing such programs. Of those 36 firms that currently offer internship and co-op opportunities, 30 of them recruit permanent employees from their pool of interns.

Thirty-seven of the 96 companies frequently recruit graduates from specific universities or colleges within Ohio.

CHART 13: OHIO UNIVERSITY RECRUITMENT BASED ON SURVEYED BUSINESS RESPONSE

Ohio Student Recruitment



Twenty of the 126 companies frequently recruit graduates from universities and colleges outside of Ohio. These companies are not exclusively pursuing graduates outside of Ohio; rather, an array of programs are pursued to diversify the company's workforce training types used by their workforce. In some cases, junior employees are recruited from selected universities (outside Ohio) renowned for their engineering, science, and technology programs. The companies report that this diversifies the training base of new employees.

CHART 14: OUT OF STATE RECRUITMENT BASED ON SURVEYED BUSINESS RESPONSE

Out of State Institutions and the Programs from which Businesses Recruit

OUT OF STATE COLLEGES AND UNIVERSITIES	TARGETED PROGRAMS
• Bradley University • Eastern Michigan • Georgia Tech • Iowa State • Purdue University (4 companies cited) • Rose Hulman (Indiana) • Texas Tech • Trine U • University of California, Los Angeles • University of Illinois (2 companies cited) • University of Kansas • University of Maryland • University of Michigan (2 companies cited) • University of Missouri (2 companies cited) • University of North Dakota • USM* • UT* • Vincennes University • Western Michigan University • Worcester Polytechnic	Aerospace Engineering, Mechanical Engineering, Electrical Engineering, Fire Protection Engineering, Civil Engineering, Computer Engineering, Computer Science, Math, Pulsed Power

*Colleges represented in column 1 were reported by businesses in an anonymous survey. Abbreviated colleges that could not be defined with certainty remain abbreviated.

One employer said they need talent with five-ten years experience in Power Electronics (a PhD in EE preferred), Electromagnetics Engineering (PhD in EE preferred), and Systems Engineering (a master's is preferred and the employer requires physics and systems work experience). They currently recruit from Texas Tech for Power Electronics.

Another employer (a Prime Contractor) said there is little the State of Ohio can do to assist them in meeting their needs. Their manufacturing is done on the West Coast, along with design expertise, and they look to prior Air Force employees to fill their pipeline for program managers. They did offer that financial managers are key to their operations as they are better able to articulate the employment needs. Many of these positions are filled through recruitment from the East Coast but could be an area of opportunity for Ohio.

When asked for reasons why these businesses were recruiting outside the state, several factors emerged.

CHART 15: OUT OF STATE RECRUITMENT FACTORS BASED ON SURVEYED BUSINESS DEMAND

Factors for Out-of-State Recruitment and Recommendations for OBOR

FACTORS CITED BY SURVEYED BUSINESSES	RECOMMENDATION
One company cited Iowa State students as having a strong focus and maturity they look for in their employees.	Meet with Iowa State's Engineering Chair and determine if this is a product of the program, the type of students they attract, or merely an opinion of the company.
Several companies reported programs that were not available in Ohio: • Space Systems Engineering • Space Propulsion • Space Power • Space Communications • Fire Engineer • Power and Pulsed Power • Process Engineer • Cyber/Trust Engineers • Avionics Program • BS in Systems Engineering • Software Engineers trained in MATLAB and LabView • Finance grads with a S&T background	Evaluation should be done to determine if the statewide demand warrants the creation of any of these programs or if the national demand is so great that producing graduates in these fields would attract businesses or would position the state to export the talent, meeting national demand.
One company cited that the Laser & Electro-Optical programs are stronger outside of Ohio.	Regarding the Laser & Electro-Optical program, it's possible better communication and marketing is needed for the UD program.
Co-ops were very important to some businesses, and they cite non-Ohio schools that offer great co-op programs (this was in the general sense, no schools were named). Also, some businesses reported that a higher value is placed on experience in the industry than academic credentials.	Evaluate co-op and internship programs in the State and nationwide for best practices and determine if they can be increased or replicated. This is discussed in further detail in the Recommendations section of this document.
Recruitment outside the state to diversify the training to which candidates have been exposed.	A diverse internship program could result in less out of state recruitment for this reason.
Schools are not training to industry standards and are teaching outdated materials.	One college voiced concerns with their ability to update curriculum to keep up with Accreditation Board for Engineering Technology (ABET) changes. It can take 6 weeks to 8 months to get approval. More flexibility is needed in order to modify curriculum contents in a rapidly changing industry.
The Computer Science Program at the University of Cincinnati was a major source for one company's recruitment.	Determine the possibility of restarting this program.

WORKFORCE CONCERNS

In the forefront of many Aerospace, Aviation, and Defense workforce concerns is eligibility. U.S. citizenship is a requirement to work on defense contracts. This limits accessibility to some top talent. Of the students enrolled in Master's and Doctorate primary degree programs, only 28 percent are eligible and retained. In addition, the Air Force Institute of Technology (AFIT) often appears in enrollment databases like the Integrated Postsecondary Education Data System (IPEDS); most of these students are active duty, typically attend programs at WPAFB, and move to a follow-on assignment after graduation. Though AFIT active duty military students cannot be considered candidates for the private industry workforce pipeline, recently enacted legislation will permit some private sector students to enroll in degree-granting AFIT programs.

CHART 16: ELIGIBLE AND RETAINED NUMBERS FOR CRITICAL DEGREES

Critical Degrees Enrollment vs. Eligibility and Retention

DEGREE FIELDS	TOTAL ENROLLED			ELIGIBLE AND RETAINED		
	BACHELOR'S	MASTER'S	PHD	BACHELOR'S	MASTER'S	PHD
Aerospace Engineering	95	100	11	63	15	0
Chemistry	429	82	78	416	56	39
Computer Engineering	156	55	18	100	6	3
Computer Science	1,467	425	18	1,026	147	4
Electrical Engineering	389	379	26	243	37	2
Mechanical Engineering	810	195	10	539	54	2
Physics	140	59	7	102	43	5
TOTAL	3,486	1,295	168	2,489	358	55

Note: AFIT numbers removed from the Total Numbers and Aliens Removed from the Eligible and Retained numbers; Retention rates from OBOR applied.

Recommendations

RECOMMENDATIONS

The following are recommendations to close the gap between workforce supply and demand in the Aerospace and Aviation industry. As OBOR prioritizes their initiatives, the following goals should be considered:

1. Develop a sustainable pipeline for postsecondary education that meets business demand;
2. Respond to the needs of the Defense sector;
3. Align state programs with national Aerospace initiatives; and
4. Develop marketing strategies for both supply and demand needs.

The State of Ohio has many Aerospace and Aviation initiatives underway, strategies that have been developed, organizations studying the issues, and businesses willing to participate in internships and advise on workforce issues. Recommendations for the issues addressed in this document can be made; however, unless the state has an organization willing to focus on all the previously mentioned factors and oversee implementation, the efforts will remain segmented. It is the overall recommendation that a State Agency take the lead in all Aerospace and Aviation activities.

CHART 17: RECOMMENDED PLAN FOR A STATEWIDE AEROSPACE AND AVIATION INITIATIVE

Goals, Activities, and Metrics

GOAL	NEAR TERM	MID TERM	LONG TERM
Develop a sustainable pipeline for post secondary education that meets business demand	Develop a business council of companies needing assistance with their existing internship programs or are looking to create programs. Incentivize clearable student placement into the primary and secondary degrees discussed in this document.	Implement an Aerospace-focused internship program that can develop the experience needed for the aerospace industry. Streamline curriculum updates and creation to meet business demands and ABETs requirements. Develop targeted recruitment of Technicians and other associate-degree holders with industry experience.	Offer scholarships and grants to clearable students enrolled in the primary or secondary degrees in their junior and senior years or when considering masters and doctorate level degrees in the primary or secondary programs.
Respond to the needs of the Defense sector	Convene a council of HR and Education and Training reps at WPAFB and NASA Glenn to identify workforce shortfalls and ways OBOR or ODOD can assist. Develop a priority list of programs that could be developed for the defense industry and an implementation plan.	Enhance current internship programs at WPAFB and NASA Glenn. Develop short-term certification programs and long-term degrees as needed to respond to workforce needs.	Serve as a resource to federal defense workforce initiatives.
Align state programs with national Aerospace initiatives	Gather an inventory of federal and commercial studies of the Aerospace industry. Consolidate all state Aerospace Strategies into a master Strategy.	Continue to monitor state and national Aerospace initiatives and industry demand and be ready to respond.	Serve as best practice model for Aerospace workforce; incorporate national and Aerospace Strategies and initiatives.
Develop marketing strategies for both supply and demand needs	Inform Aerospace employers of opportunities in Ohio. Communicate Aerospace demand to the general public, K-12, and colleges and universities.	Monitor supply and demand data to identify gaps and target marketing efforts.	Share success of Aerospace efforts with businesses interested in investing in Ohio.

RECOMMENDATION: Ohio Aerospace and Aviation Workforce Center

The Ohio Aerospace and Aviation Workforce Center should look to the Florida Banner Center for Aviation and Aerospace as a model. The Florida Center is Florida's first designated industry resource center—a One-Stop shop for addressing the aviation and space industry's current and future workforce training needs.
The following objectives help to define the services of the Banner Center:

- Assist in providing a pipeline of workers for Florida, entry level to advanced;
- Ensure that programs within Florida educational institutions are relevant and meet the workforce needs of Florida;
- Establish such centers as leaders of industry training and industry certifications deem appropriate to consult and direct other Florida institutes to programs and practices of industry responsiveness and relevance;
- Maximize lifelong learning in settings demanded by today's marketplace;
- Allow industry ongoing access to research and educational developments and access to a source for skilled workers;
- Promote economic development within targeted industries for Banner Centers in Florida.

The Ohio Aerospace and Aviation Workforce Center should be a strategic, Aerospace arm for both the OBOR and the ODOD, with its leadership being comprised from both organizations.

This center would:

- Maintain state strategies and incorporate third party strategies
- Manage an Aerospace internship program
- Manage and raise scholarship/grant funds to incentivize security clearable student retention
- Recruit from untapped populations that have the industry experience but not the education level required
- Identify/commission incumbent worker training or offer grants that would bridge the gap between primary degrees and secondary degrees
- Represent small Aerospace and Aviation business aggregate needs
- Oversee programs or collaborate with existing programs that fill the Aerospace and Aviation pipeline for post-secondary education
- Assist with curriculum development and serve in an advisory capacity in streamlining the update process

INTEGRATION OF OTHER STATEWIDE AND NATIONAL STRATEGIES

The State cannot rely on non-profit organizations to represent Ohio in national organizations or for national and global marketing/recruitment. If the State is going to be considered competitive for a prime manufacturing firm to relocate or a key player in organizations like the Aerospace States Association, it must offer a State agency and have a marketing plan that includes all State assets.

INTERNSHIPS

Given the Aerospace Industry's consistent need for degrees coupled with experience, several options must be explored. The OBOR could greatly impact the positions requiring one to three years of experience by sponsoring and/or supporting an Aerospace internship program. Students could be recruited from high schools, colleges, and universities across the State and eventually nationwide. This program would be managed by the Ohio Aerospace and Aviation Workforce Center and administered through OBOR to assess and monitor the work of the internships throughout the state in STEM fields. This program would also lead the marketing efforts to inform students of opportunities available in STEM occupations, educate colleges and universities on the process for intern applications, reach out to job centers and displaced workers, and collaborate with colleges across the State.

This program would:

- Develop a screening process for employers to determine their capacity to provide interns with the support needed to ensure successful internships
- Serve as a matchmaker between the student and the hiring business or agency
- Develop a mechanism to extend productive relationships between interns and employers. This would be developed to address the requirements shared by regional employers for long term interns
- Provide for a total immersion experience for the students
- Use existing partnerships and programming to offer a curriculum of professional development courses and social activities so interns could network with peers and business leaders
- Develop a process for students to document their experiences and learning
- Offer externships for secondary teachers and postsecondary faculty, leveraging the success of the STEM Center and reproducing it statewide (program information explained on page 31).
    - Teachers and faculty would gain experience and understanding of the growth industries by working on critical projects
    - With this experience teachers would incorporate new real-world experiences into their curriculum.
    - Students would then be better prepared to enter the workforce
- Track each participant to determine progress through the program, evaluate the overall program success, identify best practices, and provide monitoring that would ensure continuous improvement
- Develop appropriate metrics to measure, and dissemination of best practices created to enable schools throughout Ohio to work effectively with business and government organizations

This model would enable the State to build the workforce experience the Aerospace and Aviation industry needs, anticipate business needs, provide talent with a view toward the opportunities, and align academia and student experiences.

SCHOLARSHIPS/GRANTS

To address the recruitment and retention of qualified U.S. citizens and the occupations that require three to ten years of experience, the state must consider incentives to retain talent and identify untapped pools of candidates.

A program should be created that can recruit the U.S. citizens who have clearable backgrounds (no negative records that would result in a denied security clearance) and assess and place them into the critical degrees. This program should offer scholarships or grants to these students the first semester in which they begin the core course work for their declared major.

The State also has several populations of workers who have the industry experience needed, but lack the advanced degree. The many enlisted corps located at WPAFB have an associate degree and industry experience. This population could greatly benefit from the establishment of a Bachelors in Applied Science (BAS) that would lead to a four-year degree in engineering, computer science, physics, or chemistry. This would create a pipeline for the Air Force Civil Service corps and for the Aerospace and Aviation industry looking for a workforce versed in the Defense industry and experienced with Aerospace programs.

A BAS could also be applied to dislocated workers if attached to experiential learning credit, student assessment, and guided student placement.

INCUMBENT WORKING TRAINING FUNDS FOR SECONDARY DEGREES

OBOR could capitalize on the secondary degrees by coordinating/offering incumbent worker training dollars. This funding would be applied to education and training needed to fill the skill gaps between the primary and secondary degrees. Examples based on secondary degree shortfalls listed in chart 9:

- If the company is willing to hire a Physics graduate to fill a computer science occupation, funding would be used for Java Programming
- An Electrical Engineering graduate may need on the job training to gain the experiential knowledge of hardware used
- Mechanical Engineers could enroll in Aerospace systems classes to gain the knowledge needed to fill an Aerospace Engineer occupation

The key to this funding would be to remain flexible to the training opportunities [for credit, on-the-job training (OJT), seminars, certificates, online training, etc].

SMALL BUSINESS NEEDS

Small Aerospace and Aviation businesses expressed a need for an association or committee that could aggregate the requirements of small businesses together. This would allow their demand to be documented and substantial enough for colleges to respond to their requirements.

They also requested an online help wanted system that had a pool of candidates who have been qualified according to small business needs. This candidate pool would be searchable by topic and by size of employer. Currently, recruitment occurs when Aerospace companies go out of business or downsize as the talent base is sought on an informal basis. This could be systematized to ensure that talent stays within the state.

CURRICULUM UPDATE PROCESS

ABET (the Accreditation Board for Engineering Technology) updates at the speed of business. A slow curriculum update process can jeopardize ABETs accreditation. There is a general consensus that a faster process for implementation of adjusted curriculum would be helpful to the students, the university, and the industry partner. OBOR should consult with key engineering schools, like MIT, to understand best practices and implement a fast, more efficient update process.

RECOMMENDATION: Master's in Public Administration for Program Managers

WPAFB and ASC have identified a critical skill gap in their acquisition corps. They require a program that can address these training needs for their Program Managers.

ASC's Acquisition Directorate (AQ) could utilize a Master's of Public Administration (MPA) that would have an emphasis on Risk Management. This MPA would result in a master's degree and the track would include 1) Integrated Master Plan/Integrated Master Schedule (IMP/IMS), 2) Risk Analysis, 3) Cost Estimating, 4) Earned Value Management, and 5) Systems Engineering.

Creating this concentration would not only assist ASC with their incumbent worker skill gaps, it would create a pipeline for program managers across the Aerospace and Aviation industry. This could also address some of the Business Services critical gaps.

CHART 18: PROGRAM RECOMMENDATIONS

Core competencies and their descriptions

CORE COMPETENCIES	DESCRIPTION
Integrated Master Plan/Integrated Master Schedule (IMP/IMS)	An IMP is an event-driven plan that documents the significant accomplishments necessary to complete the work and ties each accomplishment to a key program event. An IMS is an integrated networked schedule of program tasks required to complete the work effort captured in a related IMP. The IMS should include all IMP events and accomplishments and support each accomplishment closure criterion. IMP/IMS originated in DoD contracting.
Risk Analysis	The overall process of managing risk through identification, analysis, and mitigation. This includes Risk Assessment and Risk Management to identify and assess the probability of occurrence and the resulting consequences of events that may affect the cost, schedule, and technical attributes of a project.
Cost Estimating	The ability to estimate the influences of the project schedule, resources, and risk items on cost.
Earned Value Management	A management technique that integrates work scope, schedule, and cost goals and objectively measures progress toward those goals. In its simplest form, Earned Value Management (EVM) is the discipline of managing projects successfully. It is the planning and controlling of authorized work to achieve cost, schedule, and technical performance objectives. Special emphasis is placed on efficiency and effectiveness in the execution of work through the development and operation of an Earned Value Management System (EVMS) to consider the application of people, systematic processes, and innovative tools and techniques. EVM helps project managers and their teams operate more effectively in the execution of risky—high dollar and complex programs. Routine surveillance is the best way to help ensure DoD gets the performance and dependability it expects from the Earned Value Management System (EVMS). The focus of maintaining the EVMS while it is operating effectively will go a long way toward preventing major deficiencies and expenses later.
Systems Engineering	An interdisciplinary field of engineering that focuses on how complex engineering projects should be designed and managed over the life cycle of the project. Issues such as logistics, the coordination of different teams, and automatic control of machinery become more difficult when dealing with large, complex projects. Systems engineering deals with work-processes and tools to handle such projects, and it overlaps with both technical and human-centered disciplines such as control engineering, industrial engineering, organizational studies, and project management. It is understood that class accreditation is a lengthy process. This program would be possible if an existing MPA program was restructured to include the topics listed above. Wright State University is currently exploring a program similar to the outlined requirements.

RECOMMENDATION: K–12 STEM Education

Although the focus of this strategy is for the workforce pipeline as it relates to post-secondary education and beyond, K–12 STEM issues must be considered as a challenge to feeding the pipeline. OBOR's pipeline issues would improve through a collaboration with the Ohio Department of Education.

The two main complaints at the university engineering school level have been that there are not enough U.S. citizens going into the engineering fields and that students who are coming into the program do not have the appropriate and needed math skills. The State already has several initiatives that have been regionally successful and could be models for statewide programs.

THE STEM CENTER

The STEM Center is a model other States are seeking to implement. An Ohio-wide initiative would ensure the State is leading the way. An economical way K-12 schools can address the lack of interest in engineering fields by their U.S. students is by using the STEM Center, whose lessons are free. They have created an environment where teachers learn interdisciplinary lessons in topics such as power and propulsion, sensors, advanced manufacturing materials, human performance and medicine, and air vehicles/air systems. These teachers are called STEM Fellows and are K-12 educators. They learn collaboration and hands-on learning by working side-by-side with faculty and researchers from colleges/universities and engineers and scientists from local STEM industries and AFRL at WPAFB.

Other benefits of the STEM Center for teachers and administrators:

THE QUALITY RUBRIC

- Measures the degree to which science, technology, engineering, and math are integrated into a lesson
- Helps teachers to design their own quality STEM learning experiences
- Provides a valuable mechanism for reflection and self-assessment

THE STEM INQUIRY RUBRIC

- Measures a teacher's ability to use inquiry
- Provides valuable feedback on student understanding and performance on individual lessons
- Is especially helpful in conjunction with inquiry-based instruction, during which students are encouraged to struggle, experiment, and arrive at their own solutions

STEM TRAINING

- Is offered for teachers, principals, and administrators periodically throughout the year
- Offers professional development seminars tailored to the unique needs and schedules of individual districts, schools, or classrooms
- Offers teachers the ability to observe best practices and inquiry-based STEM instruction, gain confidence, and improve their teaching methods
- Offers seminars for principals and schools district leaders stressing techniques for integrating STEM education into classrooms and the specifics of lesson implementation and evaluation

PROJECT LEAD THE WAY (PLTW)

Another program currently being utilized successfully by Ohio schools is Project Lead the Way. Their two programs, Pathway to Engineering (PTE) and Biomedical Sciences (BMS) for high school students and the Gateway to Technology (GTT) for middle school students, are geared to appeal to all students in those grades. Their goal is to have high standards for a rigorous curriculum that will develop the students' innovative, collaborative, critical-thinking, and problem solving skills and for the students to make the connection between STEM and its benefit in daily life. Once the teacher goes through the intensive summer training for each course, the lesson plans are designed to be teacher friendly.

PLTW classes are hands-on and based in real-world experience but are offered as electives to supplement required classes in science and math. PLTW reports the benefits of their program as:

- A comprehensive, turnkey curriculum package
- Online resources and professional communities
- A program based on national standards
- Teacher training (PLTW Core Training) through affiliate universities
- Conferences for school counselors and administrators that demonstrate how courses fit into students' academic and career paths
- End-of-Course assessments
- Access to a nationwide support network that includes Master Teachers, university affiliates, state education officials, business and industry partners, and professional associations

WRIGHT STATE UNIVERSITY

Wright State University has addressed the math problem for its College of Engineering at the university level by creating a curriculum structured around the different engineering programs called EGR 101. The primary goal of EGR 101 is to facilitate a large-scale restructuring of the early engineering curriculum, in which students can advance in the program without having completed a traditional freshman calculus sequence. This program has been so successful that other universities around the country have started looking at implementing it into their curriculums. OBOR should evaluate the benefits of implementing this program at other universities.

CAREER CENTERS

From a Career Center standpoint, there is a need for a database of Aerospace and Aviation industry members and contact information so invitations can be sent for career fairs and other employment events. One of the services they would like to offer again is testing to guide students into careers that match up with their strengths; however, to do this, they need more staffing and funding. These centers have offered assessments in the past and would be equipped to implement skill assessments to match dislocated workers to jobs and academic programs.

Next Steps

NEXT STEPS

CONVENING BUSINESSES

As a result of the survey, 47 companies indicated their willingness to assist OBOR with developing solutions and strategies for the Aerospace and Aviation industry. These companies, along with education, should be convened to discuss practical implementation of the recommendations offered and issues raised in this document. Facilitated discussions would produce a better understanding of the impact of each recommendation as well as different solutions to the problems.

A subset of these companies would be good candidates for the creation of a business council that can represent small business needs in the industry and advise the state agency leading Ohio's aerospace and aviation initiative.

SETTING PRIORITIES

The outcomes from the facilitated meetings will result in a list of priorities based on the most pressing industry needs. Once funding is identified, implementation plans can be developed with business coordination. Leveraged resources will also be a high priority to ensure businesses stay invested and engaged in the solutions.

COORDINATING REGIONAL EFFORTS

A State agency needs to take the lead for Ohio's aerospace initiatives. To do this, a clearing house of state, federal and commercial studies and strategies should be developed. Much groundwork has already been laid, but very little of it has been coordinated leading to duplication of efforts or missed opportunities to collaborate. Economic Development organizations are also critical assets to developing strategies, messaging, and partnerships needed to implement a comprehensive state initiative.

COLLABORATE WITH DEPARTMENT OF EDUCATION

Long-term issues can be solved, in part, by addressing the broader issues in the K-12 STEM gaps. Partnering with the Department of Education to implement a statewide initiative tied to the university system will better prepare high school students for STEM degrees and will give the students a view toward the programs and job opportunities in the Aerospace and Aviation Industry.

Conclusion

CONCLUSION

In addition to the known shortages in the workforce pipeline, the Aerospace and Aviation industry has the potential to surge in the next 10 to 15 years. There is an alignment of industry R&D and manufacturing that can position Ohio to capture a substantial percentage of the future market share. In order to take advantage of this, the State must develop and implement a strategy to address the critical issues in economic and workforce development. Meeting existing workforce needs is not enough to secure future jobs; the State must produce critical primary and secondary degrees to meet national demands and attract Aerospace and Aviation companies.

Ohio can compete with many aerospace powerhouses like Colorado, Alabama, Florida, and Massachusetts but must set itself apart and market its unique attributes from the state level. Ohio has:

- Concentration and projected growth in R&D
- Current manufacturing workforce
- Existing aerospace and aviation parts manufacturing
- Capacity to grow due to pool of skilled unemployed manufacturing workforce
- Vast university system willing to respond to business demands
- Federal industry sector expertise and R&D

The major void that exists is a prime manufacturer production line. Strategies must focus on recruiting a production line to the state, and a key component to these strategies is producing the workforce needed to meet the needs of Aerospace and Aviation businesses and initiatives that demonstrate the state's priorities to the nation and the world.

Appendix

Ohio

Ohio Board of Regents

AEROSPACE AND AVIATION WORKFORCE STRATEGY

EXECUTIVE SUMMARY

Despite the struggling economy and the challenges that have plagued the commercial aviation market, the U.S. Aerospace and Aviation industry has experienced growth and an increase in profits and sales from 2005 to 2009. Concurrently, aircraft production lines have contracted due to decreased defense spending over the past 15 years. This has limited production surge capacity, an event that is looming as a result of aging aircraft in both the commercial and defense fleets.

There is a window of opportunity for the State of Ohio to emerge as a global industry leader. In order to capitalize on this opportunity, the State must address critical gaps in workforce and economic development. The talent development pipeline must focus not only on meeting the current business demand, but also on anticipating future national demand. This forward reaching strategy would position the state to receive aircraft production lines as the industry strains to meet commercial and defense demands.

The U.S. Aerospace and Aviation industry is fractured, with research and development (R&D) located mainly in the Eastern United States and the majority of the manufacturing workforce on the West Coast. However, there are areas in the country that have been successful in gaining traction with Aerospace and Aviation manufacturing jobs, like Kansas and South Carolina.

The Aerospace and Aviation industry job numbers across the nation have fluctuated over the past 20 years. Despite those shifts, Ohio has maintained a steady share of the jobs; current the state's industry has a direct workforce of 85,215 across 3,280 establishments.

DEMAND

More than 120 private Aerospace and Aviation companies in the State of Ohio participated in a workforce survey to define Aerospace and Aviation workforce requirements over the next five years. Even though this timeframe is limited compared to the long-term growth in the Aerospace and Aviation industry, most businesses struggled to define these short-term needs as their workforce demand depends on the company's success in winning defense contracts.

Ninety occupations were specified by the 126 private sector companies surveyed as critical occupations of the Aerospace and Aviation Industries. Engineering and Information Technology emerged as the most critical and complicated. In these two fields, little standardization of occupation titles and experience required, as a result the focused analysis shifted to degrees required for the occupations. The top five common degrees were defined as: Mechanical Engineering, Aerospace Engineering, Electrical Engineering, Computer Science, and Computer Engineering. The study also looked at secondary degrees that would be considered by the businesses if the primary degrees were unavailable.

SUPPLY

Twenty of the 126 companies frequently recruit graduates from universities and colleges outside of Ohio. These companies are not exclusively pursuing graduates (outside of Ohio); rather, an array of programs are pursued to diversify the company's workforce training types used by their workforce. In some cases, junior employees are recruited from selected universities outside Ohio renowned for their engineering, science and technology programs. The companies report that this diversifies the training base of new employees.

In the forefront of many Aerospace, Aviation, and Defense workforce concerns is eligibility. U.S. citizenship is a requirement to work on defense contracts. This limits accessibility to some top talent. Of the students enrolled in Master's and Doctorate primary degree programs, only 28 percent are eligible and retained.

RECOMMENDATIONS

Recommendation 1: First and foremost, a State agency must take the lead on Aerospace and Aviation strategy and marketing. Relying on non-profit organizations to give Ohio a voice on the national stage diminishes the message when other state governments are leading their initiatives.

Recommendation 2: Establish goals for the State's Aerospace and Aviation strategy:

1. Develop a sustainable pipeline for postsecondary education that meets business demand;
2. Respond to the needs of the Defense sector;
3. Align state programs with national Aerospace initiatives; and
4. Develop marketing strategies for both supply and demand needs.

Recommendation 3: Establish an Aerospace and Aviation Workforce Center in the State of Ohio modeled after the Florida Banner Center for Aviation and Aerospace. The Center would serve as the strategic, Aerospace arm of the Ohio Board of Regents and the Ohio Department of Development and would be staffed and co-led by both organizations. The Center would strive to:

- Maintain and manage state Aerospace and Aviation strategies
- Manage an Aerospace internship program
- Manage and raise scholarship/grant funds to incentivize security clearable student retention
- Recruit from untapped, properly educated populations
- Work to fund and educate incumbent workers for the Aerospace industry
- Represent small Aerospace business aggregate needs
- Fill the Aerospace pipeline for post-secondary education
- Assist with curriculum development

In addition to the known shortages in the workforce pipeline, the Aerospace and Aviation industry has the potential to surge in the next 10 to 15 years. This surge requires Ohio's alignment of industry R&D and manufacturing to position the state to capture a substantial percentage of the future market share. The successful alignment of industry and manufacturing relies heavily on the implementation of a strategy at the state-level to address the critical issues in economic and workforce development. Simply meeting existing workforce needs is not enough to secure future jobs, the pipeline should strive to produce critical primary and secondary degrees that meet national demands of the Aerospace and Aviation industry, thereby positioning the State of Ohio as the national leader.

Ohio can compete with many aerospace powerhouses like Colorado, Alabama, Florida, and Massachusetts but must set itself apart and market its unique attributes from the state level. Ohio has:

- Concentration and projected growth in R&D
- Current manufacturing workforce
- Existing Aerospace and Aviation parts manufacturing
- Capacity to grow due to pool of skilled unemployed manufacturing workforce
- Vast university system willing to respond to business demands
- Federal industry sector expertise and R&D

The major void that exists is a prime manufacturer production line. Strategies must focus on recruiting a production line to the state, and a key component to these strategies is producing the workforce needed to meet the needs of Aerospace and Aviation businesses and initiatives that demonstrate the state's priorities to the nation and the world.

APPENDIX 2: AEROSPACE AND AVIATION RELATED PROGRAMS IN THE STATE OF OHIO

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Aeronautical/Aerospace Engineering Technology/Technician	A&T	Columbus State; Cincinnati State	16
Aeronautics/Aviation/Aerospace Science and Technology, General	B	Ohio University; Kent State University-Kent; Miami University-Oxford; The Ohio State University	96
	A&T	Sinclair; Ohio University; University of Cincinnati-Clermont	29
Aerospace, Aeronautical and Astronautical Engineering	D	University of Cincinnati; The Ohio State University; Air Force Institute of Technology	13
	M	Ohio University; Kent State University-Kent; Miami University-Oxford; The Ohio State University; Case Western Reserve University	100
	B	Case Western Reserve University; The Ohio State University; University of Cincinnati	95
Agricultural/Biological Engineering and Bioengineering	D	The Ohio State University	3
	M	The Ohio State University	5
	B	The Ohio State University	38
	A&T	Clark State	0
Aircraft Powerplant Technology/Technician	A&T	Great Oaks; Sinclair	14
Airframe Mechanics and Aircraft Maintenance Technology/Technician	A&T	Sinclair; Great Oaks	14
Airline/Commercial/Professional Pilot and Flight Crew	A&T	Sinclair	1
Applied Mathematics	D	Case Western Reserve University, Kent State University-Kent; Air Force Institute of Technology	2
	M	University of Cincinnati; The Ohio State University; Case Western Reserve University; University of Akron; Ohio University; Case Western Reserve University	17
	B	Case Western Reserve University; University of Akron; Ohio University	15
Applied Mathematics, Other	A&T	Mount St. Joseph	0
Astronomy	D	The Ohio State University	3
	B	Case Western Reserve University; The Ohio State University; University of Toledo; Youngstown State University	9
Astrophysics	B	Ohio Wesleyan; Ohio University	3
Aviation/Airway Management and Operations	B	Bowling Green State University; Ohio University	33
Avionics Maintenance Technology/Technician	A&T	Cincinnati State; Columbus State; Miami Valley Career Technology Center; Sinclair; Toledo Public Schools	29
Biomedical Technology/Technician	B	DeVry	11
	A&T	Owens; Brown Mackie College-Cin; Cincinnati State; Stark State; Diagnostic Imaging Tech Education Center	43
Biomedical/Medical Engineering	D	Case Western Reserve University; University of Cincinnati; University of Akron; The Ohio State University	34
	M	The Ohio State University; University of Toledo; Youngstown State University; Ohio Wesleyan; Ohio University; Bowling Green State University; Ohio University	71
	B	Case Western Reserve University; University of Akron; University of Cincinnati; University of Toledo; Wright State University	191

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Chemical Engineering	D	Ohio University; University of Akron; Case Western Reserve University; University of Cincinnati; The Ohio State University	34
	M	DeVry; Case Western Reserve University; University of Akron; University of Cincinnati; University of Toledo; Wright State University; Ohio University; University of Akron; Cleveland State University	56
	B	Ohio University; University of Akron; Cleveland State University; Case Western Reserve University; The Ohio State University; University of Cincinnati; University of Dayton; University of Toledo; Youngstown State University; Miami University-Oxford	242
	A&T	Ohio University; University of Akron	5
Computer and Information Sciences, General	D	The Ohio State University	24
	M	Case Western Reserve University; The Ohio State University; University of Cincinnati; University of Dayton; University of Toledo; Youngstown State University	152
	B	Mount St. Joseph; Rio Grande; Bowling Green State University; Cleveland State University; Miami University-Oxford; The Ohio State University; University of Cincinnati; Wright State University; Cedarville; Defiance; Franciscan; Heidelberg; Marietta; Mount Vernon; Oberlin; Otterbein; Ohio University; Phoenix-Cin; Phoenix-Cle; Tiffin; University of Dayton; Wilberforce	327
	A&T	Edison; Sinclair; Southwestern; University of Cincinnati-Clermont; Mount St. Joseph; Rio Grande; Bryant and Stratton-Cle; Cincinnati State; Columbus State; Lorain County Community College; Northwest State; Terra State; University of Toledo; Akron Institute of Herzing University; Cleveland Institute of Technology; Eastern Gateway; IT Certification Institute LLC	453
Computer Engineering Technology/Technician	B	Shawnee State; University of Cincinnati; DeVry; University of Dayton; Youngstown State University	40
	A&T	Lakeland; Lorain County Community College; Owens; Bowling Green State University-Firelands; Cuyahoga Community College; Cincinnati State; Stark State; Career Technical Learning Center of Portage; Northwest State; Shawnee State	129
Computer Engineering, General	D	University of Cincinnati; Wright State University; Case Western Reserve University; Air Force Institute of Technology; University of Akron	18
	M	Miami University-Oxford; Mount St. Joseph; Rio Grande; Bowling Green State University	55
	B	Case Western Reserve University; University of Cincinnati; Wright State University; Cedarville; Cleveland State University; Miami University-Oxford; Ohio Northern University; University of Akron; University of Dayton; University of Toledo; Wilberforce	156
	A&T	Northwest State; TechSkills-Cin; TechSkills-Cle; TechSkills-Col	15
Computer Hardware Technology/Technician	A&T	Edison	0

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Computer Programming, Specific Applications	A&T	Columbus State; Kent State University-Tuscarawas; Kent State University-Trumbull; Lakeland; Marion Technical College; Owens; Rhodes State; Cincinnati State; Clark State; Eastern Gateway; Kent State University-Ashtabula; Kent State University-East Liverpool; Kent State University-Salem; Kent State University-Geauga; Southern State; Stark State	184
Computer Programming, Vendor/Product Certification	A&T	Cleveland Institute of Electronics; TechSkills-Cin; TechSkills-Cle; TechSkills-Col	41
Computer Programming/Programmer, General	M	Cleveland State University	15
	B	Youngstown State University; Mount Union	34
	A&T	Bradford School; Columbus State; Edison; Terra State; Youngstown State University; Belmont Technical College; Cuyahoga Community College; Central Ohio Technical College; Hocking College; ITT-Col; ITT-Day; ITT-Hil; ITT-Mau; ITT-Nor; ITT-Str; ITT-WH; ITT-You; Kaplan-Col; Lorain County Community College; Northwest State; University of Toledo; Washington State; Cleveland Institute of Electronics; NewLife	79
Computer Science	D	Case Western Reserve University; Air Force Institute of Technology	10
	M	Miami University-Oxford; The Ohio State University; University of Cincinnati; Wright State University; Cedarville; Defiance	79
	B	Franklin; Findlay; Rio Grande; Walsh; University of Akron; Case Western Reserve University; Ohio University; University of Dayton; Ashland; Bluffton; Baldwin-Wallace; Capital; Cedarville; Central State; Denison; Franciscan; Heidelberg; Hiram; John Carroll University; Malone; Marietta; Mount St. Joseph; Muskingum; Ohio Wesleyan; Ohio Northern University; Wilberforce; Wittenberg; Wooster; Xavier; Youngstown State University	208
	A&T	North Central State; Franklin; Findlay; Rio Grande; Walsh; Herzing University; Washington State; University of Akron	31
Computer Software Engineering	A&T	TechSkills-Cin; TechSkills-Cle; TechSkills-Col	0
Computer Software Technology/Technician	M	Franciscan	7
Computer Systems Analysis/Analyst	D	Kent State University-Kent	8
	M	Heidelberg; Marietta	15
	B	Baldwin-Wallace; Kent State University-Kent; DeVry; Miami University-Oxford; Urbana	176
	A&T	University of Akron; Lakeland; Southern State; Baldwin-Wallace; Career Technical Learning Center of Portage; Delaware Area Career Center; Kent State University-Ashtabula; Kent State University-Trumbull; Sandusky Career Center	53
Computer Systems Networking and Telecommunications	M	Mount Vernon; Oberlin	24
	B	University of Akron; DeVry; Baldwin-Wallace; Ohio University	113
	A&T	University of Akron; Clark State; Edison; Lakeland; Marion Technical College; Stautzenberger College; University of Akron-Wayne; DeVry; Antonelli College; Beckfield College; Bowling Green State University-Firelands; Davis College; Hocking College; ITT-Col; ITT-Day; ITT-Hil; ITT-Mau; ITT-Nor; ITT-Str; ITT-WH; ITT-You; Lorain County Community College; Remington-Cle; Remington-CleWest; Terra State; Baldwin-Wallace; Cleveland Institute of Electronics; Goodwill Training and Employment Center; IT Certification Institute LLC; Owens; TechSkills-Cin; TechSkills-Cle; TechSkills-Col; University of Cincinnati	537

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Computer Technology/Computer Systems Technology	A&T	Gallipolis Career College; OBC-Sheffield; Rhodes State; University of Cincinnati-Clermont; Cincinnati State; Edison; Lakeland; National-Cin; National-Col; National College; National College-You; National-Day; Rio Grande; Southern State; University of Cincinnati-RWC; Washington State; Eastern Gateway; Kaplan College; O C Collins Career Center; Ohio Business College	89
Data Processing and Data Processing Technology/Technician	B	University of Cincinnati	2
	A&T	Trumbull Business College; University of Cincinnati-Clermont; Central Ohio Technical College; Mount Vernon; Miami University-Oxford; University of Toledo; Belmont Technical College; Cleveland Institute of Electronics; Kaplan-Col; National-Col; National College; National College-You; National-Day; Northwest State; Zane State	114
Electrical, Electronics and Communications Engineering	D	University of Cincinnati; Case Western Reserve University; Ohio University; University of Akron; University of Dayton; The Ohio State University; Air Force Institute of Technology	51
	M	Otterbein; Ohio University; Phoenix-Cin; Phoenix-Cle; Tiffin; University of Dayton; Wilberforce; Shawnee State; DeVry; University of Cincinnati; University of Dayton	379
	B	Bryant and Stratton-Cle; Cleveland State University; Case Western Reserve University; The Ohio State University; Ohio University; University of Akron; University of Cincinnati; University of Dayton; University of Toledo; Wright State University; Youngstown State University; Cedarville; Miami University-Oxford; Ohio Northern University; Wilberforce	391
	A&T	Lorain County Community College; Bryant and Stratton-Cle; ETI Technical College; RETS College; Cleveland Institute of Electronics	75
Electrical/Electronic Engineering Technologies/Technicians, Other	A&T	Cincinnati State; Clark State; Columbus State; Terra State; Cuyahoga Community College; Hocking College; Kent State University-Ashtabula; Kent State University-Trumbull; Kent State University-Tuscarawas; National Institute of Technology; Southern State; Stark State; Youngstown State University; Washington State; Zane State; Cleveland Institute of Electronics; Marion Technical College; Owens	200
Electrical/Electronic/Communications Engr Technology/Technician	B	University of Akron; DeVry; University of Cincinnati; Youngstown State University; Bowling Green State University; Cleveland State University; University of Dayton	108
	A&T	University of Akron; Cincinnati State; Edison; Hocking College; Lakeland; Lorain County Community College; Marion Technical College; Northwest State; Owens; Sinclair; Terra State; DeVry; University of Cincinnati; Youngstown State University; Belmont Technical College; Cuyahoga Community College; Bowling Green State University-Firelands; Central Ohio Technical College; Cleveland Institute of Electronics; Columbus State; Eastern Gateway; ITT-Col; ITT-Day; ITT-Hil; ITT-Mau; ITT-Nor; ITT-Str; ITT-WH; ITT-You; North Central State; Rhodes State; Stark State; Washington State; University of Toledo; Buckeye Joint Vocational School; ETI Technical College; Kaplan College; Remington-Cle; Remington-CleWest	575
Electromechanical Instrumentation/Maintenance Techs, Other	A&T	Hocking College	1

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Electromechanical Technology/Electromechanical Engineering Tech	B	University of Toledo	29
	A&T	Edison; North Central State; Sinclair; Belmont Technical College; Central Ohio Technical College; Bowling Green State University-Firelands; Cincinnati State; Columbus State; Owens; Shawnee State; Great Oaks; Terra State	83
Engineering Mechanics	M	Youngstown State University	1
Engineering Physics	D	Air Force Institute of Technology	5
	M	Case Western Reserve University	12
	B	Case Western Reserve University; John Carroll University; Miami University-Oxford; The Ohio State University; Wright State University	33
Engineering Science	D	University of Toledo; Case Western Reserve University	14
	M	University of Cincinnati; Wright State University	39
	B	Wright State University; Franciscan; Muskingum	3
Engineering Technologies/Technicians, Other	B	Shawnee State	2
	A&T	Cuyahoga Community College; Columbus State; Bowling Green State University-Firelands; Clark State; Kent State University-Tuscarawas; Ohio University-Lancaster; Terra State; Zane State; Cleveland Institute of Electronics	169
Engineering, General	D	University of Akron; University of Cincinnati; Wright State University; Cleveland State University	28
	M	Cedarville; Cleveland State University; Miami University-Oxford; Ohio Northern University; University of Akron	63
	B	Case Western Reserve University; Kent State University-Kent; University of Akron; University of Cincinnati; Miami University-Oxford; University of Toledo	194
	A&T	Owens; Sinclair; Stark State; Terra State	30
Engineering, Other	D	Ohio University	5
	M	University of Dayton	16
	B	The Ohio State University; Oberlin	24
	A&T	Northwest State	0
Engineering/Industrial Management	M	University of Toledo; Wilberforce	57
	B	Chancellor University; Miami University-Oxford	20
	A&T	Northwest State; Mahoning CTC	0
Heavy/Industrial Equipment Maintenance Technologies, Other	A&T	O C Collins Career Center; Pickaway Ross JVSD	78
Industrial Engineering	D	The Ohio State University; University of Cincinnati	12
	M	Youngstown State University; Mount Union; Franklin; Findlay; Rio Grande; Walsh	70
	B	Cleveland State University; The Ohio State University; Ohio University; University of Toledo; Youngstown State University; Kent State University-Kent	103
	A&T	Cuyahoga Community College; Lorain County Community College; Sinclair; Cleveland Institute of Electronics	43
Industrial Mechanics and Maintenance Technology	A&T	Rio Grande; Apollo Career Center; Ashland County-West Holmes Career Center; Auburn Career Center; Butler Tech; CTC of Licking County; Gallia Jackson Vinton JVSD; Mahoning CTC; Northwest State; Ohio Hi Point JVSD; Scioto County CTC; Tri-Rivers Career Center; Upper Valley JVS; Washington County Career Center; Wayne County Schools Career Center	119
Industrial Production Technologies/Technicians, Other	A&T	Kent State University-Trumbull; Marion Technical College; Sinclair; Rio Grande; Kent State University-Geauga; Washington State; Columbus State; North Central State; Washington County Career Center	59

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Industrial Technology/Technician	M	University of Akron	2
	B	Rio Grande; Central State; Ohio Northern University; Ohio University; University of Dayton	79
	A&T	Clark State; Edison; Lakeland; Owens; Rhodes State; Stark State; Rio Grande; Cuyahoga Community College; Cincinnati State; Washington State	48
Information Science/Studies	M	Case Western Reserve University; Ohio University	22
	B	University of Toledo; University of Cincinnati; Bluffton; Baldwin-Wallace; Hiram; Ohio Dominican; Rio Grande; Tiffin; Urbana	79
	A&T	Southwestern; Zane State; University of Toledo; University of Cincinnati; Cuyahoga Community College; Eastern Gateway; Wright State University-Lake	89
Information Technology	M	University of Dayton	32
	B	Franklin; Youngstown State University; University of Cincinnati; Bluffton; Defiance; DeVry; Ohio University; Tiffin; University of Toledo	237
	A&T	Franklin; Youngstown State University; Brown Mackie College-Cin; Brown Mackie-Akron; Bryant and Stratton-Parma; Bryant and Stratton-Eastlake; Miami-Jacobs Career College; Ohio Business College; Owens; RETS College; Cleveland Institute of Electronics; Lorain County Community College; National-Cin; National-Col; National College; National College-You; National-Day; TechSkills-Cin; TechSkills-Cle; TechSkills-Col; Vatterott College-Cleveland; Warren County Career Center	324
Manufacturing Engineering	M	Ashland	27
	B	Central State; Miami University-Oxford	16
	A&T	Apollo Career Center	11
Manufacturing Technology/Technician	B	University of Akron; Ohio Northern University; University of Dayton	28
	A&T	Cincinnati State; Lorain County Community College; Sinclair; University of Akron; Bowling Green State University-Firelands; Central Ohio Technical College; Owens; University of Cincinnati; Wright State University-Lake; Edison; Terra State	60
Materials Engineering	D	Case Western Reserve University; University of Cincinnati; The Ohio State University; University of Dayton	29
	M	Bluffton; Baldwin-Wallace; Capital; Cedarville; Central State	56
	B	Case Western Reserve University; The Ohio State University; University of Cincinnati; Wright State University; Youngstown State University	42
Materials Science	D	Air Force Institute of Technology	0
	M	Denison	6
	A&T	Hocking College	4
Mathematics and Statistics, Other	B	Denison	0

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Mathematics, General	D	University of Cincinnati; Kent State University-Kent; Ohio University; Ut; Bowling Green State University; The Ohio State University	32
	M	Franciscan; Heidelberg; Hiram; John Carroll University; Malone; Marietta; Mount St. Joseph; Muskingum; Ohio Wesleyan; Ohio Northern University; Wilberforce; Wittenberg; Wooster	137
	B	Rio Grande; Shawnee State; Bowling Green State University; Cleveland State University; Case Western Reserve University; John Carroll University; Kent State University-Kent; The Ohio State University; Miami University-Oxford; Ohio University; University of Akron; University of Cincinnati; University of Toledo; Wright State University; Youngstown State University; Antioch University McGregor; Ashland; Bluffton; Baldwin-Wallace; Capital; Cedarville; Defiance; Denison; Findlay; Franciscan; Heidelberg; Hiram; Kenyon; Lake Erie; Malone; Marietta; Mount St. Joseph; Mount Union; Mount Vernon; Muskingum; Notre Dame College; Oberlin; Ohio Dominican; Ohio Wesleyan; Ohio Northern University; Otterbein; University of Dayton; Urbana; Ursuline; Walsh; Wilmington; Wittenberg; Wooster; Xavier	405
	A&T	Rio Grande; Shawnee State; Owens; Sinclair; Terra State	7
Mechanical Engineering	D	University of Cincinnati; University of Akron; University of Dayton; Case Western Reserve University; The Ohio State University	40
	M	Xavier; Youngstown State University; Baldwin-Wallace; Kent State University-Kent; DeVry; Miami University-Oxford; Urbana; University of Akron; DeVry; Baldwin-Wallace	195
	B	University of Cincinnati; University of Akron; Cleveland State University; Case Western Reserve University; The Ohio State University; Ohio University; University of Dayton; University of Toledo; Wright State University; Youngstown State University; Cedarville; Miami University-Oxford; Ohio Northern University	812
	A&T	University of Cincinnati; Northwest State; Stark State; University of Akron	17
Mechanical Engineering Related Technologies/Technicians, Other	B	Cleveland State University	9
	A&T	Terra State; Lakeland; Rhodes State; Sinclair; Northwest State	37
Mechanical Engineering/Mechanical Technology/Technician	B	University of Toledo; University of Akron; Youngstown State University; Bowling Green State University; University of Dayton	137
	A&T	University of Toledo; Edison; Marion Technical College; Miami University-Oxford; Northwest State; Rhodes State; University of Akron; Youngstown State University; Bowling Green State University-Firelands; Cuyahoga Community College; Cincinnati State; Clark State; Columbus State; Eastern Gateway; Kent State University-Ashtabula; Kent State University-Trumbull; Kent State University-Tuscarawas; Lakeland; North Central State; Owens; Terra State; University of Cincinnati; Washington State; Lorain County Community College; Sinclair	135
Nuclear Engineering	D	Air Force Institute of Technology; University of Cincinnati	2
	M	Ohio University; University of Cincinnati; Bryant and Stratton-Cle	20

A&T = Associates and Technical Programs; B = Bachelor's; M = Master's; D = Doctorate

PROGRAM	LEVEL	INSTITUTIONS	2009 COMPLETERS
Operations Research	D	Air Force Institute of Technology; Case Western Reserve University	6
	M	Cleveland State University; Case Western Reserve University	32
Optics/Optical Sciences	D	University of Dayton; Air Force Institute of Technology	3
	M	The Ohio State University; Ohio University	18
Petroleum Engineering	B	Marietta	21
Petroleum Technology/Technician	A&T	North Central State	4
Physics, General	D	Kent State University-Kent; University of Toledo; Case Western Reserve University; University of Cincinnati; Ohio University; The Ohio State University	56
	M	University of Akron; University of Cincinnati; University of Dayton; University of Toledo; Wright State University; Youngstown State University; Cedarville; Miami University-Oxford; Ohio Northern University; Wilberforce; University of Akron; DeVry	65
	B	Bowling Green State University; Cleveland State University; Case Western Reserve University; John Carroll University; Kent State University-Kent; Miami University-Oxford; The Ohio State University; Ohio University; University of Akron; University of Cincinnati; University of Toledo; Wright State University; Ashland; Bluffton; Baldwin-Wallace; Cedarville; Denison; Heidelberg; Hiram; Kenyon; Marietta; Mount Union; Muskingum; Oberlin; Ohio Wesleyan; Ohio Northern University; Otterbein; University of Dayton; Wittenberg; Wooster; Xavier; Youngstown State University	147
	A&T	Sinclair	3
Physics, Other	M	University of Cincinnati	0
	A&T	University of Akron	0
Polymer/Plastics Engineering	D	University of Akron; Case Western Reserve University	15
	M	Youngstown State University; Bowling Green State University	2
	B	University of Akron; Case Western Reserve University	11
	A&T	University of Akron	0
Quality Control and Safety Technologies/Technicians, Other	A&T	Cincinnati State; University of Cincinnati-Clermont	3
Quality Control Technology/Technician	B	Bowling Green State University	2
	A&T	Lakeland; Lorain County Community College; Owens; Rhodes State; Sinclair; Terra State; Columbus State; Northwest State; Edison; Marion Technical College; University of Akron	37
Robotics Technology/Technician	A&T	Rhodes State; Terra State; Rio Grande	12
Statistics, General	D	Case Western Reserve University; Bowling Green State University; The Ohio State University	18
	M	Cleveland State University; University of Dayton; University of Toledo; Case Western Reserve University; John Carroll University; Miami University-Oxford; The Ohio State University	84
	B	Case Western Reserve University; Miami University-Oxford; University of Akron; Wright State University; Ohio Northern University	35
Systems Engineering	D	Case Western Reserve University; Air Force Institute of Technology	3
	M	Wright State University	26
	B	Case Western Reserve University	4
	A&T	Eastern Gateway	1
Theoretical and Mathematical Physics	B	Case Western Reserve University	2