

## **Executive Summary**

### **Workforce Needs Assessment for the Aerospace Industry in North Carolina**

In December 2008 the Golden LEAF Foundation (GLF) provided funding through the North Carolina Eastern Regional Partnership to contract with Susan Seymour and Regional Technology Strategies, Inc. to carry out a workforce needs assessment for North Carolina's aerospace industry. This report is the result of a six-month process involving GLF staff, the North Carolina Department of Commerce, representatives of the state's aerospace companies, all levels of the state's educational system, the state's military facilities, industry and non-profit organizations with an interest in the industry. In addition, the team visited with out-of-state workforce systems in Kansas and Oklahoma and interviewed representatives from other states in order to understand best practices in aerospace workforce development.

#### ***Report's Purpose***

The report is designed to both provide the background needed to understand the state of the aerospace industry in North Carolina and recommend actions that will improve the capacity of the state to support the industry's workforce needs both now and into the future. While our focus was on workforce, the recommendations have relevance to other competitiveness factors because workforce issues and these factors are too intertwined to examine in isolation. Many of the recommendations would involve lead or supporting roles for GLF, but most affect a broad range of governmental, educational, industry, and funding organizations.

#### ***Methodology***

Defining the aerospace manufacturing, maintenance, and repair industry is more art than science. For the purposes of this study, aerospace is defined as aerospace manufacturing; maintenance, repair, and overhaul of aircraft (both civilian and military planes serviced by private contractors); and avionics. These industry segments have experienced recent growth across North Carolina and are poised to provide future economic benefits for the state.

Our examination of the industry began with substantial data analysis and background research of the state, national and international aerospace industry. We conducted an online survey to develop a stronger understanding of the specific experience and workforce needs of the state's aerospace companies. This was supplemented with a series of on-site visits to some of the companies and telephone interviews with others. We worked with the state's military facilities to understand their needs. These efforts provided the information on *workforce training demand* within the industry.

To understand the state's workforce system – K-12, community college, four-year colleges and research universities – we used similar methods. We collected information

on relevant programs and examined data on individuals trained in relevant programs. We visited and interviewed various educational institutions and systems to better understand their programs and achievements as well as their needs for meeting the challenge of training the growing aerospace industry. These efforts provided the information on *workforce training supply* within the industry.

All of this data and analysis fed into a series of *findings* on the state's aerospace industry from which the team extracted three broad *goals* that need to be addressed. The *recommendations* were then tailored to address the findings and goals.

## **North Carolina's Aerospace Industry**

North Carolina has not historically been a significant factor in the US aerospace industry. Within the last few years the state has attracted an increasing number of companies including Smiths Aerospace (now GE Aviation), HondaJet, Honda Aero, and Turbomeca. The largest new entrant is Spirit Aerosystems presently under construction at the Global TransPark and projected to ultimately hire over 1,000 workers. The state's profile in aerospace is now strong enough that a recent report for the State of Washington listed North Carolina and Global TransPark as one of its four major competitors.<sup>1</sup>

Aerospace firms are found in nearly half of the state's counties and in all of its regions with strong clustering around Charlotte, the Research Triangle Park area, and the Piedmont Triad regions (Figure ES-1). Concentrations are also found in the eastern part of the state often in support of the state's military presence.

The state is home to over 200 aerospace firms employing nearly 11,000, a figure that does not reflect many of the recent corporate decisions to locate or expand in North Carolina that should increase employment. Leading sectors within aerospace include broadcast and wireless equipment used in aerospace, maintenance, repair, and overhaul (MRO) and aircraft engine manufacturing (Table ES-1). Table ES-1 demonstrates the impact of the recent emergence of the industry. From 2002 to 2007 the state's aerospace industry grew by a remarkable 60% adding 4,085 jobs, led by increases in avionics, engine manufacturing and maintenance, repair and overhaul (MRO) of aircraft (Figure ES-1).

Additionally, aerospace is one of the highest paying industries in the state paying on average over \$70,000. The higher average pay for aerospace product and parts industries is not unique to North Carolina. According to the Bureau of Labor Statistics (BLS), workers in industries that manufacture aerospace product and parts often earn higher than average wages because of the "high levels of skill required by the industry and the need to motivate workers to concentrate on maintaining high quality standards in their work."

An overarching finding that underlies this report is that the aerospace industry in the state, while significant, has not grown to a scale in which firms, labor markets, training

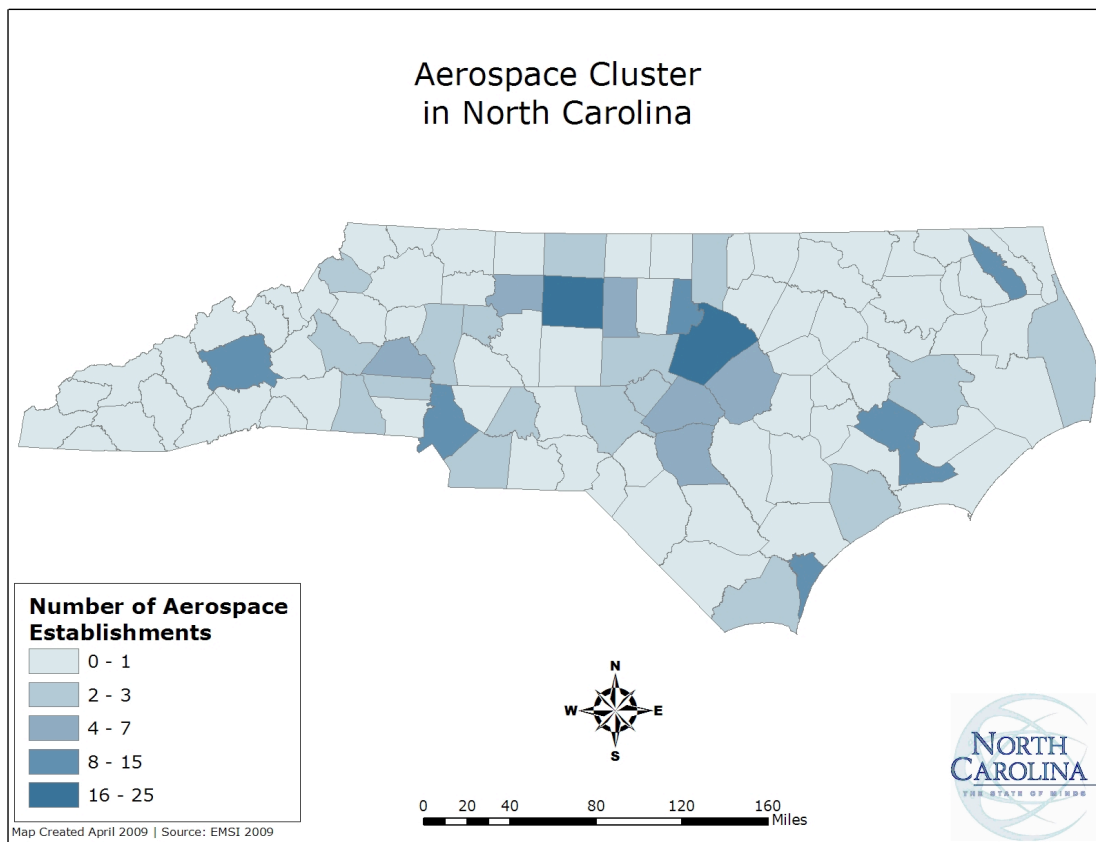
---

<sup>1</sup> *Aerospace Industry Competitiveness Study*. Prepared by Deloitte Consulting for the Economic Development Council of Snohomish County, April 2009.

resources, educational institutions and research and development exhibit the strong and mature interactions that define a *cluster*. A cluster is a geographic concentration of interconnected businesses, suppliers, and associated institutions that through synergy increase the productivity with which companies can compete, nationally and globally; in other words the whole is greater than the sum of the parts.

Aerospace as a relatively young and growing industry instead reflects firms that largely are co-located rather than integrated. There are concentrations within the state, for example in the Triad region, but even there the companies consider *lack of scale and critical mass* a problem, particularly concerning labor markets and supply chains. Companies report that more mature aerospace regions such as Wichita and Seattle have an aerospace culture that helps support the industry. In this sense aerospace in NC is an *emerging cluster* with the opportunity to grow into a mature cluster like biotechnology.

**Figure ES-1. Aerospace Related Businesses in North Carolina, 2007**

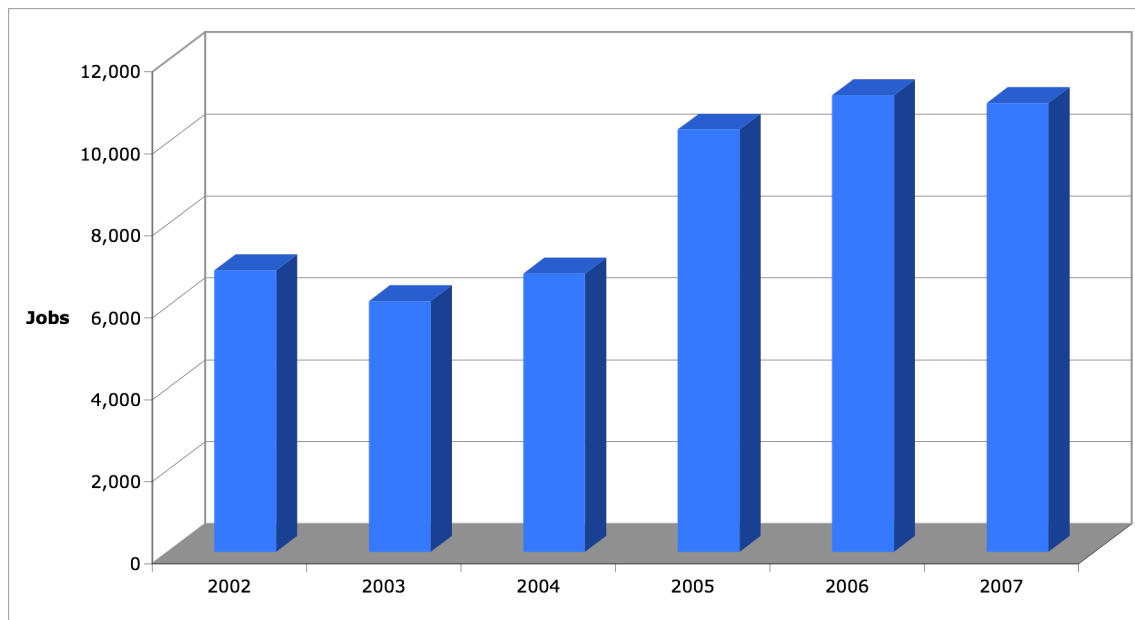


**Table ES-1. North Carolina Aerospace Jobs by Sector, 2002-2007**

Description	Jobs 2002	Jobs 2007
<b>Avionics:</b>		
Broadcast and wireless communications equip.	1,930	3,220
Search, detection, and navigation instruments	598	803
<b>Aerospace Manufacturing &amp; MRO's:</b>		
Aircraft manufacturing	198	502
Aircraft engine and engine parts mfg.	1,415	2,615
Other aircraft parts and equipment	603	548
Other support activities for air transportation (inc. MRO)	2,122	3,263
<b>Total Aerospace Mfg., Maintenance &amp; Repair</b>	<b>6,866</b>	<b>10,951</b>

*Source: Economic Modeling Specialists, Inc.-Complete Employment, Fall 2008*

**Figure ES-1. Aerospace Related Jobs in North Carolina, 2002-2007**



### **North Carolina's Aerospace Workforce**

Of the 11,000 workers within the state's industry about 60% or 6,273 are in occupations specific to the industry (Table ES-2). According to national and state reports, these are the jobs that require the most technical and specialized skill sets and for which it can be difficult to find qualified employees. The specialized occupations are the focus of this study as they suggest targeted needs of the aerospace not the broader economy. The remaining jobs are in general occupations such as management and office operations that are common to a range of industries.

Approximately 80% of the 6,200 jobs are in production occupations while the other 20% are in design (engineering). The engineers fall into a number of specialties including software, mechanical, industrial, electrical and, of course, aerospace engineers. Mechanics and assemblers lead the production occupations.

**Table ES-2. Key Aerospace Jobs by Occupational Group**

<b>Group Name</b>	<b>2007 Jobs</b>
<b>Engineers</b>	<b>1245</b>
<b>Assemblers</b>	<b>1160</b>
<b>Drafters and Design Technicians</b>	<b>83</b>
<b>Electrical/Electronic Technicians</b>	<b>280</b>
<b>Fabricators</b>	<b>107</b>
<b>Machine Operators</b>	<b>557</b>
<b>Machinists</b>	<b>261</b>
<b>Mechanics</b>	<b>1733</b>
<b>Quality and Process Technicians</b>	<b>350</b>
<b>First-Line Supervisors</b>	<b>362</b>
<b>Logistics</b>	<b>135</b>
	<b>6,273</b>

*Source: Economic Modeling Specialists, Inc.-Complete Employment, Fall 2008*

It is difficult to project job growth for aerospace because of the historic recession during which this analysis is being carried out. Aerospace has been hit hard, and companies interviewed and surveyed for this project revealed uncertainty about the future. Our analysis relies on government job projection data as well as insights and data from the RTS survey and company interviews. These projections should be viewed as relevant but subject to large variance and should be supplemented regularly by dialogue with industry to revisit anticipated job growth as conditions change.

Federal data indicate that the state’s industry will need nearly 6,000 workers with skills specific to the industry over the next decade (Table ES-3). This includes both new jobs and jobs to replace those who retire or leave the industry. The issue of worker age and looming retirement is a key issue with aerospace and much of the manufacturing sector.

Through conversations and surveys with aerospace companies, the research team gathered data on companies’ anticipated employment needs. The 36 companies that responded to the survey expect to hire for 2,500 new positions in the coming three years. Engineers, mostly with bachelor’s degrees and two to four years of experience, make up 545 of these positions. The greatest need, however, comes from production positions including assemblers and fabricators. For example the companies indicated a need for 800 fabricators typically with a high school diploma and two to four years of experience desired. Businesses are also planning to hire hundreds of assemblers, machine operators, and mechanics over the next three years.

**Table ES-3. Key Aerospace Job Needs by Occupational Group, 2007-2017**

<b>Occupation</b>	<b>2007 Jobs</b>	<b>2017 Jobs</b>	<b>New Jobs</b>	<b>Replacement Jobs</b>	<b>New &amp; Replacement Jobs</b>
<b>Engineers</b>	1,245	2,607	1,362	260	1,622
<b>Assemblers</b>	1,160	1,861	701	383	1,084
<b>Drafters and Design Technicians</b>	83	146	63	17	80
<b>Electrical/Electronic Technicians</b>	280	486	194	61	255
<b>Fabricators</b>	107	168	61	25	86
<b>Machine Operators</b>	557	849	265	205	470
<b>Machinists</b>	261	409	148	76	224
<b>Mechanics</b>	1,733	2,714	967	250	1,217
<b>Quality and Process Technicians</b>	350	549	199	109	308
<b>First-Line Supervisors</b>	362	592	230	53	283
<b>Logistics</b>	135	241	106	32	138
<b>Total</b>	<b>6,273</b>	<b>10,622</b>	<b>4,296</b>	<b>1,470</b>	<b>5,766</b>

Source: Economic Modeling Specialists, Inc.-Complete Employment, Fall 2008

## ***Producing Workers for North Carolina’s Aerospace Industry***

The state of North Carolina offers training for current and future aerospace workers through three main sources: K-12 education, the state’s 58 community colleges, and the universities. There are also numerous private education schools and colleges in the state. Combined, these sets of institutions support aerospace by providing individuals with 1) critical foundational skills and knowledge, 2) skills that apply across the spectrum of advanced manufacturing, and 3) skills specifically geared towards the aerospace industry.

### **K-12 Education**

The role of the state’s public secondary school system in preparing the workforce for the aerospace industry is threefold. First, the K-12 system provides the basic foundational skills—basic reading, mathematics, and problem-solving, for instance, that are critical to any advanced industry. Second, through more explicit Science, Technology, Engineering, and Mathematics (STEM) education, schools can generate interest in aerospace careers and provide the technical basis to encourage young people to enter the industrial workforce. Third, high schools provide specific industrial training in such disciplines as welding that can be utilized by the industry.

It is worth noting, however, that in the RTS survey and during interviews, aerospace companies more frequently report looking to community colleges and universities as sources for new employees, rather than high schools.

*Career and Technical Education:* Some high schools throughout the state offer specific technical education courses that can have direct application in the aerospace industry. There are four main technical training courses offered in K-12 with applications to the aerospace industry: electronics, welding, metals manufacturing, and computer aided drafting.

*STEM Education:* North Carolina offers numerous STEM programs and initiatives that support the aerospace industry in specific, and advanced manufacturing in general. The UNC General Administration has recently compiled an inventory of STEM efforts (<http://www.northcarolina.edu/academies/usp/reports.htm>). Some key STEM programs are:

- NC New Schools Project: Learn and Earn Early College High Schools & Redesigned High Schools
- Project Lead the Way Schools
- Career Academies

The project team identified two high school programs that are a direct feeder of workers for an aerospace firm. Pisgah High School in the west works with a local aerospace company in an apprenticeship relationship. In the Piedmont Triad there is a new Aviation Academy at Andrews High School that is forging a relationship with industry and Guilford Tech.

### **North Carolina Community Colleges**

The North Carolina Community College System (NCCCS) serves as a pipeline for career changers and new entrants into aerospace-related jobs, and as a source of crosscutting and company-specific skills that serve aerospace and other advanced manufacturing industries. The system provides three main types of education and training that impact the aerospace industry: 1) credit programs, a few specific to aerospace but most in other manufacturing-related curriculum programs; 2) non-credit courses ranging from aerospace specific classes such as the FAA Airframe and Powerplant (A&P) modules, for example, to welding; and 3) customized training programs geared toward specific aerospace companies.

The costs associated with starting and maintaining advanced manufacturing programs at community colleges, whether credit or non-credit, can be prohibitive, and aerospace programs are among the most expensive. The facilities to house them must be large and near a runway. The equipment and consumable supplies are also costly. The state does not have dedicated funds for equipment for start-up programs. The North Carolina Community College System is seeking higher reimbursement rates from the General Assembly for high cost programs such as aerospace.

Certification as an FAA approved training provider/school is very important for aircraft maintenance and repair education programs. Three community colleges in the state are approved to offer FAA A&P programs that prepare individuals to sit for the A&P certifications. These institutions are: Craven Community College, Guilford Technical Community College and Wayne Community College. Becoming an FAA certified school requires significant equipment, close monitoring by the FAA, and meeting robust requirements to continue as an FAA approved training provider. GTCC is also seeking to become a Radio Operator's License provider as part of its planned avionics program.

Beyond aviation specific programs, however, the federal government's National Center for Education Statistics identifies 61 other credit programs at North Carolina's community colleges where completers are expected to be qualified for the 17 technician (and engineering) occupations that are the focus of this workforce needs assessment.

In addition, community colleges offer a tremendous number and variety of non-credit continuing education courses. Unlike many states, North Carolina's community colleges are reimbursed for non-credit course enrollments, called occupational extension, though at lower rates than credit courses. Common non-credit courses offered with direct relevance to the aerospace industry are aviation maintenance, industrial maintenance, electronics, and welding. The FAA A&P modules are offered as both credit-based and non-credit programs at some colleges.

Finally, North Carolina's Customized Training Program is one of the oldest and most respected in the nation. There is quite a lot of latitude regarding the content and structure of these training programs, and companies work closely with colleges to develop them. Two current large customized programs for aerospace are for HondaJet in the Triad, through Guilford Tech and Spirit in Kinston through Lenoir Community College.

#### **Universities and Four-Year Colleges**

The state's four-year institutions provide another source of qualified workers for the state's aerospace industry. Universities are particularly critical in meeting the engineering needs of the industry through the provision of both baccalaureate and post-graduate degrees.

The project team examined North Carolina completer data in undergraduate and graduate programs that feed occupations in the aerospace industry. These 65 programs range from business administration programs offered by most 4-year institutions to industrial engineering offered by only two. Among the results of the analysis are:

- There is one aerospace engineering program in the state (at NC State University) but four mechanical engineering programs that are closely related. The universities offering mechanical engineering programs are: NC State, NC A&T, UNC Charlotte and Duke University. Duke also has an aerospace certificate in its mechanical engineering department.
- There is one Materials Science and Engineering program in the state also at NC State. Input from industry suggests that the importance of this field will grow as the aerospace industry increasingly depends on composites.
- Electrical engineers were more than double that of mechanical engineers in 2007.

Other aerospace-relevant capacity exists at East Carolina University, with its new engineering program that is emphasizing producing generalized engineers with significant hands-on and problem-solving skills. In addition, Elizabeth State University has the state's only Aviation Science program, and NC A&T has a composites program.

Quantitative data show there is aerospace-related educational capacity in our state to help meet the workforce needs of aerospace companies. But these data clearly only tell part of the story—while the total number of completers who could, theoretically go into aerospace jobs is significant, a closer look shows that many are in business and computer fields who do not fill jobs that employers report having trouble filling. Further, completers may leave the state or change fields, and there are other advanced manufacturing firms competing for the same graduates.

## **Gaps**

Based on research, survey results, site visits and interviews conducted for this workforce needs assessment, these are key aerospace workforce gaps in North Carolina.

### *Labor Market Gaps*

- Aerospace jobs anticipated to both be in high demand and difficult to fill over the next three to five years:
  - Sheet metal fabricators
  - Mechanics
  - Mechanical and aerospace engineers
- Skilled employee gaps for aerospace appear to be more significant in some parts of North Carolina than others. Difficulty attracting and retaining engineers in rural areas is one component of this gap. Further, the new large Spirit aerospace manufacturing facility in Kinston will likely lure skilled workers from other manufacturers and nearby military bases creating skilled worker gaps in the region. In northeastern NC, the gap appears to stem more from limited education and training capacity for the aerospace industry.
- Aerospace leaders report an ‘aerospace culture’ gap in North Carolina. By this they mean a lack of interest or awareness of jobs in aerospace as well as a deficit of students, from as early as middle school, pursuing the types of science and technology coursework that would lead to aerospace jobs.

### *Skills Gaps*

- Technical skills gaps most often identified by employers for production and technician level workers are blueprint reading; precision measurement; computer numeric control (CNC); fabrication welding; and composites lay-up.
- Soft and foundational skills gaps most often identified by employers for production and technician level workers are problem-solving; leadership; attention to detail; and general math.
- Soft and foundational skills gaps most often identified by employers for engineers are leadership; integration/coordination across disciplines; and project management.

### *Education and Training Capacity Gaps*

- Composites-related skills, particularly lay-up and non-destructive inspection and testing, are increasingly important for the aerospace industry and there are very few training resources in the state to create qualified workers with these skills.
- There is a gap in knowledge about the quality of industrial programs, particularly welding and machining programs, in terms of whether curricula, facilities, and

equipment are sufficient to meet aerospace employers' needs. The scope and timeframe of this project did not allow the project team to evaluate these programs' effectiveness.

- Aerospace firms require experience for almost all of their hires, from technicians to engineers, but most aerospace-related education programs in North Carolina do not incorporate industry experiences such as internships.
- Community colleges in rural areas have difficulty securing resources to fund physical space and equipment for aerospace-related training. In addition, they report more difficulty attracting and retaining qualified faculty.

## **Goals and Strategies**

The culmination of the analysis of workforce demand and supply and the gaps that need to be addressed is the following series of goals and strategies. Details on the specific action steps to implement the strategies are in the main report. Various actors – government, education, aerospace companies, industry organizations and philanthropic organizations like GLF – have a role in action steps that we recommend.

### **Goal 1: Generate interest in aerospace careers among the future and existing workforce and increase the pipeline of qualified workers**

A common thread to our discussions with aerospace firms in the state – small and large, manufacturers and MROs – was the need for a pipeline of workers with the skills needed to be effective workers in advanced manufacturing. While a knowledge of and experience in the specific needs of aerospace and their firms was seen as important, firms expressed a great concern for having a pipeline of skilled workers who could step in quickly, with appropriate training, and be productive. Skills mentioned included reading blueprints, precision measurement, welding, process and quality control, and electrical understanding, all skills applicable to 21<sup>st</sup> century advanced manufacturing.

This is an important finding as it suggests that efforts need to start with these broader set of skills particularly since aerospace is still an emerging industry within pockets of the state. Our goals, strategies and action steps all reflect our conviction that building good and transferable skills for advanced manufacturing should come first, followed by industry specific training and when appropriate specific company training efforts.

**Strategy 1: Provide the future workforce with the appropriate STEM skills to move into advanced manufacturing industries like aerospace.**

**Strategy 2: Promote aerospace as a viable and attractive career choice to young adults.**

**Strategy 3: Work with the Workforce Commission and other partners in the state to identify jobs that could transition dislocated workers, career changers and separating military into the aerospace industry.**

## **Goal 2: Strengthen education capacity in high schools, community colleges and universities**

There are three broad categories of knowledge and skills required for a qualified aerospace workforce: 1) those shared across many advanced manufacturing industries and companies; 2) those specific to the aerospace industry and companies; and 3) those specific to a company's manufacturing or operational process. Our recommendations are organized into these three areas.

**Strategy 1: Increase advanced manufacturing, maintenance, and engineering skills that are vital to aerospace but also support other industries.**

**Strategy 2: Increase aerospace specific skills and knowledge through specialized education and training resources.**

**Strategy 3: Develop new education and training capacity in two key areas: composites manufacturing and non-destructive inspection & testing.**

**Strategy 4: Meet training needs of specific companies, or for civilian workers at military facilities, in ways that have spillover benefits for workers and regions.**

## **Goal 3: Develop organizational systems and mechanisms required to meet the workforce needs of the aerospace industry**

The recommendations offered in this report outline strategies and action steps aimed at increasing the pipeline of workers for the aerospace industry and making sure that these workers have the necessary skills to make the state's aerospace companies competitive. While many of these recommendations can be implemented using existing institutions and actors, conversations with firms, educators and analysis of best practices from other states suggest that several steps need to be taken to ensure that there are systems in place to implement these new strategies, and just as importantly, to react to this changing and emerging industry. In these strategies and action steps, we don't suggest creating institutions that will add new levels of bureaucracy but rather build capacity to focus on the workforce needs of the aerospace industry.

**Strategy 1: Create a new industry-focused entity, the North Carolina Aerospace Industry Coordinating Council that supports collaboration and advancement of the industry.**

**Strategy 2: Ensure that state policies allow for the purchase of equipment to support aerospace training.**

**Strategy 3: Develop and implement a process for choosing two community college Aerospace Centers of Excellence.**

**Strategy 4: Develop evaluation criteria for evaluating proposals aimed at meeting the needs of the aerospace industry.**

**Strategy 5: Develop an Implementation Strategy and Action Plan for Recommendations.**

## **Summary**

Aerospace is one of the state's fastest growing industries and an industry with exceptional wages, fringe benefits and excellent opportunities for advancement. Yet it is still relatively small compared to mature economic clusters such as biotechnology. Like biotechnology 20 years ago, aerospace is an emerging cluster that can grow into a 21<sup>st</sup> century version of the furniture and textile industries of the 20<sup>th</sup> century that helped build the state's economy. To take NC aerospace from an *emerging* to a *mature* cluster requires attention to global competitiveness factors. Developing a world-class workforce system for aerospace is a key part of the solution.