The Aerospace Economy in North Carolina

An Assessment of Current Performance and Future Industry Prospects

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FOREWORD

A study done by the North Carolina Space Initiative in 2006 ("The Aero/Space Industry in North Carolina") has suggested that North Carolina has a modest presence in a narrowly defined core aerospace industry and a far more significant presence, and potential for growth, in the broadly inclusive aerospace-related cluster. These findings also suggest that North Carolinas' current and developing role in the Aerospace Economy could be multi-faceted, with activity in the broader Aerospace Economy having widely distributed impacts throughout virtually all major industry sectors and geographic regions.

This report explores those findings, and provides a useful resource to support the collaborative development of a statewide strategy for aerospace workforce development in North Carolina. Creation of the North Carolina aerospace workforce development strategic plan is a collaborative effort between the N.C. Space Initiative, the NC Department of Commerce, N.C. State University, N.C. Community College system, and the National Aerospace Development Center.

This report provides as comprehensive an overview as possible for the current status of the aerospace industry clusters in North Carolina, depicting the strengths and opportunities of the State with regard to the aerospace economy as a whole. Particular emphasis is given to identifying opportunities for enabling workforce development to support the aerospace sector and related high-tech high-growth segments that can enhance the competitive advantage of current NC aerospace activities.

Data used in this report is dynamic, and while the data supplied with this report is considered by the authors as more than sufficient to offer a fair representation of the strengths of the State, it is suggested that a comprehensive review and industry be conducted to secure current field data directly from industry sources. Additional financial and human resources will be required to proceed with more comprehensive follow up research that would build upon the preliminary analysis offered here.

EXECUTIVE SUMMARY

North Carolina has experienced a dramatic economic transformation in recent years amidst the onset of increased global competition and the continued diffusion of more and more sophisticated technologies. This period has been particularly turbulent for North Carolina as some its longest standing economic cornerstone industries – textiles, furniture, and tobacco – dwindled from the landscape. As North Carolina looks to the future, efforts are underway to identify industries that hold promise to become important elements in the state's 21st century economic portfolio.

In a March 2006 the North Carolina Space Initiative released a white paper (Brown et. al, 2006) that suggested that North Carolina had a modest presence in the traditional aerospace industry, such as aircraft production and airport operations. The analysis contained in the attached report extends this earlier work with a more encompassing definition of aerospace that includes related aerospace support and commercial space activities[1]. This report has four fundamental goals:

1) To develop a more complete picture of what North Carolina's traditional aerospace presence (A NORTH CAROLINA INDUSTRY SNAPSHOT pg. 6);

2) To make a realistic assessment of North Carolina's capacity to expand its aerospace presence (A NORTH CAROLINA RESOURCE CATALOG pg. 24);

3) To examine the development experiences of other states where the aerospace industry is already an important part of their economy (LESSONS FROM OTHER STATES pg. 60);

4) To gauge whether or not North Carolina's case for aerospace is a realistic one (CONCLUSIONS REVISITED pg. 70).

Results of this study supports the conclusion that aerospace is an emerging part of North Carolina's economy with tremendous positive potential for the state's economic future. Traditional aerospace is a promising industry for North Carolina because of six primary factors.

[1] Commercial space is defined by the Federal Aviation Administration (FAA) as "the movement of, or means of moving objects, such as communications and observation satellites, to, from, or in space" (FAA, 2007a, par. 2). Essentially, commercial space is about the growing participation of private industry in space operations – a historically public sector-only endeavor.

- **High Wages**: Traditional aerospace firms in North Carolina consistently pay wages that exceed the overall state average and in some cases that of the national industry average.
- **Strengths in growth segments**: North Carolina has a favorable mix of traditional aerospace industry segments. While the state does not yet have a commanding presence in every facet of the traditional aerospace industry, there is substantial growth in the industry in the areas in which the state is strongest – engine and engine parts manufacturing, replacement parts manufacturing, and maintenance and repair. Furthermore, North Carolina has become a player in the emerging very light jet market with the recent addition of HondaJet.
- **Strong Institutional Support**: The state has strong aerospace-related institutions, including active educational partners such as N.C. State University and aerospace-driven organizations such as the North Carolina Aerospace Alliance.
- **Statewide Economic Impact:** The economic benefit of the traditional aerospace industry is dispersed throughout the entire state. At present, the state's main industry clusters are concentrated in the Triad region and eastern North Carolina – arguably the regions most in need of a new economic direction and revival.
- **Supports the State's Military Installations:** North Carolina is home to six important military installations that require private sector business such as replacement part production, thus providing thousands of aerospace-related employment opportunities. Also, retiring military personnel often have the skills and training that private aerospace firms are seeking.
- **Catalyst for Growth in Emerging High-Tech Sectors:** Support for traditional aerospace can also encourages growth in the emerging space industries, including satellite construction for communications, mapping, and other applications including electronics, controls, advanced composite materials development and advanced propulsion.

Competition from other states and countries in recruiting aerospace firms to the state will be intense. North Carolina must take measures to maintain its position of leadership as one of the best states in which to do business. Workforce development is the primary means by which to accomplish this goal. The significant potential for growth in this industry in North Carolina could be threatened by key workforce shortages, especially the state's current lack of skilled machinists. The quality of the workforce available for aerospace also needs to be looked at more closely.

I. A NORTH CAROLINA INDUSTRY SNAPSHOT

The ultimate goal of this study is to assess whether the aviation and commercial space sectors of the aerospace industry can be expected to be a meaningful part of North Carolina's economic future. To that end, this section will attempt to answer five fundamental questions:

- What segments of the aerospace industry are actually present in North Carolina?
- Has the aerospace industry in North Carolina changed in recent years, i.e. does the state's presence appear to be growing, declining, or stagnant?
- Do the opportunities that currently exist benefit North Carolina and its citizens?
- What is the geographic distribution of aerospace industry across North Carolina?
- What is the current occupational composition of the state's aerospace industry?

The analysis in this section will focus solely on the aviation sector, including industries that directly create aerospace and aviation products and services; it will exclude those components of the military that are engaged in aerospace and aviation-related activities. Due to its emerging nature, historical data analysis of commercial space is unlikely to yield any meaningful insights. The question of commercial space will be addressed in full in subsequent sections, especially "Lessons From Other States" and "Conclusions Revisited". All activities examined are encompassed in the 17 North American Industry Classification System (NAICS) codes shown in Table 1. Fuller descriptions of these categories are found in Appendix A.

Table 1 – Traditional Aerospace Industry NAICS Codes[2]

334511	Search, Detection, and Navigation Instruments Mfg.	481211	Nonscheduled Chartered Air Passenger Transportation
336411	Aircraft Manufacturing	481219	Other Nonscheduled Air Transportation
336412	Aircraft Engine and Parts Mfg.	488111	Air Traffic Control
336413	Other Aircraft Parts and Auxiliary Equipment Mfg.	488112	Other Airport Operations
336414	Guided Missile and Space Vehicle Mfg.	488190	Other Support Activities for Air Transportation
336415	Space Vehicle Propulsion Units and Parts Mfg.	517410	Satellite Communications
336419	Other Guided Missiles and Space Vehicles Mfg.	611512	Flight Training Schools
481111	Scheduled Passenger Air Transportation		
481111	Scheduled Freight Air Transportation		

[2] See Appendix B for a description of industry segments included in the various NAICS codes.

What segments of traditional aviation are currently present in North Carolina? Has the aerospace industry in North Carolina changed in recent years – is it growing?

A. Employment

Using Quarterly Census of Employment and Wages (QCEW) data from the Bureau of Labor Statistics and the Employment Security Commission of North Carolina, this analysis gauges traditional aerospace's presence by examining employment and establishment figures.

Table 2 presents North Carolina's employment totals in the 17 traditional aerospace NAICS industries in 2001 and 2005 as well as the percentage change in those totals during that period.[3] Fourteen of the 17 identified industries register a presence in North Carolina; NAICS codes 336414, 336415, and 336419 (essentially all the space vehicle and missile manufacturing) are not part of the state's aerospace portfolio. The largest of the industry sectors present in 2005 was scheduled air transportation (481111), which essentially represents all the commercial airline operations in the state. North Carolina also appears to have a sizable presence in airport operations (488119), aircraft repair and maintenance[4] (488190), and aircraft engine and engine parts manufacturing (336412). Conversely, the state appears to have very little presence in nonscheduled cargo operations (481212) and satellite communications (517410).

Looking at raw employment totals out of context can be misleading so Table 2 also displays location quotients (LQ) as a means of comparing the employment concentration for each of these aerospace industries within the state against that of the U.S.[5] That information shows that only airport operations (LQ 1.30) and aircraft maintenance and repair (LQ 1.06) have location quotients over 1.00. In contrast, scheduled passenger transportation and aircraft engine and engine parts manufacturing, the two industries with the largest presence in terms of raw numbers had LQ scores of 0.90 and 0.74 respectively. Other industry segments of note based on the LQ analysis include scheduled freight operations and nonscheduled passenger operations which both saw their quotients increase between 2001 and 2005. On the opposite end of the spectrum,

[3] The data are end of the year totals for private industry only in 2001 and 2005, the most recent year where the comparable N.C. and U.S. data used in Location Quotient analysis could be obtained.

[4] Based on NAICS' description of the industry, this analysis will often refer to Other Support Activities for Air Transportation as Aircraft Maintenance and Repair in order to add meaning to the more generic title.

[5] See Appendix 1 for definition of Location Quotient.

aircraft manufacturing and satellite communications both registered low levels of concentration with location quotients of 0.07 and 0.11 respectively.

The primary value of using location quotients is that they permit comparisons against a normalized base. An industry may register a huge jump in its location quotient from one year to another, but that increase could be due to the fact that the industry in the state did not decline as much as did the industry in the nation. This is seen in Table 2 where the percent change in each industry segment for North Carolina is compared to that in the U.S. between 2001 and 2005. This shows that despite some low location quotients and seemingly unimpressive employment levels, **North Carolina experienced growth in eight out of the fourteen industries.**

Table 2 also shows the probable impact that events on September 11, 2001 had on the industry, reflected in sharp losses in scheduled passenger transportation during the subsequent four-year period. However, **when scheduled passenger transportation is removed, North Carolina experienced a nearly thirteen percent increase in traditional aerospace employment between 2001 and 2005, whereas the national total decreased nearly six percent.** That growth was fueled by sizable increases in aircraft manufacturing, aircraft engine and engine part manufacturing, instrument manufacturing, scheduled freight operations, nonscheduled passenger transportation, aircraft maintenance and repair, satellite communications, and flight school training. Making that result even more impressive is the fact that **five of those eight increases occurred while the corresponding national totals declined.**

In summary, using employment levels alone, a description of North Carolina's traditional aerospace industry presence as "modest" appears to be a fair assessment, given that the industry as of 2005 comprises less than one percent of total state employment. Nonetheless, when at least partially controlling for the recent instability in commercial airline industry, the data indicate that traditional aerospace is growing in North Carolina. In fact, growth in traditional aerospace without commercial airline operations (12.84%) far outpaced overall employment growth in the state (0.49%) between 2001 and 2005. Furthermore, the state appears to be particularly well positioned in aircraft engine and engine part manufacturing (336412) and aircraft maintenance and repair (488190) based on their sizable raw numbers, solid growth, and promising location quotients.

Table 2 – Traditional Aerospace Employment in North Carolina: Totals, Percent Change, and Location Quotients

NAICS Industry	Employment Total		Percent Change '01-'05		Location Quotient	
	2001	2005	North Carolina	United States	2001	2005
Search, Detection, and Navigation Instrument Manufacturing – 334511	551	580	5.26%	4.79%	0.13	0.13
Aircraft Manufacturing – 336411	134	403	200.75%	-11.32%	0.02	0.07
Aircraft Engine and Engine Parts Manufacturing – 336412	1,501	1,750	16.59%	-13.65%	0.54	0.74
Other Aircraft Parts and Auxiliary Equipment Manufacturing – 336413	659	447	-32.17%	-11.05%	0.23	0.18
Scheduled Passenger Air Transportation – 481111	16,971	11,497	-32.26%	-20.17%	1.05	0.90
Scheduled Freight Air Transportation – 481112	71	174	145.07%	-16.76%	0.16	0.46
Nonscheduled Chartered Passenger Air Transportation – 481211	206	774	275.73%	5.79%	0.21	0.77
Nonscheduled Chartered Freight Air Transportation – 481212	33	31	-6.06%	-14.95%	0.13	0.14
Other Nonscheduled Air Transportation – 481290	204	30	-85.29%	-46.30%	1.83	0.51
Air Traffic Control – 488111	89	43	-51.69%	-50.18%	0.58	0.57
Other Airport Operations – 488119	2,541	2,324	-8.54%	2.45%	1.45	1.30
Other Support Activities for Air Transportation – 488190	2,219	2,578	16.18%	11.02%	1.00	1.06
Satellite Communications – 517410	33	53	60.61%	-22.93%	0.05	0.11
Flight Training – 611512	108	234	116.67%	-17.81%	0.18	0.48
TOTAL	**25,320**	**20,918**	**-17.39%**	**-11.47%**	**0.62**	**0.59**

Source: Bureau of Labor Statistics' Quarterly Census of Employment and Wages

B. Establishments

Establishment data allows determination of whether the industry sectors are dominated by several large companies or is comprised of a number of small to mid-sized firms. Table 3 displays aerospace establishment data for North Carolina in 2001 and 2005 and compares the industry makeup within the aerospace sector in the state against a US aerospace sector baseline. In terms of raw numbers of establishments as of 2005, aircraft maintenance and repair had the largest presence in the state with 80 establishments followed by scheduled passenger services and airport operations with 51 and 47 respectively. As with employment data, LQ analysis allows comparison of the relative number of firms in a particular industry in the state against that of the same industry in the U.S. overall. Only three of the fourteen aerospace industries in the state had LQ values of 1.00 or greater in 2005, and all three of those values had decreased since

2001. With respect to percentage change**, eight industries saw their total number of establishments decrease, two had no change, and four industries experienced establishment growth during the four-year span.**

Confidentiality issues complicate interpretation of data on establishments. Data related to certain factors are routinely suppressed to protect competitive information, making it difficult to calculate some indicators. Nonetheless, it appears that the number of workers-per-firm is higher in traditional aerospace than it is in the overall state economy, with 65 employees-per-establishment in aerospace compared to only around 14 employees-per-establishment for the state as a whole.[6] While that is a fairly rough calculation, the pattern is the same for the U.S. with 70 workers per establishment in traditional aerospace compared to only thirteen-per-establishment in the total U.S. economy.[7] Traditional aerospace establishments tend to be larger – a result that seems to make sense when taking into account the economies of scale present in many of aerospace's key segments, such as commercial airline operation and aircraft production.

Establishment data presents a fairly similar picture to the employment analysis. In both instances aerospace has a modest presence, accounting for less than one percent of total employment and of the establishments in the state.[8] Unlike the employment situation, **the number of traditional aerospace establishments in the state decreased between 2001 and 2005 while the total number of all establishments in the state increased nearly five percent.** The two bright spots from the aerospace employment analysis – aircraft engine and engine part manufacturing and aircraft maintenance and repair – did not fare quite as well in the establishment analysis. Yet, maintenance and repair did account for over a quarter of all the state traditional aerospace establishments in 2005 and was one of only four industries to experience establishment growth during the four-year span from 2001 to 2005. Overall, in terms of establishments, North Carolina's traditional aerospace presence does appear rather "modest" (Brown et. al, 2006, p.16).

[6] Calculation: total employment for both traditional aerospace and entire state divided by total number of establishments for each – 20,918/319=65.5 and 3,208,940/225,901=14.2, respectively

[7] Calculation: total employment for both traditional aerospace and entire U.S. divided by total number of establishments for each – 1,228,664/17,561=69.9 and 110,611,016/8,294,662=13.1, respectively

[8] Calculation: total establishments in traditional aerospace divided by total state establishments – 319/225,901=0.14%

Table 3 – Traditional Aerospace Establishments in North Carolina: Totals, Percent Change, and Location Quotients

NAICS Industry	Establishment Total		Percent Change 01-05		Location Quotient	
	2001	2005	North Carolina	United States	2001	2005
Search, Detection, and Navigation Instrument Manufacturing – 334511	8	8	0.00%	2.60%	0.34	0.34
Aircraft Manufacturing – 336411	5	5	0.00%	32.70%	0.38	0.29
Aircraft Engine and Engine Parts Manufacturing – 336412	11	10	-9.09%	-1.15%	0.65	0.61
Other Aircraft Parts and Auxiliary Equipment Manufacturing – 336413	9	8	-11.11%	-11.97%	0.21	0.21
Scheduled Passenger Air Transportation – 481111	53	51	-3.77%	-5.27%	0.77	0.81
Scheduled Freight Air Transportation – 481112	13	11	-15.38%	10.58%	0.77	0.60
Nonscheduled Chartered Passenger Air Transportation – 481211	26	31	19.23%	6.42%	0.46	0.53
Nonscheduled Chartered Freight Air Transportation – 481212	9	11	22.22%	1.39%	0.56	0.69
Other Nonscheduled Air Transportation – 481290	20	13	-35.00%	-20.55%	1.63	1.37
Air Traffic Control – 488111	15	6	-60.00%	-11.16%	2.40	1.11
Other Airport Operations – 488119	53	47	-11.32%	-4.88%	1.16	1.11
Other Support Activities for Air Transportation – 488190	76	80	5.26%	9.56%	0.72	0.71
Satellite Communications – 517410	13	12	-7.69%	-5.95%	0.44	0.44
Flight Training – 611512	19	26	36.84%	0.56%	0.63	0.88
TOTAL	**330**	**319**	**-3.33%**	**0.99%**	**0.68**	**0.67**

Source: Employment Security Commission of North Carolina

Do the opportunities that currently exist benefit North Carolina and its citizens?

C. Wages

The next question that arises is whether the opportunities that exist are quality positions – a particularly important issue in assessing if North Carolina should target the industry. In this analysis, average annual pay as determined by the Bureau of Labor Statistics will serve as a proxy for job quality.[9] Table 4 lists the average annual pay for each of the fourteen industries in North Carolina, the difference between that figure and the national average and the change in average annual pay between 2001 and 2005.

[9] Average annual pay is computed by dividing total annual pay of employees covered by unemployment insurance programs by the average monthly number of these employees. In addition to salaries, average annual pay data include bonuses, the cash value of meals and lodging when supplied, tips and other gratuities, and, in some states, employer contributions to certain deferred compensation plans such as 401(k) plans, and stock options.

The average annual pay for the traditional aerospace industry in North Carolina is more than 30 percent higher than the overall average for the state – $46,582 compared to $35,764.[10] Furthermore, that finding holds true across aerospace industry segments: in 2005, thirteen out of the state's fourteen traditional aerospace industry segments registered average pay levels above the overall state mark.

Wage Growth: Between 2001 and 2005 average annual pay in traditional aerospace did not grow nearly as much as it did in the North Carolina economy as a whole – less than 1 percent increase in traditional aerospace compared to a twelve percent increase in the overall North Carolina pay level. As was the case with traditional aerospace employment, this result seems to have been caused at least in part by the aftermath of September 11th. If the pay data for scheduled commercial passenger transportation is removed from the equation for both years, then the average annual pay in North Carolina's traditional aerospace industry is found to increase nearly 24 percent between 2001 and 2005 – nearly twice the growth in the overall state level for the same period. If the same adjustment is made for the U.S. industry, the average annual pay in North Carolina's traditional aerospace industry outperforms the national mark of 19 percent by a full three percentage points over the period between 2001 and 2005.

The high-water mark for an individual aerospace industry segment in North Carolina was in aircraft engine and engine parts manufacturing with an average annual pay in 2005 of $79,055. As of 2005 that level was $11,199 higher than the national average for that same industry and its percentage change increase between 2001 and 2005 in North Carolina was roughly double what it was for the national industry. Other individual industry segments of note include other aircraft part manufacturing which experienced a 52.6 percent increase between 2001 and 2005 and other nonscheduled air transportation which more than doubled its average annual pay during that same period.

[10] Average annual pay for the entire traditional aerospace industry was calculated as a weighted average of its fourteen industry segments.

Table 4 – Average Annual Pay in Traditional Aerospace Industries in NC

NAICS Industry	Average Annual Pay		Difference between N.C. and U.S. (NC minus US)		Percent Change 2001-2005	
	2001	2005	2001	2005	North Carolina	United States
Search, Detection, and Navigation Instrument Manufacturing – 334511	$51,079	$55,976	-$18,491	-$27,774	9.59%	20.38%
Aircraft Manufacturing – 336411	$40,254	$53,037	-$22,222	-$24,098	31.76%	23.46%
Aircraft Engine and Engine Parts Manufacturing – 336412	$62,158	$79,055	$2,676	$11,199	27.18%	14.08%
Other Aircraft Parts and Auxiliary Equipment Manufacturing – 336413	$46,081	$70,331	-$3,855	$13,659	52.62%	13.49%
Scheduled Passenger Air Transportation – 481111	$48,595	$41,936	-$4,220	-$10,484	-13.70%	-0.75%
Scheduled Freight Air Transportation – 481112	$31,308	$27,531	-$15,291	-$22,405	-12.06%	7.16%
Nonscheduled Chartered Passenger Air Transportation – 481211	$39,774	$43,503	-$3,966	-$10,837	9.38%	24.23%
Nonscheduled Chartered Freight Air Transportation – 481212	$45,895	$40,208	$3,375	-$10,985	-12.39%	20.40%
Other Nonscheduled Air Transportation – 481290	$21,209	$49,610	-$15,664	-$4,276	133.91%	46.14%
Air Traffic Control – 488111	$42,214	$63,628	$10,107	$14,222	50.73%	53.88%
Other Airport Operations – 488119	$37,771	$43,176	$13,243	$16,909	14.31%	7.09%
Other Support Activities for Air Transportation – 488190	$33,541	$43,619	-$3,765	-$1,290	30.05%	20.38%
Satellite Communications – 517410	$52,449	$58,366	-$9,089	-$16,513	11.28%	21.68%
Flight Training – 611512	$28,369	$37,749	-$7,853	-$3,941	33.06%	15.10%
INDUSTRY TOTAL	$46,490	$46,582	-$6,911	-$13,157	0.20%	11.87%
OVERALL TOTAL	$31,910	$35,764	-$4,247	-$4,741	12.08%	12.03%

Source: Bureau of Labor Statistics' Quarterly Census of Employment and Wages

What is the geographic distribution of aerospace industry across North Carolina?

D. Geographic Distribution

Is traditional aerospace benefiting areas of the state that are already very successful, such as the Research Triangle, or is it providing benefit in regions that are in greater need of a new economic engine? While confidentiality concerns and corresponding suppression of data make it somewhat difficult to develop a truly complete picture of the industry's geographic distribution in the state, there are some available data which provide insight. Table 5 shows the available, unsuppressed four-digit NAICS code employment data for each of North Carolina's seven economic

development partnership regions[11] as of the second quarter of 2006.[12] There is some traditional aerospace activity in each of the seven regions, although the available data suggest that the industry's presence is fairly light in the western corner of the state. The Charlotte and Piedmont Triad regions both appear to have sizable concentrations of traditional aerospace activity, as does the Southeast and Research Triangle regions.

Table 5 – Geographic Distribution of North Carolina's Traditional Aerospace Industry by Regional Economic Development Partnership Region

Regional Partnership	NAICS Grouping	NAICS Code	2Q:06 Employment
Advantage West	Support Activities for Air Transport	4881	80
			Total: 80
Charlotte	Aerospace Product & Parts Manufacturing	3364	565
Charlotte	Scheduled Air Transportation	4811	5,374
Charlotte	Nonscheduled Air Transportation	4812	111
Charlotte	Support Activities for Air Transport	4881	556
			Total: 6,606
Eastern	Support Activities for Air Transport	4881	738
			Total: 738
Northeast	Support Activities for Air Transport	4881	770
			Total: 770
Southeast	Aerospace Product & Parts Manufacturing	3364	1,465
Southeast	Scheduled Air Transportation	4811	127
Southeast	Nonscheduled Air Transportation	4812	10
Southeast	Support Activities for Air Transport	4881	519
			Total: 2,121
Piedmont Triad	Aerospace Product & Parts Manufacturing	3364	203
Piedmont Triad	Scheduled Air Transportation	4811	2,947
Piedmont Triad	Support Activities for Air Transport	4881	2,495
			Total: 5,645
Research Triangle	Scheduled Air Transportation	4811	1,907
Research Triangle	Nonscheduled Air Transportation	4812	32
Research Triangle	Support Activities for Air Transport	4881	478
			Total: 2,417
OVERALL TOTAL			**18,377**

Source: Employment Security Commission of North Carolina

[11] A map of the seven economic development partnership regions is included in Appendix D.

[12] Four-digit NAICS codes were used in Table 4 in an effort to try and provide as full a picture as possible, i.e. to get around data suppression issues that come into play at a six-digit level. The consequence of doing so is the loss of some detail. Table 4 is meant to provide some idea of regional activity so detail isn't as important in this case. Essentially what has happened by going up to a higher level, i.e. four-digit instead of six, is that the component industries under each four-digit code have simply been aggregated together. For example, all the aircraft manufacturing industries are now all summed up together under aerospace product and parts manufacturing. Unfortunately, this necessary step eliminates the analysis' ability to address instrument manufacturing, satellite communications, and flight training schools because their four-digit groupings include a whole array of other activities unrelated to traditional aerospace. Hence, including them would greatly skew the results. On a related note, this is also the same logic that is employed with the occupational analysis at the end of this chapter.

Closer inspection reveals that the bulk of the activity in both the Charlotte and Research Triangle regions is in scheduled air transportation – undoubtedly a result of the major airports located in each area. Conversely, the activity in the Piedmont Triad and Southeast regions seems to be based on other more promising segments of the traditional aerospace industry. The Piedmont Triad has 2,495 employees in support activities for air transport, including aircraft maintenance and repair. The Southeast region's activity centers on the manufacturing segment of the industry.

What is the current occupational composition of the state's aerospace industry?

E. Occupational Composition

To gain an understanding of the occupational structure of the aerospace employment in North Carolina, Standard Occupation Classification (SOC) data – the occupational equivalent of NAICS – were collected for the state's traditional aerospace industry. To minimize data suppression problems data were collected for the same group of four-digit industries used in Table 5.[13] Despite some suppression, the occupational data provide a much more complete picture than does the regional employment breakdown. Tables 6-9 provide a solid understanding of the occupational composition in North Carolina's traditional aerospace industries compared to that of the national industry. This comparison reveals areas of relative strength and weakness that could be the focus of strategic improvement efforts that could strengthen the state's competitive position.

Table 6 presents the occupational structure in aerospace product and parts manufacturing as of the second quarter of 2006 in North Carolina. These data show that the bulk of the occupations in the industry are production-related. Machinist, comprising 12.8 percent of the 2,350 occupations listed, is of particular importance. It is also important to note that the Production Occupations in aerospace pay hourly wages much higher than the statewide average – $21.82 compared to $13.36, a finding that confirms the prior assertion from the employment analysis that aerospace manufacturing in North Carolina is a relatively high paying industry. Table 6 identifies a potential pool of 11,930 machinists employed in other disciplines in the state who might be available to support expansion in the aerospace industry. Other individual occupations of note include aircraft mechanics and inspectors and testers at 7.2 percent and 5.1 percent of the total

[13] See footnote 12.

industry, respectively, with both occupations earning higher wages in aerospace manufacturing than in other sectors in the overall North Carolina economy.

Table 6 – The Occupational Composition of Aerospace Product and Parts Manufacturing (3364) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Hourly Occupation Wage in Industry	Estimated Employment in State	Average Hourly Occupation Wage in State
Management Occupations	**80**	**3.4%**	**$49.49**	**179,430**	**$40.86**
General Managers	30	1.3%	$61.41	56,570	$46.94
Engineering Managers	10	0.4%	$42.44	4,650	$45.55
Business and Financial Occupations	**70**	**3.0%**	**$27.50**	**124,260**	**$25.85**
Purchasing Agents	20	0.9%	$21.27	350	$23.46
Logisticians	20	0.9%	$26.35	990	$28.80
Accountants and Auditors	10	0.4%	$27.55	21,600	$25.91
Computer and Mathematical Occupations	**20**	**0.9%**	**$31.79**	**78,020**	**$31.20**
Computer Systems Analysts	20	0.9%	$30.32	13,790	$33.45
Architecture and Engineering Occupations	**240**	**10.2%**	**$29.25**	**52,570**	**$27.29**
Aerospace Engineers	40	1.7%	$31.74	N/A	$33.09
Mechanical Engineers	50	2.1%	$31.47	3,840	$31.42
Sales Occupations	**20**	**0.9%**	**$32.91**	**406,400**	**$14.58**
Sales Representatives	10	0.4%	$32.77	41,710	$23.56
Office and Administrative Support Occupations	**180**	**7.7%**	**$18.49**	**601,250**	**$13.55**
1st Line Supervisors	10	0.4%	$25.13	38,170	$20.15
Bookkeeping, Accounting, and Auditing Clerks	20	0.9%	$15.04	49,670	$13.78
Production, Planning, and Expediting Clerks	60	2.6%	$22.38	8,130	$17.70
Shipping and Receiving Clerks	20	0.9%	$15.10	24,110	$12.22
Stock Clerks	10	0.4%	$15.88	41,620	$10.26
Executive Secretaries	20	0.9%	$21.03	49,050	$16.33
General Office Clerks	30	1.3%	$12.70	67,130	$11.24

Table 6 – (Continued)

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Hourly Occupation Wage in Industry	Estimated Employment in State	Average Hourly Occupation Wage in State
Installation, Maintenance, and Repair Occupations	**330**	**14.0%**	**$23.24**	**172,130**	**$17.34**
1st Line Supervisors	30	1.3%	$27.61	17,890	$24.40
Aircraft Mechanics	170	7.2%	$21.52	4,230	$19.30
General Maintenance and Repair Workers	30	1.3%	$21.92	45,430	$15.75
Production Occupations	**1,410**	**60.0%**	**$21.82**	**422,090**	**$13.36**
1st Line Supervisors	80	3.4%	$25.89	28,930	$22.08
Electrical Equipment Assemblers	100	4.3%	$20.82	6,080	$12.41
Team Assemblers	50	2.1%	$12.96	62,130	$11.95
Computer Controlled Machine Tool Operators	10	0.4%	$16.58	4,210	$15.10
Machinists	300	12.8%	$16.82	11,930	$15.19
Welders, Cutters, Solderers, and Brazers	10	0.4%	$12.77	9,000	$15.01
Inspectors, Testers, Sorters, Samplers, and Weighers	120	5.1%	$21.24	23,890	$13.60
TOTAL	**2,350**	**100.0 %**			

Source: Employment Security Commission of North Carolina

Tables 7 and 8 present similar results for scheduled and nonscheduled air transportation, respectively. However, data suppression reduces the number of occupational categories that can be shown, especially with respect to nonscheduled air transportation. The available data show that the state's scheduled air transportation industry has a very heavy concentration of reservation and ticket agents.

Table 7 – The Occupational Composition of Scheduled Air Transportation (4811) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Management Occupations	**110**	**2.2%**	**$34.51**	**179,430**	**$40.86**
General Managers	40	0.8%	$43.21	56,570	$46.94
Transportation and Distribution Managers	20	0.4%	$22.64	2,330	$33.27
Office and Administrative Support Occupations	**4,790**	**96.4%**	**$15.95**	**601,250**	**$13.55**
Reservation and Ticket Agents	3,350	67.4%	$15.93	4,430	$15.06
Dispatchers	N/A	N/A	$15.26	4,120	$15.12
Secretaries	10	0.2%	$15.43	49,130	$12.39
Installation, Maintenance, and Repair Occupations	**50**	**1.0%**	**$19.54**	**45,430**	**$15.75**
General Repair and Maintenance Workers	50	1.0%	$19.54	45,430	$15.75
Transportation and Material Moving Occupations	**20**	**0.4%**	**$16.53**	**6,840**	**$18.33**
1st Line Supervisors	20	0.4%	$16.53	6,840	$18.33
TOTAL	**4,970**	**100.0%**			

Source: Employment Security Commission of North Carolina

Table 8 – The Occupational Composition of Nonscheduled Air Transportation (4812) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Management Occupations	**70**	**16.3%**	**$37.88**	**179,430**	**$40.86**
General Managers	40	9.3%	$36.71	56,570	$46.94
Office and Administrative Support Occupations	**130**	**30.2%**	**$15.27**	**601,250**	**$13.55**
1st Line Supervisors	N/A	N/A	$23.22	38,170	$20.15
Bookkeeping, Accounting, and Auditing Clerks	N/A	N/A	$10.60	49,670	$13.78
Transportation and Material Moving Occupations	**230**	**53.5%**	**$23.94**	**304,680**	**$12.75**
TOTAL	**430**	**100.0%**			

Source: Employment Security Commission of North Carolina

Table 9 shows the occupational structure in the support activities for the air transport industry. The industry is dominated by installation, repair, and maintenance occupations, which comprise 57 percent of the entire industry. More specifically, that 57 percent consists mainly of aircraft mechanics along with avionics technicians and general maintenance and repair workers. The maintenance and repair positions pay better than the state average as a grouping, while, the largest individual occupation, aircraft mechanic, pays slightly under the state average.

Table 9 – The Occupational Composition of Support Activities for Air Transport (4881) in North Carolina

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Management Occupations	**220**	**5.0%**	**$39.93**	**179,430**	**$40.86**
General Managers	100	2.3%	$46.47	56,570	$46.94
Business and Financial Occupations	**70**	**1.6%**	**N/A**	**124,260**	**$25.85**
Purchasing Agents	20	0.5%	$18.59	7,200	$23.46
Compliance Officers	10	0.2%	$20.22	2,850	$22.18
Accountants and Auditors	40	0.9%	$21.94	21,600	$25.91
Computer and Mathematical Occupations	**60**	**1.4%**	**$20.64**	**78,020**	**$31.20**
Computer Support Specialists	20	0.5%	$16.33	16,850	$20.58
Education, Training, and Library Occupations	**10**	**0.2%**	**$21.33**	**248,850**	**$17.66**
Self Enrichment Education Teachers	10	0.2%	$21.33	3,980	$15.65
Building and Grounds Cleaning and Maintenance Occupations	**20**	**0.5%**	**$9.19**	**118,100**	**$9.61**
Sales Occupations	**50**	**1.1%**	**$24.84**	**406,400**	**$14.58**
1st Line Supervisors	10	0.2%	$28.14	11,520	$31.12
Sales Representatives	30	0.7%	$25.46	41,710	$23.56
Office and Administration Support Occupations	**520**	**11.7%**	**$13.66**	**601,250**	**$13.55**
1st Line Supervisors	50	1.1%	$19.72	38,170	$20.15
Billing and Posting Clerks	30	0.7%	$12.47	14,510	$13.34

Table 9 – (Continued)

Occupation Classification	Estimated Employment in Industry	Percent of Industry Total	Average Occupation Wage in Industry	Estimated Employment in State	Average Occupation Wage in State
Bookkeeping, Accounting, and Auditing Clerks	60	1.4%	$13.65	49,670	$13.78
Customer Service Representatives	80	1.8%	$10.09	59,940	$13.61
HR Assistants	10	0.2%	$14.71	4,140	$14.68
Stock Clerks and Order Fillers	70	1.6%	$12.63	41,620	$10.26
Executive Secretaries	50	1.1%	$15.75	49,050	$16.33
Other Secretaries	20	0.5%	$13.89	49,130	$12.39
General Office Clerks	30	0.7%	$10.48	67,130	$11.24
Installation, Maintenance, and Repair Occupations	**2,530**	**57.0%**	**$19.52**	**172,130**	**$17.34**
Avionics Technicians	120	2.7%	$21.86	450	$21.22
Aircraft Mechanics and Service Technicians	1,830	41.2%	$18.40	4,230	$19.30
General Maintenance and Repair Workers	120	2.7%	$19.06	45,430	$15.75
Helpers	90	2.0%	$16.13	6,530	$10.41
Transportation and Material Moving Occupations	**960**	**21.6%**	**$18.71**	**304,680**	**$12.75**
Aircraft Cargo Handling Services	20	0.5%	$18.37	60	$20.18
1st Line Supervisors	60	1.4%	$19.69	8,920	$21.81
Other Transportation Workers	330	7.4%	$11.66	640	$12.29
Cleaners of Vehicles	20	0.5%	$8.85	8,210	$8.90
Laborers and Material Movers	30	0.7%	$12.60	78,220	$10.43
TOTAL	**4,440**	**100.0 %**			

Source: Employment Security Commission of North Carolina

Tables 10 and 11 present the top 25 occupations in aerospace manufacturing and support activities for air transport at the national level (scheduled and nonscheduled air transportation were not included due to limited data availability). The tables list each occupation's percentage of total U.S. industry employment and compare that figure to the corresponding mark of North Carolina. Table 10 shows that the top occupation in the national industry is aerospace engineer

at 9.12 percent of total employment, compared to 1.7 percent of North Carolina's aerospace manufacturing industry. Conversely, only 3.6 percent of the U.S. industry is made up of machinists, compared to North Carolina where machinists comprise 12.8 percent of the state's aerospace workers. North Carolina appears to be more focused on the production end of the industry, as opposed to R&D functions. Nonetheless, R&D-type operations are an important, high-paying part of the industry into which the state would want to expand its presence.

Table 10 – The Occupational Composition of Aerospace Product and Parts Manufacturing (3364) Compared to the Structure of the National Industry

Occupation Classification	Estimated National Employment in Industry	Percent of National Total in Industry	Percent of State Total in Industry
Aerospace Engineers	40,860	9.12%	1.7%
Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	20,510	4.58%	N/A
Aircraft Mechanics and Service Technicians	18,070	4.03%	7.2%
Machinists	16,290	3.64%	12.8%
Inspectors, Testers, Sorters, Samplers, and Weighers	14,930	3.33%	5.1%
Mechanical Engineers	13,270	2.96%	2.1%
Industrial Engineers	13,020	2.91%	N/A
Engineering Managers	10,000	2.23%	N/A
Computer Software Engineers – Applications	9,890	2.21%	N/A
Management Analysts	8,750	1.95%	N/A
Purchasing Agents	8,600	1.92%	0.9%
1st Line Supervisors - Production	8,600	1.92%	3.4%
Business Operations Specialists	8,190	1.83%	N/A
Other Engineers	7,820	1.75%	N/A
Production, Planning, and Expediting Clerks	7,300	1.63%	2.6%
Executive Secretaries	7,050	1.57%	0.9%
Team Assemblers	6,820	1.52%	2.1%
Industrial Engineering Technicians	6,350	1.42%	N/A
Aerospace Engineering Technicians	5,280	1.18%	N/A
Computer Software Engineers – Systems Software	5,180	1.16%	N/A
Industrial Production Managers	5,060	1.13%	N/A
Computer-Controlled Machine Tool Operators	5,060	1.13%	0.4%
General Maintenance and Repair Workers	4,750	1.06%	1.3%
Avionics Technicians	4,720	1.05%	N/A
Computer Systems Analysts	4,590	1.02%	0.9%
TOTAL	**260,960**	**58.25%**	**41.40%**

Source: U.S. Bureau of Labor Statistics

With respect to support activities for air transport, Table 11 shows that aircraft mechanic is the top occupation in both the U.S. and state industry. However, their representation in North Carolina is more than double that of the U.S. industry – 41.2 percent compared to 18.1 percent.

Table 11 – The Occupational Composition of Support Activities for Air Transport (4881) Compared to the Structure of the National Industry

Occupation Classification	Estimated National Employment in Industry	Percent of National Total in Industry	Percent of State Total in Industry
Aircraft Mechanics and Service Technicians	26,060	18.09%	41.2%
Freight, Stock, and Material Movers	11,180	7.76%	0.7%
Other Transportation Workers	7,960	5.52%	7.4%
Baggage Porters	6,110	4.24%	N/A
Cargo and Freight Agents	5,430	3.77%	0.5%
Customer Service Representatives	4,280	2.97%	1.8%
Reservation and Ticket Agents	3,870	2.69%	N/A
Avionics Technicians	3,470	2.41%	2.7%
1st Line Supervisors – Maintenance and Repair	3,180	2.21%	N/A
Other Transportation Attendants	3,030	2.10%	N/A
Commercial Pilots	3,010	2.09%	N/A
General Maintenance and Repair Workers	2,750	1.91%	2.7%
Cleaners of Vehicles	2,700	1.87%	0.5%
General Managers	2,250	1.56%	2.3%
General Office Clerks	2,180	1.51%	0.7%
Security Guards	2,150	1.49%	N/A
Janitors	2,010	1.39%	N/A
1st Line Supervisors – Office and Administrative	1,690	1.17%	1.1%
Bookkeeping, Accounting, and Auditing Clerks	1,550	1.08%	1.4%
Transportation Inspectors	1,510	1.05%	N/A
Machinery Maintenance Workers	1,460	1.01%	N/A
Maintenance and Repair Helpers	1,440	1.00%	2.0%
Service Station Attendants	1,410	0.98%	N/A
Executive Secretaries	1,360	0.94%	1.1%
Truck Drivers	1,220	0.85%	N/A
TOTAL	**103,260**	**71.66%**	**66.1%**

Source: Bureau of Labor Statistics

F. Industry Snapshot Summary Findings

This data presented in this industry snapshot suggests four key findings:

- **North Carolina has a modest *overall* traditional aerospace presence**.
- Traditional aerospace is a **relatively high-paying** industry.
- Traditional aerospace has a **significant presence in most of the regions of NC**.
- **Aerospace manufacturing** (specifically engine and engine part manufacturing) and **aircraft maintenance and repair – seem to be areas of existing strength and potential.**

II. A NORTH CAROLINA RESOURCE CATALOG

Numbers alone cannot tell the whole story, especially when it comes to issues like understanding whether or not the state is well positioned to expand its presence in traditional aerospace or the commercial space industry. This section will employ a more qualitative approach – relying on interviews, articles, reports, and data – in an attempt to paint a more complete picture of North Carolina's aerospace economy and its potential in the future. The following six criteria will be evaluated:

- Corporate presence;
- Military presence;
- Educational capacity;
- Institutional presence;
- Infrastructure availability;
- Innovation.

A. Corporate Presence

Employment levels are useful, but it is also important to gain an understanding of the firms that employ them. This section highlights a number of the key aerospace companies currently operating in the state. The list is not exhaustive; instead its focus is to inventory those firms that serve as the foundation of the state's aerospace presence, especially those which are headquartered in North Carolina.

B/E Aerospace (http://www.beaerospace.com/)

B/E Aerospace is the leading manufacturer of cabin interior products for the world's airlines, aircraft manufacturers, and business jet owners. Headquartered in Wellington, Florida; B/E's Commercial Aircraft Division, with specialization in seat manufacturing, is based in Winston-Salem. B/E is reportedly the world's largest producer of aircraft seating, with more manufacturing capacity for aircraft seats than all other competing companies combined. The company has received over a billion dollars worth of orders from international carriers in the past two years alone (Craver 2006a). The Winston-Salem facility, which focuses primarily on design

and engineering, is located near the Smith-Reynolds Airport and employs nearly 600 workers. However, a recent $165,000,000 contract to produce seating and other cabin products for United Airlines has prompted the announcement of an expansion at the Winston-Salem location which translates into another 50 jobs and new production facilities (Craver 2006b).

Bridgestone Aircraft Tire (http://ap.bridgestone.co.jp/index.html)

Bridgestone Aircraft Tire is a division of the Bridgestone Corporation, the world's largest tire and rubber company. The company announced in May of 2006 that it was relocating its U.S. production facility to Mayodan in Rockingham County. The move will create 95 new jobs with anticipated average wage levels 25 percent higher than the overall county average. The new 160,000 square foot facility will manufacture tires for both the Boeing 787 Dreamliner and the Airbus A380 (Bridgestone 2006).

Curtiss-Wright Corporation (http://www.curtisswright.com/default.asp)

Curtiss-Wright Corporation's Motion Control segment, headquartered in Charlotte, is a global leader in the design, manufacture, service, and integration of motion control components and subsystems for defense, aerospace, naval and other industrial applications. The Motion Control division is one the leading subsystem suppliers in the U.S. as it maintains long-term business relationships with customers such as Boeing, Lockheed Martin, Northrop Grumman, and all the branches of the military. Offerings include commercial and military aircraft secondary flight controls, utility actuation, ammunition handling, airborne fire protection systems, and rotor ice detection. In addition to the headquarters facility, the division also operates production facilities in Gastonia and Shelby plus recently expanded engineering and test facilities also located in Gastonia. In total, the Motion Controls division has 2,200 employees nationwide, 320 of which are located in the Charlotte region (Hartnett 2005).

Geomagic, Inc. (http://www.geomagic.com/en/)

Geomagic, Inc., a software and services company headquartered in the Research Triangle Park, is emerging as a leader in digital shape sampling and processing software for the development of highly detailed 3-D models of objects in order to detect potential imperfections. Their software is of particular use in the aerospace industry where the quality of parts is paramount. Geomagic's

products are used by NASA to test sensitive components and also by companies to help reconstruct parts no longer in production.

General Dynamics Armament and Technical Products (http://www.gdatp.com/)
General Dynamics' Armament and Technical Products (GDATP) division, headquartered in Charlotte, is a proven systems integrator of defense products for all branches of the U.S. Department of Defense and the ministries of defense of over 30 other foreign nations. GDATP specializes in the production of gun, weapon, and detection systems, and the manufacture of a wide range of advanced material products that include internal and external aircraft structural components. GDATP operates eight production facilities throughout the U.S., only one of which is located in North Carolina, a chemical and biological detection system facility in Charlotte.

General Electric Aviation (http://www.geae.com/)
GE Aviation, a division of General Electric, is the world's leading producer of large and small jet engines for commercial and military aircraft. GE has an impressive history that includes the development of some the military's first aircraft engines during World War I and the production of the country's first jet engine in the 1940s. Headquartered in Cincinnati, Ohio, GE Aviation has an engine assembly facility in Durham.

Goodrich Corporation (http://www.goodrich.com/Main)
Goodrich Corporation, headquartered in Charlotte, is a leading global supplier of aerospace systems and services. Goodrich, which boasts "if there's an aircraft in the sky, we're on it", manufactures a wide array of aerospace and defense products including ice detection systems, laser warning systems, engine control systems, rotor brake systems, fuel pump systems, temperature and pressure sensors, windshield wiper systems, engine actuation systems, and others. Goodrich operates more than 120 facilities worldwide in 20 countries with annual revenues of over $4.7 billion. The company moved to Charlotte in 1998 and currently employs about 280 people at its headquarters facility and another 460 at its customer service center in Monroe which is in actuality a large industrial facility which specializes in refurbishing old Goodrich parts and components.

Honda Aircraft Company (http://hondajet.honda.com/)

Honda Aircraft Company, the aircraft division of the world-renowned automaker, has been conducting all of its prototype assembly and testing for the HondaJet, the company's entry into the new very light jet (VLJ) market, at the Piedmont Triad International Airport since 2001. In February 2008 Honda Aircraft announced that Greensboro will be the permanent headquarters and production facilities for HondaJet. This is expected to bring $60,000,000 worth of investment and more than 300 new jobs for the city – positions which include engineers, researchers, sales and marketing staff, production workers, and the company's management team. Phase one of the project is scheduled to be complete by the end of 2007 and the first HondaJet is expected to roll out of the facility by 2010. Their VLJs, which will reportedly retail for $3,650,000, are expected to set themselves off from the competition by offering a class-topping cruise speed of 420 knots and 30-35 percent better fuel efficiency than other similar jets. The company reports that it has already received more than 100 orders for the HondaJet.

Why Greensboro?

The HondaJet announcement is a huge development for Greensboro, but in terms of future aerospace development in the Triad and elsewhere in the state it is especially important to understand what factors led the company to choose Greensboro. Andrea Miller, Manager of Cluster Development for the Greensboro Economic Development Alliance, says several factors played a role. First and foremost, Honda was drawn to the airport facility itself -- it was important for the company to be at an airport that was big enough to handle their take-off and landing needs, but that could also offer them enough room to grow without running into too much other traffic. Second, Honda was impressed by the educational offerings available in the area, specifically, the T.H. Davis Aviation School – part of Guilford Technical Community College which offers students training in aviation systems and airport management. Additionally, Guilford Tech offers students a transfer program with Embry-Riddle Aeronautical University in Daytona, Florida and N.C. A&T University in Greensboro has a composite materials center that was of interest to the company.

Background on Very Light Jets: A Product for the Future

Very lights jets or VLJs, are aircraft typically designed to carry between three-to-seven passengers in addition to a single pilot and crew member. They are lighter than the traditional business jet, usually targeting a take-off weight of less than 10,000 pounds. VLJs cost considerably less than the standard business jet, retailing in a range from just over $1million up to nearly $4 million. VLJs are ideal for point-to-point travel of up to 1,000 miles. Additionally, VLJs are capable of landing on runways as short as 2,500 feet, which greatly increases the number of potential destinations. Their main market is expected to be corporations, high-end private owners, and air taxi companies intending to offer customizable point-to-point charter service. Despite their growing popularity, VLJs have their skeptics. Some industry experts dismiss the hype around VLJs and cite concerns about increased traffic in the skies and an overburdened air traffic control system. Proponents counter that VLJs are intended to take advantage of the country's network of smaller airports where they are no threat to busy international hubs. Companies across the country are set to start delivering fleets of VLJs. There are five major players in the industry: Cessna, Eclipse, Adam Aircraft, Embraer, and Greensboro's own HondaJet. The industry pioneer, Eclipse Aviation, is leading the production charge. Eclipse reportedly already has orders for 2,500 of its Eclipse 500 jet which it is selling for an industry low $1,520,000 – DayJet, an air taxi company out of Delray Beach, Florida, has already ordered 239 of the Eclipse VLJs in an attempt to get their point-to-point operations underway throughout the southeast. Industry forecasts predict that around 5,000 VLJs will be demanded by 2010 (Hirschman 2006).

TIMCO (http://www.timco.aero/)

TIMCO (Triad International Maintenance Company) is the largest independent, third-party maintenance, repair, and overhaul (MRO) provider in the country. The company, which employs over 4,000 employees worldwide, is headquartered in Greensboro where they operate a 600,000 square foot MRO facility at the Piedmont Triad International Airport, complete with four state-of-the-art hangars. Also on site is a composites repair shop, a training facility, and a 63,000 square foot machining center. In addition to their extensive MRO operations, TIMCO also produces aircraft replacement parts, overhauls aircraft interiors, and offers various engineering support services.

Unison Engine Components (http://www.unisonenginecomponents.com/)

Unison Engine Components (formerly Smiths Aerospace) is a subsidiary of GE Aviation, which acquired Smiths Aerospace January 2008. Unison is a transatlantic aerospace systems and equipment company, with over $2 billion sales and more than 11,000 employees worldwide. Headquartered in Jacksonville FL. Unison currently operates two facilities in North Carolina, one in West Jefferson and one in Asheville. Both plants specialize in machining precision components for aircraft engines, which Unison supplies to GE Aircraft Engines, Pratt and Whitney, and Rolls-Royce. Both plants provide well-paid employment to their respective areas – the average weekly wage in West Jefferson is said to be nearly $100 more than the average wage for the county as a whole. Prospects for these two facilities look good, with recent expansions at both locations. Unison opened a new 90,000 square foot production facility adjacent to its existing Asheville plant that was expected to provide the area with around 200 additional high-tech manufacturing jobs over the next five years. Specifically, the new Asheville plant will look to hire skilled machinists to produce complex parts for jet engines – positions that are expected to pay wages well above the average for the region.

B. Military Presence

In terms of aerospace activity, particularly with respect to traditional aerospace, the military is also a key aerospace employer, producer, and consumer. This section is intended to provide a full inventory of the state's military assets related to aerospace.

Seymour Johnson Air Force Base (http://www.seymourjohnson.af.mil/units/)

Seymour Johnson Air Force Base, located in Goldsboro, is home to the Air Force's 4th Fighter Wing and the 916th Refueling Wing. The 3,300-acre base, which opened in 1942, has 6,400 military personnel stationed there, and an additional 600 civilian employees. Of those, 2,300military and civilian personnel are assigned to the 4th Fighter Wing's Maintenance Group which is responsible for the maintenance and repair of the base's 96 F-15E Strike Eagles. The 4th Fighter Wing also consists of a mission support group, an operations group, and a medical group.

Marine Corps Base Camp Lejeune (http://www.lejeune.usmc.mil)

Camp Lejeune a 156,000-acre base, located in Onslow County, is home to 43,000 marines and around 5,000 civilian employees. Camp Lejeune is home base to the II Marine Expeditionary Force, the 2nd Marine Division, to the 2nd Marine Logistics Group and others. The base is not home to any direct aviation presence. The 2nd Marine Air Wing, which is affiliated with Camp Lejeune, is actually stationed at the nearby Cherry Point Marine Corps Air Station.

New River Marine Corps Air Station (http://www.newriver.usmc.mil/index.htm)

The New River Air Station, established in 1941, is a 2,600-acre facility which sits adjacent to Camp Lejeune in Onslow County. New River is considered to be the principal operating location for marine helicopters on the United States east coast. Specifically, the station is home to the 200 aircraft of the Marine Aircraft Groups 26 and 29.

Elizabeth City Coast Guard Air Station (http://www.uscg.mil/d5/airstaelizabethcity/default.asp)

The Elizabeth City Air Station, located on the Albemarle Sound, is the headquarters for all Coast Guard aviation operations. The station, established in 1940, is home to 500 active-duty personnel and 450 civilian employees. The air station operates a fleet of HH-60 Jayhawk and HC-130 Hercules helicopters. More importantly, the Elizabeth City complex is also home the Aircraft Repair and Supply Center which is in charge of the overhaul and repair of all U.S. Coast Guard aircraft, as well as, managing the procurement, storage, and issuance of all U.S. Coast Guard aircraft parts and supplies. The air station also houses the Coast Guard's Aviation Technical Training Center.

Pope Air Force Base / Fort Bragg (http://www.pope.af.mil/) and (http://www.bragg.army.mil/)

Currently, Pope Air Force Base's 2,194 acres house the 43rd Airlift Wing, the 23rd Fighter Group, and the 18th Air Support Operations Group. The base is also home to 4,700 active-duty military personnel and another 500 civilian employees. The base's primary mission includes the worldwide transportation of military personnel, equipment, and supplies, as well as, providing support to the 82nd Airborne Division and other units at the adjacent Fort Bragg. However, the latest round of base realignment and closure (BRAC) announcements calls for Pope to

essentially be annexed by its massive neighbor within the next four years in order to make room for the relocation of the Army's U.S. Force Command Headquarters (FORSCOM) and U.S. Army Reserve Command from Forts McPherson and Gillen to Fort Bragg. In response, Pope's 43rd Airlift Wing will be distributed to Little Rock Air Force Base in Arkansas and its 23rd Fighter Group will be moved to Moody Air Force Base in Georgia. The Fort Bragg facility will be stripped of much of its aviation presence; however, the Fayetteville base – already one of the largest military facilities in the world – will receive approximately 20,000 more military personnel, family members, and civilian employees. Importantly, the state's traditional aerospace and defense industries potentially stand to benefit greatly from the presence of FORSCOM, which is responsible for all of the Army's procurement decisions. In addition to bolstering the Fayetteville region itself, the relocation of FORSCOM could significantly improve the North Carolina's current lack of defense contract business and potentially attract valuable supply companies to the state.

Cherry Point Marine Corps Air Station (http://www.cherrypoint.usmc.mil/)

North Carolina's true crown jewel in traditional aerospace is the Cherry Point Air Station. The 13,000 acre facility, located in Havelock, is home to the 2nd Marine Aircraft Wing (MAW) which includes three AV-8B Harrier squadrons, four EA-6B Prowler squadrons, and one KC-130 Hercules refueling squadron. There are 7,486 marines stationed at Cherry Point plus another 5,700 civilian employees. Studies have estimated that the facility pumps around $610,000,000 directly into the local economy each year in the form of salaries and local supply and capital expenditures.

In addition to the 2nd MAW, Cherry Point also houses the Navy's Fleet Readiness Center (FRC) East. The FRC employs more than more than 4,000 civilian and military personnel making it the single largest industrial employer in eastern North Carolina. FRC East began in 1943 as the Assembly and Repair Department for Cherry Point. It has developed into a state-of-the art repair facility for Marine and Navy Aircraft, one of only six such facilities in the entire country. FRC East specializes in the maintenance and repair of airframe, engines, and more than 16,000 other avionics components and is the only location in the continental U.S. that can repair certain types of engines, namely, specific rotary wing engines and turbofan vectored thrust engines. The FRC

East's lengthy client list includes 202 different Navy and Marine Corps operations, five Air Force operations, three Army operations, two other federal agencies, and 24 foreign countries.

The FRC facility, which spans 150 acres and over 100 buildings, also houses The Naval Engine Airfoil Center, which focuses on the repair of aircraft turbines and replacement blades and vanes. The FRC also has a research and engineering group whose staff of engineers helps ensure work quality and develop testing and troubleshooting procedures for the center's various operations. FRC's engineering staff is available to be dispatched anywhere in world in order to provide technical support to assorted military endeavors.

Department of Defense Procurement

North Carolina touts itself as one of the most military friendly states in the country, yet that hospitality has garnered little Department of Defense (DoD) contract activity. As of 2005, according to the DoD's Statistical Information Analysis Division, North Carolina was home to 8.9 percent of all military personnel – the fourth largest presence in the U.S. (California at 13.3 percent Virginia at 11.0 percent, and Texas at 9.6 percent). However, in terms of military spending North Carolina is not home to a corresponding level of procurement activity. In fiscal year 2005 the state only received 1.24 percent – roughly $2.9 billion – of total defense procurement contracts awarded in the U.S. On a positive note, the military spending that does occur in North Carolina is dispersed throughout the state, with firms in 97 out of North Carolina's 100 counties awarded defense contracts. The top five recipients were Cumberland County, the home of Fort Bragg, with $946,000,000, Onslow County with $390,000,000, Craven County with $199,000,000, Wake County with $197,000,000, and Mecklenburg County with $148,000,000. Keep in mind that "awarded to a county" simply means that a contract was given to company with a presence there, not necessarily that the production or service was actually performed in that county.

In terms of aerospace-related contracts specifically the story is the same. In FY 2005 North Carolina received less than 1 percent of the total contracts awarded in each of four major aerospace supply categories (see Table 12). A similar picture emerges in Table 13 which shows the dollar amount in each of the four major categories as a percentage of the total contracts

awarded at both the state and national-level – aerospace contracts represent nearly a quarter of all U.S. DoD procurement spending, compared to less than 7 percent of military contracts in North Carolina are related to aerospace. The state lags significantly in airframes and is almost nonexistent in missile and space systems.

Table 12 – Major Aerospace-Related Procurement Program Spending in North Carolina as a Percentage of Total Program Spending

Major Procurement Program	North Carolina Contract Dollars	Percentage of Total Program Dollars
Aircraft Engines and Spares	$17,440,942	0.26 %
Airframes and Spares	$102,648,128	0.37 %
Missile and Space Systems	$2,860,086	0.02 %
Other Aircraft Equipment	$74,967,845	0.91 %
TOTAL CONTRACT DOLLARS (All Programs)	**$2,948,582,828**	**1.24 %**

Source: The Department of Defense's Statistical Information Analysis Division

Table 13 – Major Aerospace-Related Procurement Program Spending in North Carolina as a Percentage of Total DoD Spending in the State

Major Procurement Program	As a Percentage of Total North Carolina Contract Dollars	As a Percentage of Total DoD Contract Dollars
Aircraft Engines and Spares	0.59 %	2.85 %
Airframes and Spares	3.48 %	11.59 %
Missile and Space Systems	0.10 %	7.03 %
Other Aircraft Equipment	2.54 %	3.48 %
TOTAL	**6.71 %**	**24.95 %**

Source: The Department of Defense's Statistical Information Analysis Division

It is important to note that tables 12 and 13 only accounts for supply contracts, not for spending on services, such aircraft maintenance and repair. An equivalent spending breakdown by state was not readily available to gauge North Carolina's participation; nonetheless, the data presented in Table 14 give some idea of the magnitude of Department of Defense (DOD) spending in those areas at a national level. Even though the nine highlighted service categories only make up a little over 1 percent of total DOD spending, that amounts to nearly $3 billion dollars worth of contracts devoted to those services, more than 85 percent of which goes to maintenance and repair.

Table 14 – Total Aerospace-Related Service Contract Spending as a Percentage of Total DoD Spending

Service Classification	Total DoD Contract Dollars in Category	Percent of Total DoD Spending
J015 Maintenance, Repair, and Rebuilding of Equipment: Aircraft and Airframe Structural Components	$1,550,434,871	0.57 %
J016 Maintenance, Repair, and Rebuilding of Equipment: Aircraft Components and Accessories	$900,110,876	0.33 %
J017 Maintenance, Repair, and Rebuilding of Equipment: Aircraft Launching, Landing, and Ground Handling Equipment	$31,687,707	0.01 %
K015 Modification of Equipment: Aircraft and Airframe Structural Components	$173,787,717	0.06 %
K016 Modification of Equipment: Aircraft Components and Accessories	$235,392,586	0.08 %
K017 Modification of Equipment: Aircraft Launching, Landing, and Ground Handling Equipment	$655,262	0.0002 %
N015 Installation of Equipment: Aircraft and Airframe Structural Components	$22,826,567	0.008 %
N016 Installation of Equipment: Aircraft Components and Accessories	$1,012,725	0.0004 %
OVERALL TOTAL	**$2,915,908,311**	**1.08 %**

Source: The Department of Defense's Statistical Information Analysis Division

C. Educational Assets

A key component of the state's capacity to expand its aerospace presence is its ability to produce the required workforce. This section is intended to provide an inventory of the aerospace-related curricula offered at the state's community colleges and universities. In addition, this section also provides an in-depth look at several of the state's most important aerospace-related educational programs.

1. Colleges and Universities

North Carolina is home to 57 four-year colleges and universities. Included in that total are the 16 campuses of the state's public university system and 41 private colleges and universities. This analysis focuses on the state's college and universities because they play a vital role in producing key segments of the workforce needed to grow and maintain a successful aerospace industry. Specifically, this analysis examines the number of engineering and other technology-related programs available at the state's colleges and universities. Attention is given to understanding whether existing programs are producing meaningful numbers of graduates.

Table 15 lists all the program offerings in the state, the degrees available within in each program and the number of students that graduated from each program in the 2005-2006 school year. Program information for both the public and private institutions was obtained from the Academic Program Inventory maintained and published by the University of North Carolina General Administration. Information detailing the number of actual degrees conferred was obtained from the annual institutional fact books published by individual institutions. The selection of specific disciplines to include in the analysis was determined using the list of top national aerospace occupations, as discussed in "An Industry Snapshot" and the results of the numerous interviews.

N.C. State University and N.C. A&T State University combined produce 57 percent of the bachelor's, 62 percent of the master's, 79 percent of the doctorates, aerospace related graduates in the state. Other institutions graduating students in relevant areas include Duke, UNC-Charlotte, East Carolina, Western Carolina, and Elizabeth City State Universities.

Another key dimension of Table 15 is the number of degrees awarded within specific disciplines. Clearly, even though there is an important need for them in the aerospace industry, most graduates in the fields of computer, industrial, and mechanical engineering will be employed in other sectors, not in aerospace. In aerospace engineering, where graduates have a fairly high probability of being employed in either traditional aerospace or commercial space, North Carolina does not produce an appreciable number of graduates. N.C. State, the only institution that offers a program in aerospace engineering, produced 45 total graduates in the 2005-2006 school year. By comparison, during the same period, Georgia Tech – the state of Georgia's leading engineering institution, produced 261 aerospace engineers – 136 bachelor's degrees, 100 master's degrees, and 25 PhD's (Georgia Tech 2006). In North Carolina's case supply appears to meet demand, as seen in the preceding occupational data that showed the state is estimated to employ only 40 such engineers in its aerospace industry.

Table 15 – Aerospace-Related Program Offerings and Degrees Conferred by North Carolina Colleges and Universities

Degree Program	College or University	Degrees Offered (B=bachelor's, M=master's, D=doctorate)	Degrees Conferred (2005-2006, unless otherwise noted)
Aerospace Engineering	N.C. State*	B, M, and D	32, 10, 3
	TOTAL		**32, 10, 3**
Computer Engineering (General)	North Carolina A&T (includes computer and electrical)	B	31
	N.C. State	B, M, and D	133, 37, 12
	UNC – Charlotte	B	21
	TOTAL		**185, 37, 12**
Industrial Engineering	North Carolina A&T*	B, M, and D	29, 11, 2
	N.C. State*	B, M, and D	55, 27, 6
	TOTAL		**84, 38, 8**
Materials Engineering	N.C. State*	B, M, and D	31, 14, 14
	TOTAL		**31, 14, 14**
Mechanical Engineering	North Carolina A&T* (includes mechanical and chemical)	B, M, and D	52, 18, 4
	N.C. State*	B, M, and D	145, 32, 9
	UNC – Charlotte*	B, M, and D	83, 26, 6
	TOTAL		**280, 76, 19**
Mechanical Engineering and Materials Science	Duke*	B, M, and D	41, 9, 7
	TOTAL		**41, 9, 7**
Computer Engineering Technology	East Carolina	B	30
	TOTAL		**30**
General Engineering Technology	Western Carolina*	B	12 (04-05)
	TOTAL		**12**
Engineering and Industrial Management	UNC – Charlotte	M	15
	TOTAL		**15**
Industrial Technology	East Carolina	B and M	94, 47
	Elizabeth City State	B	8 (02-03)
	North Carolina A&T	B and M	8, 22
	Western Carolina	B and M	12, 7 (04-05)
	TOTAL		**122, 76**
Manufacturing Technology	East Carolina	B	8
	Western Carolina	B	13 (04-05)
	TOTAL		**21**
Mechanical Technology	UNC – Charlotte	B	76
	TOTAL		**76**
Aeronautics, Aviation, and Aerospace Technology	Elizabeth City State	B	Not Available
	TOTAL		**Not Available**
	OVERALL TOTAL		**914, 275, 63**

Source: The University of North Carolina's Office of General Administration

*****Signifies that the program has been accredited by the Accreditation Board for Engineering and Technology (ABET), the recognized accreditor for college and university programs in applied science, computing, engineering, and technology. http://www.abet.org/

In addition to the degrees awarded and programs offered at the state's universities, several university-affiliated programs exist with goals that will benefit the enhancement of North Carolina's nascent aerospace industry. These are the North Carolina Aerospace Alliance, the National Institute for Aerospace, and the Center for Integrated Technologies, associated variously with either NC State and/or NC A&T. Descriptions follow.

Aerospace Alliance (http://www.nc-aa.org/)

The Aerospace Alliance (known also as the North Carolina Aerospace Alliance) is a fairly new organization for which N.C. State serves as the academic resource center. NC State received $5.4 million from Golden LEAF (discussed below) to establish a Center of Excellence for Certification to help "aerospace companies become qualified to manufacture aircraft parts, help aerospace companies implement agile manufacturing technologies that allow for low-volume production, and to develop facilities for accelerated stress testing of aircraft parts" (N.C. State, 2005, par. 2). Also, the three faculty who are heading the Alliance work have reportedly been given authorization to begin the early planning for a potential institute of maintenance science and technology that would also be housed at N.C. State. The Alliance traces back to a pre-existing relationships between NC State and Cherry Point MCAS. In 2004, N.C. State entered into an agreement with the Fleet Readiness Center at Cherry Point to provide technical assistance to the center's engineering staff. That work was soon followed up by another arrangement where N.C. State faculty work with Cherry Point engineers on the various challenges associated with vertical lift aircraft like the V-22 Osprey. N.C. State's work with the Alliance soon followed (N.C. State 2005).

The National Institute of Aerospace (http://www.nianet.org/)

The National Institute of Aerospace (NIA) is a "non-profit research and graduate education institute formed by a consortium of research universities to ensure a national capability to support NASA's mission by expanding collaboration with academia and leveraging expertise inside and outside NASA" (National Institute of Aerospace, 2007, par. 1). Located in Hampton, VA, NIA conducts cutting-edge research in a variety of aerospace areas including: aviation safety, flight systems, and air traffic systems. NIA also offers advanced degrees in science and engineering through its network of nine university partners that includes: the College of William and Mary, Georgia Tech, Hampton University, Old Dominion University, the University of

Maryland, the University of Virginia, Virginia Tech, and North Carolina's own N.C. State and N.C. A&T. Specific sponsored programs offered at the two North Carolina schools include master's and doctorate degrees in electrical and mechanical engineering at N.C. A&T, and master's and doctorate degrees in mechanical and aerospace engineering at N.C. State. In addition, each of the North Carolina schools also houses a NIA-sponsored research center: the Center for High Confidence Cooperative Systems at N.C. A&T and the Center for Planetary, Atmospheric and Flight Sciences at N.C. State.

The Center for Integrated Technologies (http://cit.wcu.edu/)

The Center for Integrated Technologies (CIT) is part of Western Carolina University in Cullowhee. As a member of the North Carolina Aerospace Alliance Initiative, CIT was brought into the Alliance because of its expertise in reverse engineering and rapid prototyping technologies, which are capabilities of particular use to companies trying to manufacture obsolete replacement parts for aircraft.

2. Community Colleges

One of the attractions of the aviation and space sectors is the fact that they have the potential to provide well-paying jobs to workers without four-year or graduate degrees. In addition, the N.C. Community College System (NCCCS) can customize curriculum for specific companies. Many of these funding programs use matching funds and can be utilized with a minimum of twelve students. Table 16 lists key aviation and space-related programs offered and the number of degrees conferred by these programs at 55 of the state's 58-campus community college system during the 2005-2006 school year[14]. As was the case with the four-year analysis above, the specific disciplines included in the chart were selected by examining the national occupation data for the industry, in addition to input obtained from various interviews.

Research and interviews conducted for this study found that the bulk of the workforce in traditional aerospace is comprised of technicians and other trade specialists who do not necessarily need a four-year degree. Maintenance and repair technicians and skilled machinists are occupations of particular importance to North Carolina's aviation sector that are well-

[14] See Appendix C for a description of aerospace-related degree programs of the N.C. Community College System.

matched with the sort of technical training that is available through NCCCS programs. Table 16 reveals two important findings

- The NCCCS in the aggregate spans the state and offers a breadth of relevant training opportunities.
- The output, in terms of number of graduates, is low.

This represents both a potential problem and an opportunity. While the NCCCS in the aggregate only produced 63 machinist graduates from the 37 colleges offering this degree and only 18 graduates from the three programs offering aviation systems technology degrees, the NCCCS has in place a process for scaling the programs and extending the offerings to other campuses in its system.

Table 16 – Aviation and Space-Related Program Offerings and Degrees Conferred by North Carolina Community Colleges 2005-2006

Degree Program	Community College	Associates Degrees Offered	Degrees Conferred
Computer Engineering Technology (A40160)	Asheville-Buncombe	A	7
	Cape Fear	A	21
	Catawba Valley	A	3
	Central Carolina	A	4
	Central Piedmont	A	5
	College of the Albemarle	A	3
	Craven	A	0
	Davidson	A	0
	Forsyth	A	6
	Gaston	A	1
	Isothermal	A	3
	Lenoir	A	8
	Mayland	A	1
	Nash	A	5
	Richmond	A	4
	Sandhills	A	1
	Southwestern	A	1
	Stanly	A	7
	Surry	A	4
	Wake	A	6
	Western Piedmont	A	1
	Wilkes	A	5
	TOTAL		**96**

Table 16 – (Continued)

Degree Program	Community College	Associates Degrees Offered	Degrees Conferred
Industrial Engineering Technology (A40240)	Catawba Valley	A	3
	Gaston	A	6
	Lenoir	A	3
	Rowan-Cabarrus	A	4
	Wake	A	1
	TOTAL		**17**
Manufacturing Engineering Technology (A40300)	Central Piedmont*	A	2
	Forsyth	A	0
	Haywood	A	3
	Mitchell	A	3
	Pitt	A	0
	Rockingham	A	0
	Stanly	A	0
	Wake*	A	1
	TOTAL		**9**
Mechanical Engineering Technology (A40320)	Asheville-Buncombe	A	3
	Beaufort	A	1
	Blue Ridge	A	1
	Caldwell	A	0
	Cape Fear	A	7
	Catawba Valley	A	3
	Central Carolina	A	1
	Central Piedmont	A	5
	Craven	A	2
	Forsyth	A	0
	Gaston	A	3
	Guilford	A	7
	Haywood	A	0
	Isothermal	A	3
	Lenoir	A	0
	Mitchell	A	0
	Pitt	A	2
	Richmond	A	1
	Rockingham	A	0
	South Piedmont	A	0
	Stanly	A	0
	Wake	A	9
	Wayne	A	0
	Western Piedmont	A	3
	Wilson	A	0
	TOTAL		**51**
Aviation Management and Career Pilot Technology (A60180)	Caldwell	A	0
	Guilford	A	6
	Lenoir	A	6
	TOTAL		**12**
Aviation Systems Technology (A60200)	Craven#	A	11
	Guilford#	A	7
	Wayne#	A	0
	TOTAL		**18**

Table 16 – (Continued)

Degree Program	Community College	Associates Degrees Offered	Degrees Conferred
Computer Aided Drafting (A50150)	Asheville-Buncombe	A	1
	TOTAL		**1**
Industrial Systems Technology (A50240)	Alamance	A	1
	Asheville-Buncombe	A	0
	Beaufort	A	2
	Bladen	A	2
	Blue Ridge	A	2
	Brunswick	A	0
	Caldwell	A	0
	Cape Fear	A	0
	Catawba Valley	A	1
	Central Carolina	A	1
	Cleveland	A	0
	Craven	A	2
	Davidson	A	0
	Durham	A	0
	Edgecombe	A	0
	Forsyth	A	0
	Gaston	A	0
	Guilford	A	2
	Halifax	A	3
	Haywood	A	1
	Isothermal	A	3
	Johnston	A	0
	Martin	A	2
	Mayland	A	0
	McDowell	A	0
	Montgomery	A	0
	Nash	A	0
	Piedmont	A	13
	Pitt	A	6
	Randolph	A	1
	Richmond	A	2
	Roanoke Chowan	A	0
	Robeson	A	2
	Rockingham	A	0
	Rowan	A	0
	Sampson	A	0
	Sandhills	A	0
	South Piedmont	A	0
	Southeastern	A	1
	Stanly	A	0
	Surry	A	1
	Vance-Granville	A	0
	Wake	A	9
	Wayne	A	2
	Western Piedmont	A	1
	Wilkes	A	3
	Wilson	A	0
	TOTAL		**63**

Table 16 – (Continued)

Degree Program	Community College	Associates Degrees Offered	Degrees Conferred
Industrial Management Technology (A50260)	Alamance	A	0
	Caldwell	A	0
	Cleveland	A	1
	Lenoir	A	0
	Pitt	A	2
	South Piedmont	A	0
	Stanly	A	0
	TOTAL		**3**
Machining Technology (A50300)	Alamance	A	5
	Asheville-Buncombe	A	3
	Beaufort	A	0
	Blue Ridge	A	1
	Caldwell	A	0
	Cape Fear	A	3
	Catawba Valley	A	0
	Central Carolina	A	0
	Central Piedmont	A	5
	Cleveland	A	0
	Coastal Carolina	A	0
	College of the Albemarle	A	0
	Craven	A	0
	Davidson	A	0
	Durham	A	0
	Fayetteville	A	0
	Forsyth	A	0
	Gaston	A	1
	Guilford	A	8
	Haywood	A	3
	Isothermal	A	0
	James Sprunt	A	0
	Johnston	A	2
	Lenoir	A	4
	McDowell	A	6
	Nash	A	3
	Pitt	A	5
	Randolph	A	7
	Richmond	A	0
	Robeson	A	0
	Rockingham	A	0
	Stanly	A	0
	Surry	A	2
	Wake	A	1
	Wayne	A	3
	Western Piedmont	A	1
	Wilson	A	0
	TOTAL		**63**

Table 16 – (Continued)

Degree Program	Community College	Associates Degrees Offered	Degrees Conferred
Manufacturing Technology (Tool, Die, and Mold Making – A5030A)	Caldwell	A	0
	Central Carolina	A	6
	Craven	A	5
	Davidson	A	0
	Fayetteville	A	0
	Forsyth	A	0
	Wake	A	3
	Wilson	A	0
	TOTAL		**14**
Manufacturing Technology (A50320)	Central Carolina	A	0
	Central Piedmont	A	3
	Craven	A	6
	Davidson	A	0
	Edgecombe	A	3
	Guilford	A	0
	Isothermal	A	0
	Johnston	A	0
	Nash	A	0
	Richmond	A	0
	Wake	A	0
	Wayne	A	0
	Wilson	A	0
	TOTAL		**12**
Manufacturing Technology (Quality Assurance – A5032B)	Central Carolina	A	0
	TOTAL		**0**
Mechanical Drafting Technology (A50340)	Alamance	A	7
	Asheville-Buncombe	A	0
	Central Piedmont	A	0
	Cleveland	A	3
	Davidson	A	0
	Edgecombe	A	1
	Isothermal	A	0
	Piedmont	A	0
	Rowan	A	0
	Surry	A	4
	Wake	A	2
	TOTAL		**17**
	OVERALL TOTAL		**404**

Source: The North Carolina Community College System 2—5-2006 Data

***** Signifies that the program has been accredited by the Accreditation Board for Engineering and Technology (ABET), the recognized accreditor for college and university programs in applied science, computing, engineering, and technology. http://www.abet.org/

Signifies that the program has been accredited as a Federal Aviation Administration (FAA) sanctioned maintenance program. http://www.faa.gov/education_research/education/student_resources/schools_universities/index.cfm

3. Specialized NCCCS Aerospace Training Programs

In addition to the degrees awarded and programs listed in Table 16 the NCCCS supports other programs that exist solely to support the state's aviation and space industry. These are described in more detail in the following paragraphs.

The Advanced Machining Center at Lenoir Community College (AMC)

(http://www.lenoir.cc.nc.us/advancedmachiningcenter/)

The AMC, part of Lenoir Community College, is located in Kinston at the Global TransPark's Education and Training Center. The AMC is a member of the N.C. Aerospace Alliance and is funded through a $1.9 million grant from Golden LEAF. AMC provides state-of-the-art training in machining, metal forming, and computer-aided design (CAD) to produce a highly-trained workforce for the region. The center's particular emphasis is on producing graduates for the area's numerous traditional aerospace companies. At the AMC students can focus in either aviation manufacturing or general machining and manufacturing. One of the biggest current demands for graduates is in the manufacture of replacement parts for aging aircraft. The region's military bases simply cannot keep up with their parts demand internally, so they have to contract with area companies like Kinston's Workhorse Aviation to fill the gaps. In response, the AMC provides specialized, customized training for firms like Workhorse, helping those companies update their incumbent workforce, and providing them with fresh graduates. Another ready source of employment for AMC graduates is the Cherry Point Naval Air Depot (referred to previously as Fleet Readiness Center East) in nearby Havelock, which employs around 4,000 machinists.

N.C. State, another Alliance member, collaborates with the AMC to develop streamlined reverse engineering processes that are taught in the AMC training programs. Firms trying to enter the growing market for parts refurbishment and replacement are impeded by regulations that require that all replacement parts go through a rigorous certification process which can cost in the neighborhood of $75,000 in materials, labor, and the time. N.C. State's expertise helps the AMC to streamline the parts certification process.

T.H. Davis Aviation Center (http://www.greensboroeda.com/pdfs/Educ-Aviation.pdf) and (http://www.greensboroeda.com/industry_clusters/aci_subs/cluster_education_workforce.asp)
The T.H. Davis Aviation Center (DAC) is a part of Guilford Technical Community College (GTCC) in Greensboro. DAC, housed at the Piedmont Triad International Airport, offers degree, diploma, and certificate training in aviation management, aviation systems technology, and piloting. The piloting track is a two-year associate's degree program that prepares students to become professional pilots. DAC also has a working relationship with Embry-Riddle Aeronautical University in Daytona, FL, where students can transfer to continue their piloting training. The management track prepares students for jobs in aircraft dispatching, cargo/logistics operations, or even as airport managers. Finally, the aviation systems technology track produces graduates who are prepared to become FAA licensed mechanics with airframe and/or powerplant ratings. DAC's systems technology graduates have been hired by every major airline, the Triad's own TIMCO, and NASA.

Institute of Aeronautical Technology (http://www.cravencc.edu/IAT/home.cfm) and (http://www.becomeatcraven.com/IAT/program.cfm)
The Institute of Aeronautical Technology (IAT) was founded at Craven Community College (CCC) to provide specialized training in aviation maintenance to meet the demand for skilled labor at the nearby Fleet Readiness Center East located at the Cherry Point Marine Corps Air Station. In fact, CCC, located in New Bern, opened the new 24 acre campus in Havelock to be more responsive to the air station's needs. Included on the new campus are 5 computer labs, 11 classrooms, a learning lab, and a career center. Along with its peer programs at Guilford Tech and Wayne Community College, the institute prepares its graduates to become FAA certified technicians.

Wayne Community College Aviation Program (http://www.waynecc.edu/aviation/)
Wayne Community College (WCC) in Goldsboro also offers a program in aviation systems technology. The WCC program prepares students to become FAA-certified mechanics upon graduation. In addition to its curriculum program, WCC also offers continuing education classes in aviation systems technology aimed at individuals who already have a background in aviation maintenance and repair, but who need specific training in route to becoming FAA certified.

Aviation Programs at Robeson Community College (http://www.aero.und.edu/) and (http://www.robeson.edu/academics/und_aviation/index.html)

Robeson Community College in Lumberton has partnered with the University of North Dakota (UND) on an aerospace program. Students will begin their studies on campus at Robeson for the first two years and then transfer to the UND in Grand Forks to finish their four-year degree. The program offers students training in commercial aviation, flight education, air traffic control, and aviation systems management. The UND's Aerospace Foundation, which sponsors the program, says they are trying to meet the needs of the industry, particularly in the areas airport management and air traffic control. Robeson's facilities for the new program will be housed at Lumberton Regional Airport and are expected to include space for aircraft storage, classroom space, flight training devices, a flight planning room, and an aircraft dispatch area.

D. Institutional Assets

Institutional partners and intermediaries, such as business associations, can be crucial factors in an industry's success. Much of the aviation and space development that has occurred thus far in North Carolina has been driven by various institutions; further efforts will likely also include their hard work and expertise. This section is intended to provide detailed profiles of North Carolina institutions that are important to continued growth in this industry

Golden LEAF Foundation (http://www.goldenleaf.org/)

The Golden LEAF Foundation (GLF) is a nonprofit corporation founded to receive and disperse one-half of North Carolina's allocation of the funds from the master settlement with tobacco manufacturers. GLF targets strategic investment those monies to help previously tobacco-dependent areas transition into the New Economy. According to Mark Sorrells, Senior Vice President of Golden LEAF, aviation holds a lot of promise for eastern North Carolina – a region in need of a new direction following the loss of much of its tobacco and manufacturing base in recent years. This sector could spark small business growth in the region – especially in replacement parts manufacturing, a segment that is particularly well-suited for smaller firms because it tends to be a low volume/high mix type of operation. GLF is working to enhance the

prospects of the aviation industry in North Carolina through initiatives that focus on three factors critical to successful economic development: labor, technical assistance and financing.

- **Labor:** The lack of qualified machinists is seen as the single biggest constraint for traditional aerospace companies and as a threat to the continued presence of military in the state. The problem is underscored by the fact that many of the existing machinists are approaching retirement age and may soon exit the workforce. For example, 40-to-60 percent of the approximately 4,000 machinists employed by Cherry Point MCAS are scheduled to retire in the next 5-10 years, creating a potential skills deficit that could jeopardize the future of the base. In response, GLF has funded advanced manufacturing centers at Lenoir Community College (http://www.lenoircc.edu/advancedmachiningcenter/index.htm) and the Advanced Technology Center of Haywood Community College (http://www.haywood.edu/continuing_education/advanced_machining_center), in the eastern and western parts of the state respectively. Both programs are operational and the Lenoir program, housed at the Global TransPark in Kinston, has seen enrollment grow nearly threefold since its inception.

- **Technical Assistance:** GLF has enlisted the help and expertise of the College of Engineering at N.C. State to provide rapid reverse engineering services to aid companies with reconstructing replacement part manufacturing processes and to help companies with the rigorous testing and certification required on replacement parts (http://www.nc-aa.org/NCSU.htm). This work is done, in part, in collaboration with the AMC at Lenoir Community College.

Financing: The third leg of GLF's aviation and space industry stool is focused on providing financial assistance to companies. There are existing firms that want to expand and former military personnel and others that want to launch aviation-related startups in eastern North Carolina who are stopped by the lack of "patient" capital provided by investors who can apply a longer timeframe to their investments. GLF endowed the Neuse River Development Authority with a $2,000,000 grant to issue loans up to $250,000 to new and existing aviation and space businesses. The Neuse program is especially important because it provides companies with

subordinated capital that allows firms to access traditional loans and work with banks more easily (http://www.nrda.org/loan.html).

North Carolina Aerospace Alliance (http://www.nc-aa.org/)

In April 2005, Golden LEAF (GLF) awarded $9,300,000 – to be phased in over three years – to create the N.C. Aerospace Alliance (NCAA) with a goal of tackling two of North Carolina's economic development challenges, namely, a lack of military-related business and the economic recovery of the eastern part of state. NCAA's primary goal is to equip North Carolina businesses with the ability to produce replacement parts for the fleets of aging aircraft at the state's military air depots, especially the naval air depot at Cherry Point and the U.S. Coast Guard repair and service center in Elizabeth City. The $9,300,000 is being dispersed among three institutions as follows: N.C. State will receive $5,400,000 over the three-year period in exchange for engineering and technical expertise from their aerospace engineering school; Lenoir Community College will receive almost $2,000,000 to set up a worker training center that will be housed at the Global TransPark in Kinston; the Neuse River Development Authority will receive approximately $1.9 million to develop a lending program for would-be manufacturers that might not qualify for conventional financing. More recently, the Center for Integrated Technology (CIT) at Western Carolina University in Cullowhee was added to the Alliance to augment the reverse engineering and rapid prototyping expertise available at NC State's College of Engineering. Together, the engineering expertise offered by CIT and NC State will respond to the military's emergency needs for replacement parts.

Defense and Security Technology Accelerator (http://www.dstanc.org/)

The Defense and Security Technology Accelerator (DTSA), was created to help bolster the defense and security sectors in North Carolina by providing incubator services to help up-and-coming firms with the rapid development (8-to-18 months) of dual-use defense and security technology solutions to meet military needs and private commercial demands. DTSA provides entrepreneurs with lab facilities and office space, connections to resources at state universities and other subject matter experts, and exposure to potential partners in private industry. DSTA's location near Fort Bragg gives firms valuable access to the military marketplace. At full capacity DSTA can accommodate 12-to-15 firms; however, DTSA also operates an affiliate program that

can offer similar assistance to ten additional firms statewide. As of December 2006, the incubator was at 57 percent capacity. The creation of DSTA was spearheaded by the N.C. Technology Association (NCTA) and the Partnership for Defense Innovation.

N.C. Military Business Center (http://www.ncmbc.us/)

Despite having the fourth-largest military personnel contingent in the country, North Carolina received only slightly more than one percent of all U.S. Department of Defense (DoD) procurements in 2005. In response to such a continuing disparity, the state formed the N.C. Military Business Center (NCMBC) in 2005. NCMBC, which is a part of the community college system, is a business development organization that is helping North Carolina companies to identify approximately 2,000 DoD-related business opportunities per year. In 2006 NCMBC clients won 160 contracts worth approximately $165 million. NCMBC helps companies bid for contracts and keeps them abreast of general defense industry trends. NCMBC sees the production of replacement parts for the state's air bases as a growth target and cites the need for increased statewide marketing of the opportunities in this sector

E. Infrastructure Resources

A key factor in determining the success of any almost any industry is the availability of required physical infrastructure. One important infrastructure component for the aerospace industry is transportation facilities. This section provides a full inventory of this important physical infrastructure category, namely airports, including an in-depth look at the Global TransPark in Kinston.

Airport Infrastructure

As evidenced by the HondaJet deal, airports of all sizes are critical components of the state's traditional aerospace industry. Small manufacturers, maintenance operations, and firms like HondaJet are attracted to facilities that offer sufficient runway access and logistical support but do not have the air traffic of major international hubs. The Federal Aviation Administration (FAA) lists 409 aviation facilities in North Carolina – 322 airports, 78 heliports, four stolports (airports with very short runways), three ultralight-only facilities, one gliderport, and one

balloonport.[15] Only 18 of those 409 are Part 139 certified, which the FAA (FAA2007b) requires for licensure of facilities that serve scheduled and unscheduled aircraft with more than 30 seats or that serve scheduled air carrier operations in aircraft with more than nine but fewer than 31 seats. The state's three largest military installations also have FAA approved facilities.

Table 17 examines some of the more important attributes of airports, namely, runway facilities, room to grow, and repair operations. In terms of maintenance and repair, 14 of the 15 facilities in the state were considered by the FAA to house major repair operations for both airframes and engines and the only one that did not, Asheville Regional, has minor operations for both on site. With respect to scheduled commercial activity, Charlotte/Douglas International (CDI) – a U.S. Airways hub – is the commercial traffic volume leader in the state, with roughly seven times the volume of second-place Raleigh/Durham International (RDU). Similarly, CDI has four and one-half times the volume of air taxi operations as second-place RDU.

Table 17 – An Inventory of North Carolina's FAA Part 139 Certified Airport Facilities

Airport Facility	Location	Land Area (acres)	Commercial Activity	Air Taxi Activity	Airframe Repair	Engine Repair	Run-ways (feet)
Albert J. Ellis	Richlands	675	6,510	1,120	Major	Major	7,100
Asheville Regional	Asheville	900	3,109	8,615	Minor	Minor	8,001
Charlotte/Douglas International	Charlotte	5,000	246,034	235,498	Major	Major	7,502 8,676 10,000
Cherry Point MCAS	Havelock	---	---	---	---	---	7,553 8,108 8,984
Concord Regional	Concord	750	---	7,000	Major	Major	7,400
Craven County Regional	New Bern	660	6	8,581	Major	Major	6,004 4,000
Fayetteville Regional	Fayetteville	1,308	10,441	8,056	Major	Major	7,712 4,801
Hickory Regional	Hickory	739	5,199	---	Major	Major	4,400 6,400
Kinston Regional Jetport (Global TransPark)	Kinston	1,255	133	3,218	Major	Major	11,500
Moore County	Pinehurst	500	---	750	Major	Major	5,503 2,000
Piedmont Triad International	Greensboro	2,800	18,990	59,520	Major	Major	10,001 6,380
Pitt/Greenville	Greenville	872	2,555	12,500	Major	Major	6,500 4,997 2,687

[15] See Appendix E to view a map of the locations of major airport facilities in North Carolina

Table 17

Airport Facility	Location	Land Area (acres)	Commercial Activity	Air Taxi Activity	Airframe Repair	Engine Repair	Run-ways (feet)
Pope AFB	Fayetteville	---	---	---	---	---	3,000 7,501
Raleigh/Durham International	Raleigh	5,000	35,951	52,783	Major	Major	10,000 7,500 3,570
Rocky Mount/Wilson Regional	Rocky Mount	364	73	1,412	Major	Major	7,100
Seymour Johnson AFB	Goldsboro	---	---	---	---	---	11,758
Smith Reynolds	Winston Salem	702	672	3,314	Major	Major	3,938 6,655
Wilmington International	Wilmington	1,800	4,243	12,542	Major	Major	8,016 7,004
TOTAL		**23,325**	**333,916**	**414,909**			

Source: Federal Aviation Administration

Global TransPark (GTP)

Efforts to create the TransPark began in 1991 with the formation of the GTP Authority. The basic idea was to develop an international manufacturing and cargo hub that would put Eastern North Carolina on the global map. Initial impact estimates projected that the TransPark would produce nearly 60,000 jobs and $3.8 billion in annual revenues for the state. Sixteen years later the TransPark has not lived up to original projections. Transpart management cites the lack of transportation infrastructure around the facility, including no major highways or direct access to rail transport as the primary challenge that has limited development of the Transpark.

Still, in terms of traditional aerospace development, the TransPark has potential. The 5,775-acre site is home to 14 tenants, 10 of which are private firms. Included in the 10 are the Workhorse Aviation, which specializes in the production of replacement parts for military aircraft, and Seagrave Aviation which operates a sizable maintenance business in the park. In total, the TransPark is home to approximately 220 workers. However, the real value of the TransPark, in terms of aerospace development, is the facility's massive capacity for growth. The TransPark has a 300-acre industrial park with water and sewer already in the ground that is ready for immediate construction and it is home to the state's second longest runway of 11,500 feet – a length long enough to accommodate even a Space Shuttle landing. Customized training is available to tenants at the on-site state-of-the-art Advanced Machining Center of Lenoir Community College.

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F. Innovation Activity

Complete assessment of North Carolina's prospects for future aerospace industry growth has to include an examination of related innovation capacity available in the state. This section provides a brief overview of recent aerospace-related research and development that has been performed in North Carolina.

Based on the analysis of the occupational data, and specifically the limited number of aerospace engineer positions and educational programs, it might appear that North Carolina is not particularly active in aerospace-related research and development. Indeed, most of the operations taking place in the state tend to be centered on the production end of the industry. Nonetheless, research and development (R&D) is a very important and typically well-paying segment of any industry, so this analysis seeks to probe the issue further by evaluating patent applications, an admittedly narrow way to measure innovation, but one for which data are readily available. The following analysis is not intended to be inclusive or particularly systematic.

The U.S. Patent and Trademark Office (USPTO) maintains an extensive database of all the patents issued since 1790 and all the patent applications filed since 2001. For this analysis, the USPTO's patent application database was examined to assess the level of more recent aerospace-related R&D in the state. Two primary sets of parameters were used in the search. First, the database was searched for patent applications where the inventor's state was listed as North Carolina and the word aircraft was used in the application's abstract. The second search looked for applications where the patent's assignee state was listed as North Carolina and the word aircraft was in the application's abstract. The two searches were used to capture different phenomena. Inventor state was used to highlight recent R&D activity that has actually taken place in the state, but not necessarily by North Carolina companies or individuals, whereas, assignee state was chosen to highlight research that is being sponsored by North Carolina-based companies or individuals, but is not necessarily being performed in the state.

R&D, as measured by patents filed since 2001, was modest – only 34 results were returned – but one company stood out. The LORD Corporation, headquartered in North Carolina, had six aerospace-related patent applications on file, ranging from systems for absorbing helicopter

vibrations to aircraft propulsion system monitoring devices. Located in Cary, the LORD Corporation is a diversified technology company with a rich history of developing cutting-edge adhesive, coating, and motion management technologies. Using that expertise they develop various solutions for aerospace, defense, and automotive customers. LORD also operates an Aerospace Parts and Repair Station in Erie, PA, that produces high-quality, remanufactured, and overhauled parts for fixed and rotary wing aircraft.

The application search based on assignee state yielded even fewer results than the inventor search – just seven – however it too highlighted one particularly active company. The Goodrich Corp., with headquarters in Charlotte – was the assignee of all seven aerospace-related patents on file. However, in contrast to LORD, all the actual R&D work associated with those applications appears to have been performed outside of North Carolina – a result that makes sense given the company's large network of facilities around the country.

Identical searches to those described above were also completed within the issued patents database with very similar results. One interesting patent found was for a helmet restraint system developed by Speed Solutions in Statesville. The technology was described as having applications in stock car racing as well as aviation. Although, it is only a single patent, it highlights some potentially interesting synergies between North Carolina's significant NASCAR presence and its aerospace companies. Similar searches were also completed in an effort to detect more commercial space-related work, but those efforts yielded even fewer results.

G. Summary Assessment of North Carolina's Aerospace Presence

North Carolina is home to some leading aerospace development and production firms such as Goodrich, the LORD Corporation, Curtiss-Wright Motion Controls, and TIMCO among others. Additionally, traditional aerospace is a well-paying industry. Often aerospace positions paid better than their non-aerospace equivalents at the state level. Furthermore, some segments of the state's traditional aerospace industry tend to pay better than their counterparts in the national industry.

North Carolina's traditional aerospace presence seems to be distributed throughout most of the state and most regions in the state seem to be benefiting from the aerospace industry. The

Charlotte region was found to have a strong corporate headquarters presence with Goodrich, General Dynamics ATP, and Curtiss-Wright Motion Controls. Additionally, Charlotte is also home to several key traditional aerospace production operations including two Goodrich facilities. The Triangle region is home to the bulk of the state's aerospace-related R&D and software operations. The Triangle is also home to a GE engine plant, one of the state's key traditional aerospace production facilities. The Triad region seems to specialize in aircraft maintenance and repair including, but not limited to, the dense cluster of operations performed at the Piedmont Triad International Airport. However, maintenance and repair is not the region's only specialization as Greensboro is now home to HondaJet, which will mean an expanded production presence in the Triad in addition to more R&D activity. The western part of the state was found to be a particularly active traditional aerospace manufacturing region, as evidenced by the three Unison (formerly Smiths) engine plants in and around Asheville.

The most important finding in terms of geographic distribution was the story of Northeastern, Southeastern and Eastern North Carolina. These less-urban regions have a significant traditional aerospace presence highlighted by strong manufacturing activity in the southeast and as such might be the key to any future expansion. The eastern third of the state is home to four very important military aviation facilities. Elizabeth City is considered to be *the* home of Coast Guard aviation operations in addition to housing the Coast Guard's Aircraft Repair and Supply Center. The New River Air Station in Onslow County is considered to be the principal operating location for Marine helicopters on the east coast and Seymour Johnson in Goldsboro is home to the 96 F-15E Strike Eagles of the Air Force's 4th Fighter Wing. But, the crown jewel in North Carolina's traditional aerospace industry is without question the world-class Fleet Readiness Center East housed at Cherry Point Air Station in Havelock. In addition to being one of only six such facilities in the entire U.S. and a global destination for certain types of engine repair work, the Fleet Readiness Center with more than 4,000 civilian and military employees is the largest single industrial employer in all of eastern North Carolina.

The real value of Eastern North Carolina's military aviation presence lies in its ability to act as a catalyst for current and future aerospace activity in the state. The following evidence points highlight at least five ways that the military's presence is particularly meaningful to the current

and future economic prospects of both the state's traditional aerospace industry and the overall economy of eastern North Carolina.

- As evidenced by the numbers from Cherry Point, military aviation is a major employer.
- The military presence is located primarily east of I-95, which is arguably the region of the state most in need of an economic boost.
- The military facilities represent a ready source of skilled workers. Although skilled machinists the occupational cornerstone of the state's traditional aerospace industry they seem to be in short supply. Retiring military machinists and other technicians can be absorb into private industry and help fill some of the existing workforce gaps.
- The demand for replacement parts has become a driving force for significant private sector activity in small businesses in Eastern North Carolina.
- The extensive and often unique maintenance and repair operations required by the state's military aviation installations are bolstering innovative activity at state universities, as seen in the relationship between the military and NC State University.

North Carolina's strengths appear to be in engine and engine parts manufacturing and aircraft maintenance and repair. North Carolina is home to several major aircraft engine and engine part facilities, e.g., GE and Unison. Furthermore, the state is strong in maintenance and repair as evidenced by the concentration of such activity in the Triad region in conjunction with the tremendous amount of maintenance and repair work being performed at the military facilities in Eastern North Carolina. Moreover, the area of replacement part manufacturing, which bridges engine manufacturing and maintenance and repair, emerges as a third area of strength.

Educational institutions and other relevant organizations are a vitally important component of any industry, including traditional aerospace. North Carolina's aerospace industry benefits tremendously from a very responsive community college system, evidenced by the recent program additions at institutions such as Craven Community College and Guilford Tech, among others. Furthermore, investment by the Golden LEAF Foundation in the North Carolina Aerospace Alliance has been an invaluable part of the effort to bolster traditional aerospace

business in eastern North Carolina. Additionally, institutions like the Military Business Center and the Defense and Security Technology Accelerator – while not strictly dedicated to aerospace – are especially important in terms of future development of the industry in North Carolina.

Beyond its potential to benefit the state hard-pressed eastern region traditional aerospace also has strong potential to address to important economic concerns. Increased activity in this industry can be used to leverage increased investment of federal defense dollars into the state. Beyond the immediate economic impact this could also serve to further weave the state's military installations into the fabric of their respective communities. This should help to shield North Carolina's valuable military assets from future rounds of base realignment and closures (BRAC).

North Carolina's traditional aerospace industry is indeed well-positioned for future growth. The primary reason for this statement is that the niches in which North Carolina has specialized are growing. For example, by all accounts the need for maintenance and repair operations and the demand for replacement-part manufacturing will continue to grow as commercial and military fleets continue to age. Industry forecasts expect domestic maintenance and repair revenues to exceed $55 billion by 2015 up from $38 billion – a predicted compound annual growth rate of 3.6 percent. The recent addition of HondaJet in Greensboro instantly made North Carolina a leader in the budding very light jet industry – a market where some forecasts expect as many as 5,000 VLJs to be demanded by 2010. Furthermore, the state has developed a strong institutional framework, e.g., the Aerospace Alliance, new community college programs, the Military Business Center, and other entities, in recent years that can serve as a solid foundation for future traditional aerospace success. The industry seems to be bursting with potential.

There are challenges that will need to be resolved to realize this potential. Primary among these is the availability of a quality workforce, specifically skilled machinists. The state's strength in terms of traditional aerospace is more towards the production end of the industry where the key to continued success is being able to provide companies with a stream of skilled machinists.

Mark Sorrells, Senior Vice President of the Golden LEAF Foundation, reported that the single biggest constraint faced by traditional aerospace manufacturing firms is a lack of qualified machinists. Sorrells also noted that future of Cherry Point could be jeopardized by the base's inability to find skilled workers, such as machinists. That point was further reinforced by

management of Unison in Ashville who cited the need to do a nationwide search to hire 54 new workers, mostly machinists, in 2005 because such workers were not then available in the local community. Amid the announcement of a subsequent exansion in the Asheville area in March 2007 a company spokesman noted that the last thing the company needs to get operations up and running is skilled workers. Complicating the issue even further is the fact that such skilled machinists are being demanded by numerous other industries at same time. According to the Employment Security Commission, there were 176 employers related to skilled tooling and machining in Western North Carolina alone at the end of 2005 who collectively reported 354 unfilled machinists' jobs in region during that same period. Moreover, North Carolina Community College officials predict another 700 machinists' jobs will be created in the western part of the state over the next several years.

The reason for the shortage does not appear to be a lack of compensation as the 200 new jobs created via the latest expansions are all expected to pay well above the average wage for the region. Nor does the dearth of skilled machinists appear to be due to a lack of training opportunities –there are 37 community colleges in the state offering related programs. Instead, the major culprit seems to be faulty perceptions about future demand. Sharon Morrissey, Vice President of Asheville-Buncombe Technical Community College, speculates that the persistent weakness experienced in manufacturing during recent years has led many prospective candidates to view machinist jobs as careers with little long-term potential (Neal 2007). That suspicion seems to be confirmed by the graduation data presented earlier where only 63 workers were reportedly produced from the 37 community college programs during the 2005-2006 school year.

III. LESSONS FROM OTHER STATES

The preceding sections provide comprehensive quantitative and qualitative profile of North Carolina's traditional aerospace presence. But how does North Carolina compare to a select group of peer states that have already been down the road that North Carolina is now considering? Three states – Georgia, New Mexico, and Virginia – were selected to serve as benchmarks. Each state was chosen in order to evaluate certain key questions

Georgia was selected because a large portion of the state's traditional aerospace industry is focused around the existence of a major military asset, a very similar scenario to North Carolina's situation in the Eastern third of the state. New Mexico was selected to examine the effort required to break into the burgeoning commercial space industry essentially from scratch. This is the same reality that North Carolina would face if the state decided to pursue such endeavors. Furthermore, New Mexico also provides some useful insights into the impact that HondaJet and the very light jet industry in general might have on North Carolina based on New Mexico's experience with the industry's leading producer, Eclipse Aviation. Finally, Virginia was chosen because it offers a look at the commitment required to crack into the commercial space industry as well as some perspective on the intricacies of more general aerospace recruitment.

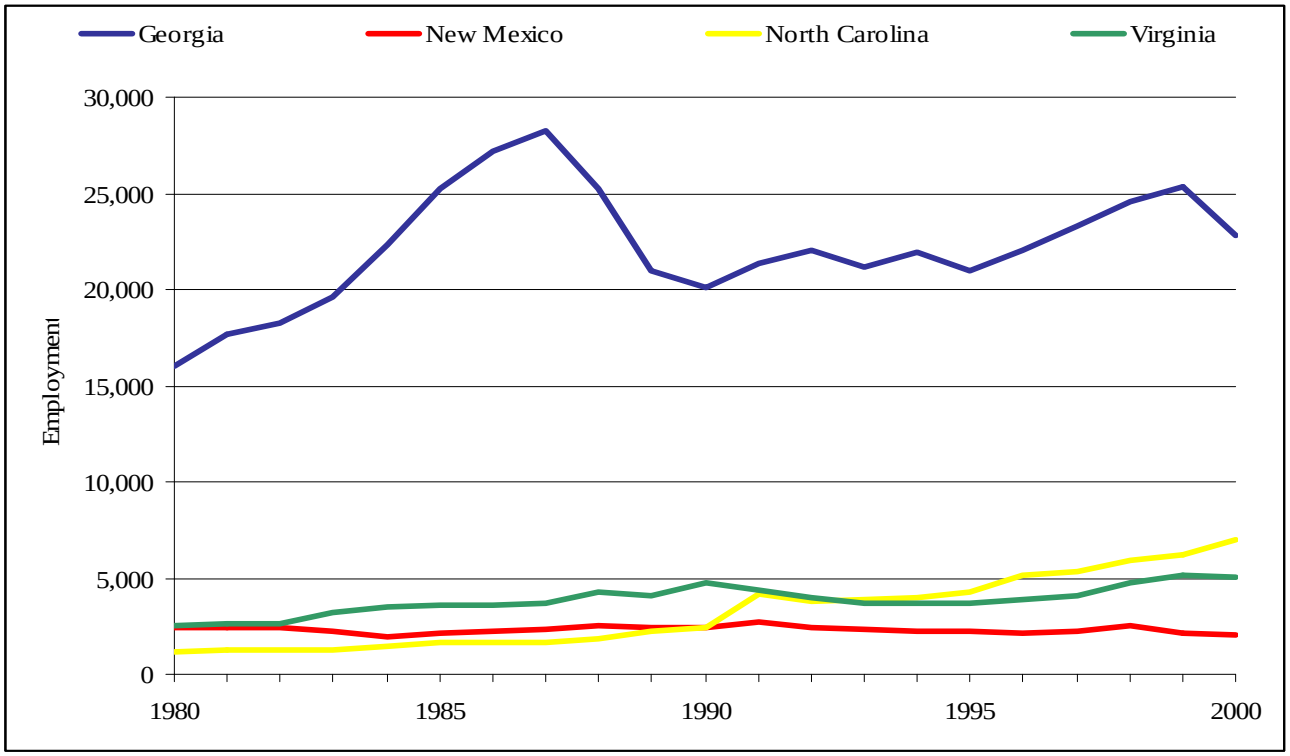
A. Development Trajectories

Before delving into the specifics of each state's experiences, we want to give the reader a general idea of how the aerospace industry has developed over time in each state. Figure 1 looks at the growth of traditional aerospace employment in each of the three benchmark states and North Carolina between 1980 and 2000.[16]

[16] The information presented in Figure 3.1 is not directly comparable with employment figures discussed anywhere else in the report because it uses SIC data. Using SIC data, instead of NAICS, was necessary in order to conduct a time-series analysis (NAICS began to phase out SIC as the official U.S. employment classification system starting in 1997). The figure displays the annual aerospace industry employment total for each state which is comprised from the totals of SIC 372 (Aircraft and Parts Manufacturing) and SIC 458 (Airports, Flying Fields, and Airport Terminal Operation).

The first result of note from Figure 1 is that Georgia's aerospace industry, on the strength of its sizable manufacturing segment, was the largest among the four states as of the end of 2000. North Carolina's industry, which began the highlighted period with the smallest total, increased more than six-fold during the 20-year span. Virginia's industry grew fairly steady between 1980 and 2000 as it tracked closely with North Carolina's path. New Mexico saw its industry total decrease slightly during the same period.

Figure 1 – Development Trajectories of the Benchmark States' Traditional Aerospace Industry



Source: Bureau of Labor Statistics

B. Georgia

The state of Georgia was selected to examine how its extensive maintenance, repair, and overhaul (MRO) industry is working together with the state's universities and military installations. Georgia could be a model for North Carolina, which is becoming quite active in the MRO sector and there is particular interest in coordinating that effort with the needs of the state's military facilities.

Aerospace development in Georgia is primarily handled through the state's Aerospace Innovation Center (AIC), located in Warner Robins, GA. The AIC is responsible for coordinating the recruitment of new, complementary aerospace companies, spearheading aerospace-related workforce development and K-12 programs, and working with companies and area universities on the development of new aerospace technologies. Georgia – the eighth largest aerospace state in the country – is home to a massive Lockheed Martin facility in Marietta that produces the F-22 Raptor and employs more than 8,000 workers, and Gulfstream Aviation in Savannah, which produces advanced business jets and provides the state with another 4,300 jobs. However, the crown jewel in Georgia's aerospace industry is the Warner Robins Air Logistics Center. The logistics center is one of five such facilities in the country and is responsible for the worldwide maintenance, repair, and overhaul of three key pieces of the Air Force's fleet, namely, the F-15 Eagle, the C-5 Galaxy, and the C-17 Globemaster. The center, located on Warner Robins Air Force Base, employs more than19,000 people in critical disciplines spanning from avionics to structural and materials science to system engineering and program management. Accordingly, the AIC is particularly interested in making sure that all of their efforts enhance the strategic value of the logistics center.

Of particular concern is the longevity of Warner Robins. AIC management believes the kind of maintenance, repair, and overhaul activity done at Warner Robins and elsewhere in the state is a big growth area in the overall aerospace industry. Two challenges are cited to the continued growth of MRO in Georgia and throughout the country, namely, the increased demand of obsolete parts for an aging fleet of aircraft and potential workforce shortages. AIC is working hard to address both issues. In terms of the obsolete parts, AIC is focused on leveraging the expertise of Georgia Tech's aerospace engineering department to alleviate supply problems. Georgia Tech is actively working with Air Force officials at Warner Robins to produce replacement parts as well as revamp out-of-date technologies with new solutions. It is hoped that this arrangement will also lead to numerous spinouts from the university and provide even more high-tech aerospace jobs for the state. Currently there are five technologies being developed in conjunction with Warner Robins and even more are on the way. Additionally, the AIC encourages collaborations between the university and private aerospace firms in the state. For example, the Aerospace Innovation Center recently announced its first successful collaboration with a member company in March of 2005 when Greensboro's own TIMCO partnered with

Georgia Tech's aerospace engineering department to infuse the principles of lean manufacturing into its maintenance, repair, and overhaul operations.

AIC management believes that providing Warner Robins with the resources its needs only helps to further weave the base into the fabric of the community, helping to shield it from future rounds of BRAC closings and consolidations. In terms of the workforce the problem is two-fold. First, there is the issue of limited program availability at state technical and four-year institutions. While there a re some related programs offered ata number of schools within the university system Georgia Tech is really the main player in terms of producing the kind of technical professionals, i.e., engineers, demanded by the state's various aerospace companies. Second, there is an even more fundamental "pipeline" problem wherein more needs to be done to encourage students in K-12 to explore aerospace as a viable career path. AIC management believes that aerospace has become lost in the shuffle amid a flurry of other high-tech careers and that there needs to be major effort in the state to advertise the diverse set of opportunities available within the industry. It is important to convey to students that aerospace has room for both "wires and pliers," workers as well as engineers, and that most potential career paths in aerospace are well-paying because of the industry's tremendous quality requirements.

C. New Mexico

A seemingly unlikely peer, New Mexico is examined because of its pioneering work towards becoming a global leader in space tourism and its efforts to attract traditional aerospace activity to the state. New Mexico's experience is particularly relevant to the situation North Carolina faces: its commercial space campaign is primarily a public start-up venture, and New Mexico is home to Eclipse Aviation, the leader in the VLJ industry and a major competitor to Greensboro's HondaJet.

Commercial space is seen as a natural fit for the state because of New Mexico's long history in the industry[17]. Robert Goddard, one of the fathers of modern rocketry, spent much of the 1930s

[17] Comments and opinions expressed in this section were offered in an interview with Clark Krause, President and CEO of the New Mexico Economic Development Partnership

working on his designs in Roswell, New Mexico. Additionally, the New Mexico deserts were also the home to some of Wernher von Braun's rocket research following World War II. Currently, New Mexico is home to the White Sands Missile Range, which, in addition to being the largest military installation in the U.S. (in terms of land area), is the premier missile range and test facility for the Army, Air Force, Navy, as well as NASA. NASA also refurbishes space shuttle components and completes some astronaut training at White Sands. New Mexico is also home to Kirtland Air Force Base Research Laboratory, Sandia National Laboratory, and the Los Alamos National Laboratory – all of which give the state a large military and R&D presence to build an aerospace cluster around. New Mexico is said to offer ideal flying conditions, including over 340 days of sunshine per year, very low air traffic, and relatively dry air, which equates to lower fuel costs for commercial space launches.

Aware of all of its assets, New Mexico began to bolster its aerospace economy over 20 years ago by pursuing Lockheed Martin's Venture Star program, an effort that never materialized. The state finally landed its big fish in December of 2005 when Virgin Galactic – Richard Branson's company that intends to offer suborbital space tourism flights to the public – announced it would locate its world headquarters in New Mexico. The state aggressively pursued Branson, who eventually chose New Mexico from a list of global sites because of New Mexico's space history and the fact that the state presented Virgin Galactic with considerably fewer regulations and red tape. With Virgin Galactic aboard, the state began to push for the development of a commercial spaceport. In January 2006, state officials, led by Governor Bill Richardson, enacted legislation that committed $225 million to the construction of the world's first purpose-built commercial spaceport, Spaceport America. This facility, which is operable now but is not scheduled to be fully completed until 2010, is the foundation for the state's campaign to become a leader in commercial space transportation and space tourism.

The spaceport is about more than just providing jobs; it is also about inspiring the next generation of residents to become interested in space again and to produce a future corps of engineers and other technical professionals. This next-generation vision was seen as a key part of selling the project to New Mexico taxpayers. State officials are keenly aware that this commercial space strategy has tremendous risks associated with it, but from the governor on down they feel that this is right path for New Mexico.

Part of their conviction is based on a series of economic impact studies that project the spaceport to generate over 2,300 jobs and over $3 million in payroll by its fifth year of operation. Virgin Galactic, alone, is expected to employ around 400 people, with scores of suppliers expected to follow as Virgin gets their operations underway. Reportedly, Branson already has some 45,000 people from around the world who have expressed interest in being potential space tourists. Virgin Atlantic's suborbital flights, which provide six minutes of actual weightlessness, are expected to retail initially for about $200,000. Virgin Galactic, hoping to have its first flight up as early as next year, is conducting its current operations at the Mojave Spaceport in California until its Spaceport America facility is fully completed. The eventual flights are expected to take place aboard Spaceship Two which is being built by Burt Rutan's Scaled Composites, LLC in California. This is the same company that built Spaceship One, the first privately-built and funded vessel to reach space.

In addition to the tremendous resources New Mexico has committed to their commercial space pursuits the state has also been very active in building up a strong traditional aerospace presence. Specifically, the state has made traditional aerospace one of its eight cluster targets. The centerpiece of state's traditional aerospace industry is Eclipse Aviation, the world-leader in very light jet (VLJ) design and production and a major competitor for Greensboro's HondaJet. Eclipse, located in Albuquerque, has been operating in New Mexico for close to five years after they were heavily recruited by the state. New Mexico viewed landing Eclipse as their big push into traditional aerospace and they pursued the company aggressively with a heavily incentivized deal that included the state taking a $25 million equity position in the company.[18]

Five years later Eclipse still has a very close working relationship with the state and the city of Albuquerque. The current focus is on making sure Eclipse's workforce needs are being met through a 40,000 square foot training facility built by the state exclusively for Eclipse's use. Eclipse is working very closely with the local community college to develop specialized curricula that meet the company's workforce needs, particularly its need for people with high-end machining skills. Almost all of Eclipse's 1,000 positions are said to be well-paying because of the skill-intensive nature of the work.

[18] Comments and opinions expressed about Eclipse in New Mexico are extracted from an interview with Angela Talbot, Senior Business Development Manager with the New Mexico Economic Development Partnership

Eclipse's facilities were initially located in the city of Albuquerque with low cost leases furnished by the city. However, Eclipse has since relocated to Albuquerque's smaller Double Eagle II Airport to avoid the heavy volumes of commercial traffic typically found at major international airports, like Albuquerque's International Sunport. Eclipse was attracted by the cheaper land and the fact that they just had more room to maneuver at the smaller facility. With Eclipse fully operational efforts are underway to recruit Eclipse's suppliers as part of the state's efforts to grow it traditional aerospace presence.

D. Virginia

Virginia was chosen as a benchmark state because it is engaged in both traditional aerospace activity as well as commercial space operations. It offers some slightly different insights than does New Mexico because its commercial space industry, which is a direct outgrowth from the state's NASA presence, offers a somewhat more sobering view of what it takes to establish a commercial space presence. With respect to traditional aerospace activity, Virginia provides an excellent example of how the industry can meet the needs of very diverse regions, similar to those in North Carolina.

Virginia is home to some the most important military facilities in the entire country[19]. The Pentagon, headquarters for the U.S. Department of Defense, is located in Arlington, VA and Norfolk Naval Station, home to the Navy's Atlantic Fleet, is located Virginia's Tidewater region. Virginia has drawn hundreds of defense-related companies trying to get their foot in the door at places like the Pentagon or NASA Langley in Hampton, the nation's first civil aeronautics laboratory. Nearly all of the country's major aerospace companies, including Boeing, Lockheed Martin, Northrop Grumman, General Dynamics, Rolls-Royce, and Airbus have operations in the state, especially around the northern Virginia and Tidewater areas, which tend to be focused on the engineering and R&D segment of the industry.

Aerospace in Virginia is not only about high-end functions clustered around federal government facilities but also includes good paying jobs that target nearly all segments of the workforce.

[19] Comments and opinions expressed about aerospace in Virginia are extracted from an interview with Ralph Stephenson, the aerospace project manager for the Virginia Economic Development Partnership

Aerospace is seen as a good fit for the state's more rural areas, especially those locales that have lost much of their manufacturing base in recent years. Original equipment and replacement part manufacturers are particularly drawn to such areas because of the relatively inexpensive land costs and the presence of a workforce that can meet their needs without too extensive retraining. The required upskilling can be an issue for workers with an "old-school" mindset of "I'm too old to learn". The real key in trying to overcome such obstacles is seen as the existence of strong, yet, flexible community college system that can tailor relevant offerings to displaced and incumbent workers. Computer skills are the biggest area where workers have needed additional training.

In addition to rural areas smaller airports are seen as big draws for aerospace companies, especially small jet assembly operations. Such companies enjoying being away from the busy hubs where they can have room to operate, but still have immediate access to runways runways of between 3,500 and 5,000 feet. While such firms can be significant well-paying employers of 50-to-100 people, they can also be susceptible to shortages in operating capital which, without some assistance, can jeopardize their longevity.

A third main driver of aerospace industry in the state besides the federal government-related activity and the rural and small airport manufacturers is Virginia's universities. The state is home to three institutions actively involved in aerospace-related research, namely, the University of Virginia in Charlottesville, Old Dominion University in Norfolk, and Virginia Tech in Blacksburg. Efforts are on-going to facilitate partnerships between private companies and the universities. UVA and Virginia Tech in particular have produced numerous spinout companies that provide the state with even more high-tech presence in the industry.

Traditional aerospace is not the only focus in Virginia which is also home to one of only six licensed U.S. commercial spaceports. Virginia's facility, the Mid-Atlantic Regional Spaceport (MARS) at Wallops Island, offers a different view of commercial space development than that of New Mexico's Spaceport America. Located on Virginia's eastern shore, Wallops Island is one of the oldest continuous launch sites in the world, having logged more than 15,000 launches during its history. The island's launch facility originally belonged to the Navy, but was transferred to the National Advisory Committee of Aeronautics (NACA), the precursor to

NASA, in 1954 and from that time NACA and then NASA have continuously operated the facility. During the mid-nineties activity at Wallops diminished substantially as NASA suffered significant budget cutbacks, so much so that NASA officials even considered closing the facility.

[20]Dr. Billie Reed, director of the Virginia Commercial Space Flight Authority (VCSFA) knew what a resource Wallops was and was quite determined not to let it disappear. Reed worked with Old Dominion University and the state's Center for Innovative Technology to develop plans to build a commercial spaceport at Wallops. The idea was to use the existing NASA assets and infrastructure already at Wallops to serve as the foundation of a commercial spaceport that could launch networks of small satellites into space. Eventually, the group received the state's blessing and formed VCSFA in 1995. VCSFA signed an official lease with NASA in 1997 and constructed a $3,600,000 launch pad and made other necessary improvements the following year. The VCSFA owns the launch pad and operates the MARS spaceport on land leased from NASA who provides all the required technical and logistical support.

Projections in 1995 speculated that activity at the spaceport would provide around 300 jobs and more than $60,000,000 for the local economy within five years. But, as of November 2006, not one single rocket had been launched from the spaceport, in part because the communications technologies VCSFA was banking on to drive business at the spaceport simply never materialized in a meaningful commercial fashion. In addition, the satellites themselves and the corresponding launch vehicles were just too expensive at the time to make such operations feasible.

Optimism remains about the facility's future. The spaceport gained a valuable ally in 2003 when the state of Maryland – whose state line is only four miles from Wallops – agreed to provide annual financial support to VCSFA. In addition, VCSFA has been awarded several very large contracts during the past couple of years, including a $49,000,000 deal with the Air Force, in anticipation of launches tentatively scheduled to occur over the next five years. The spaceport's most encouraging moment occurred in December 2006 when the first Minotaur I rocket carrying an Air Force TacSat-2 satellite was launched from the pad at Wallops. Three more launches are scheduled for 2007.

[20] Comments and opinions expressed about Virginia Commercial Space Flight Authority (VCSFA) are extracted from an interview with Dr. Billy Reed, Director of the VCSFA.

Virginia has traveled a long, tough road to get to this point. Other states could be advised to temper their expectations and be wary of building a white elephant. The MARS spaceport has a fairly unique niche, namely launching small satellites for the various federal government agencies located in and around Washington, D.C. and Norfolk so it is seen as not really being in direct competition with the numerous other spaceports that are coming online. In early 2007, the FAA, the regulatory body in charge of issuing licenses to would-be spaceports, lists six licensed facilities – the Oklahoma Spaceport, the California Spaceport, the Mojave Spaceport also in California, the Kodiak Launch Complex in Alaska, the Florida Spaceport, and the MARS facility at Wallops and another eight proposed spaceports including the Spaceport America facility in New Mexico.

These spaceports might well be in direct competition with each other for a piece of a rather small commercial space pie, particularly with respect to space tourism dollars. The commercial space industry is divided into two main parts: launching satellites as is done at Wallops and space tourism which is the primary focus of facilities like Spaceport America. Each segment of the industry has its own unique set of facility requirements that needs to be considered by states considering efforts in this arena. For example, launching satellites into orbit generally requires that the launch site be located near water because during such operations items are jettisoned and from a safety perspective it is preferable that material land out of harm's way. Performing such launches over water also increases the chances of recovering jettisoned items if needed for testing or troubleshooting. On the other hand, while space tourism, which uses reusable vehicles, does not have to be near water, it does require large tracts of land because of safety issues – hence spaceports focused more on tourism in places like New Mexico and Oklahoma where space is plentiful. While the MARS leaders have not given up on space tourism they are skeptical about how quickly meaningful commercial space tourism and/or travel will occur. Launch vehicle reliability and full regulatory approval present major roadblocks to scale up of space tourism.

IV. CONCLUSIONS REVISITED

In this final chapter, the conclusions presented throughout in the sections entitled "An Industry Snapshot" and "A Resource Catalog" will be reevaluated in light of the findings from the benchmark analysis in "Lessons from Other States". This section will be organized into the following four sub-sections. The first two sub-sections will employ the insights provided from peer states to reexamine North Carolina's standing with regards to traditional aerospace and the commercial space industry, respectively. The third part will distill the results of those two sections into a strength, weakness, opportunity, and threat (SWOT) analysis, while the fourth and final section offers concluding summary remarks.

A. Traditional Aerospace

Traditional aerospace positions are generally well-paying.

This finding was confirmed via the benchmark analysis of other states. Representatives from each of the three peer states interviewed explicitly stated that the aerospace employees in their states were generally well-paid, due in large part to the high quality work demanded in the industry. Furthermore, officials from Georgia and Virginia pointed out that traditional aerospace pays well across the employment spectrum from aerospace engineer all the way to machinist.

Traditional aerospace can provide employment opportunities for a diverse set of regions.

One of the most attractive aspects of traditional aerospace evident from the first two sections was that the industry could benefit virtually every corner of North Carolina's diverse economic landscape, especially distressed regions such eastern North Carolina. Fortunately, that notion was reinforced in the benchmark analysis – especially in Virginia where traditional aerospace is meaningful part of the state's more corporate and research and development-focused areas, as well as its more rural, production-focused regions.

North Carolina has a favorable mix of traditional aerospace industry segments.

North Carolina's existing strengths in traditional aerospace – engine and engine part manufacturing, replacement part manufacturing, and maintenance and repair – are growing segments of the industry, as confirmed by evidence from the benchmark analysis. Georgia

officials noted that maintenance and repair is a rapidly expanding part of the industry and Virginia and Georgia officials both highlighted replacement part manufacturing as a business on the rise. New Mexico's experiences with Eclipse Aviation support the idea that the very light jet market is poised for significant growth in the next decade – a particularly important finding given the move of VLJ producer, HondaJet to Greensboro.

The military is a key part of North Carolina's traditional aerospace industry.

Despite employing an initial industry definition that explicitly excluded the military from traditional aerospace, the findings in chapter two made it abundantly clear that North Carolina's large military presence was a significant part of the state's current and future involvement in aerospace. That link was strongly reinforced throughout the benchmark analysis, especially in Georgia where much of the state's aerospace-related development efforts center on Georgia's seminal military aviation asset, Warner Robins Air Force Base.

North Carolina's rich institutional network plays a crucial role in the development of the state's traditional aerospace industry.

Testimonies from the three benchmark states tied the development of traditional aerospace to the involvement of three types of institutions. First, the benchmark analysis underscored the importance of having a flexible community college system that can provide customized training and produce significant numbers of graduates for key occupations, such as machinists. Second, university involvement in traditional aerospace is critical both to producing key segments of the workforce, such as aerospace engineers and as a resource for innovation for the industry. Finally, the benchmark analysis emphasized the significance of dedicated aerospace institutions such as the Aerospace Innovation Center in Georgia which often help coordinate overall development efforts. More generally, officials in all three states noted how important all three types of institutions are as a source of partnership and collaboration.

The future of traditional aerospace development in North Carolina faces several workforce availability challenges.

North Carolina shares with benchmark states inadequate workforce, especially in the numbers of available machinist. Contributing to this scarcity are negative perceptions about manufacturing

career opportunities. Georgia and New Mexico both noted that skilled machinists are in high demand but short supply. Virginia officials reported unwillingness among displaced manufacturing workers toward obtaining the needed training that would allow them fill many of the machinist-type openings in the industry. It is fundamental that perceptions be changed to encourage young people to see traditional aerospace as a viable career option. Georgia officials suggest that the industry's attractiveness suffers from sustained weakness in manufacturing as well as an ever-increasing interest in other technology areas such as computers.

Smaller, less busy airports represent an important asset in the development of the industry. The attractions of smaller facilities were a clear factor in the decision of HondaJet to locate in Greensboro. This issue was emphasized by officials in Virginia and New Mexico who stated that smaller airports can be real engines of traditional aerospace growth. In North Carolina there are a number of such facilities headlined by the Piedmont Triad International (PTI) Airport, which have the potential to become a real hub of aerospace activity in the state. However, at some point PTI is likely to run out of room or at least become busy enough that it loses some its initial appeal. This begs the question - Where else in North Carolina might such a hub emerge?

B. Promising Prospects for the Global TransPark

Despite previously unfulfilled growth expectations the Global TransPark (GTP) in Kinston emerges as a promising focus of additional efforts to expand the traditional aerospace operations in North Carolina. GTP offers all of the attributes that make less busy airport facilities attractive to growing aerospace businesses. GTP has ample for room for expansion and sufficient infrastructure (second largest runway in the state), giving it a second chance to become a major economic success story. Previously GTP was dismissed as a global logistics hub because it lacked good land or water access and is located in eastern North Carolina and far from any significant interstate. What was overlooked is that the GTP can be reached by air, making it an attractive destination for all types of aircraft maintenance and repair operations. Finally, the GTP's location in eastern North Carolina makes it convenient to much of the state's traditional aerospace activity and all of the military aviation facilities.

Additionally, the GTP has a surplus of available space to house maintenance operations and easily accommodate aircraft manufacturers the scale of HondaJet. The GTP also consists of adjoining property of over 5,000 acres of land that has already received EPA certification. Moreover, there is a state-of-the-art training facility on-site to handle workforce needs. Experiences of the benchmark states indicate that less busy airport facilities with ample room to operate and lengthy runways are attractive sites for traditional aerospace companies; without question the GTP fits that description. The GTP could be remarketed as a facility well-suited to handle traditional aerospace functions as opposed to global cargo logistics, thus providing a much needed venue for the further expansion of the state's traditional aerospace industry, bolstering eastern North Carolina, and making use of an existing asset that many people have already written off.

C. The Developing Commercial Space Opportunity

Commercial space is defined by the Federal Aviation Administration (FAA) as "the movement of, or means of moving objects, such as communications and observation satellites, to, from, or in space" (FAA, 2007a, par. 2). This includes the nascent field of space tourism.

Too often the perception of commercialization of space seems to have been focused on space tourism, with the resultant conclusion that this would forever be a very small industry. However, advances in aerospace technology have resulted in extremely significant reductions in the cost of launching a commercial tourism vehicle into space. The cost of such a trip has dropped from $5 million to $200,000 as offered by Richard Branson in the new Virgin Aerospace vehicles. While still out of reach of most individuals, the cost is expected to continue dropping as further technology breakthroughs are made. Other countries, especially Japan, have concluded that space tourism will be a major industry by 2015.

Space tourism is clearly only a small part of the growing space economy. Expanding demands for satellite mapping, earth imaging, communications and entertainment systems, and national security and defense are being placed on an aging satellite infrastructure that is in serious need of upgrade. As needs increase, launch costs are dropping: for example, the cost to launch a one kilogram small satellite into low earth orbit has dropped from $1 million to under $35,000. New

functionalities are becoming possible through advances in electronics and controls and new research into micro-miniaturization.

There are opportunities here for North Carolina to capture interest, revenue and a new foothold in the global commercial future of space. Industry can and should drive a public-private initiative. The presence of strong R&D programs at NC State and other North Carolina institutions could position the state to attract innovative commercial space operations and/or spin-off entrepreneurial start-up space companies. The manner in which North Carolina chooses to capitalize on the unique opportunity presented by the commercialization of space and space exploration, in the next year or two, will likely decide the course of our economic success and technology leadership in this important industry in coming decades.

V. A SWOT Analysis

STRENGTHS	WEAKNESSES
Traditional Aerospace: - Provides well-paying jobs - Industry presence throughout state - Particularly meaningful presence in eastern North Carolina - State is home to four unique military aviation assets, all of which are in eastern North Carolina - Strong network of aerospace-related institutions including the North Carolina Aerospace Alliance - Favorable industry mix in traditional aerospace including growing areas such as maintenance and repair and aircraft part manufacturing - Recent addition of HondaJet gives state an aircraft production presence - Strong traditional aerospace corporate presence in Charlotte including firms such as Goodrich - State has a flexible community college system that has added numerous aerospace-focused programs - Ongoing collaboration between N.C. State, private industry, and the military - The state has a long tradition with respect to a manufacturing and military presence	Traditional Aerospace: - A lack of aerospace-related research and development activity - Limited workforce production, particularly with respect to machinists and aerospace engineers - A lack of aerospace engineering programs - The recent negative image often associated with manufacturing careers Commercial Space: - A general lack of any space-related presence and/or facilities in the state
OPPORTUNITIES	**THREATS**
Traditional Aerospace: - HondaJet's place in the emerging very light jet industry - Traditional aerospace's potential to help the state increase its share of DoD dollars - Traditional aerospace's potential to help solidify presence of the state's invaluable military aviation assets - More small business growth/entrepreneurship opportunities stemming from replacement part business - Expanded future collaborations between state universities, community colleges, private industry, and the military - Potential spinouts from university-led aerospace research - Growth fueled by smaller, less busy airports such as Piedmont Triad International - An opportunity to turn the Global TransPark into a positive - Synergy between traditional aerospace development and more general efforts to grow state's defense and security presence - Potential to recruit more production operations to the state from companies already based in North Carolina, most notably Goodrich in Charlotte	Traditional Aerospace: - The very light jet industry not materializing as experts predict - Future rounds of BRAC closures and consolidations - Consolidations among major aerospace producers such as the possible merger/consolidation of Smiths Aerospace and GE Aviation - National and international competition in the future recruitment of traditional aerospace firms - National competition for aerospace workforce as evidenced by the University of North Dakota/Robeson Community College Program Commercial Space: - Tremendous amount of competition from other states who are getting involved in the industry and getting their spaceports off the ground - Delays in the development of commercial space-enabling technologies - Regulatory hurdles

VI. Final Thoughts

While neither traditional aerospace nor the commercial space industry dominates the North Carolina economic landscape, it has been shown throughout the course of this analysis that traditional aerospace has a real presence in the state and that the commercial space industry is could be enticed to locate here. The evidence presented suggests that traditional aerospace could become a much more significant factor in North Carolina's economic future if a state-wide strategic plan for aerospace is developed and implemented. North Carolina is not competing with other states so much as it is with international players in a global marketplace. Competitiveness will be gained by centralizing and augmenting the relevant workforce development infrastructure.

Ultimately, economic development efforts are more likely to succeed when they leverage existing strengths, not when they pursue the latest trend. The evidence presented throughout this analysis makes a strong case that traditional aerospace is indeed a strength in North Carolina. The solid foundation that already exists will not only improve the chances for successfully expanding North Carolina's traditional aerospace presence but will likely nurture the state's capacity to become a force in the emerging commercial space sector

Synergies that exist between North Carolina's rich endowment of unique traditional aerospace assets and the various military aviation facilities in eastern North Carolina are offer an exciting opportunity to build competitive advantage. In fact, traditional aerospace and the defense industry are so intimately intertwined in North Carolina that the term aerodefense economy may be a more appropriate descriptor than aerospace. Investments in aerospace support will surely strengthen the state's competitive position in the military and defense sectors and contribute to the economic security and defense of the nation.

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APPENDICES

Appendix A: Methodology and Literature Review

An industry cluster is a geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field. This stuffy examines the nucleus of the aviation and space sectors of the more inclusive aerospace industry. It does not examine in detail the various supply chains that are part of the broader aerospace industry cluster. As defined by Bergman and Feser (1999), cluster analysis is a two-step process comprised of (1) cluster identification, i.e. determining which clusters exist in a particular region, and (2) cluster evaluation, i.e. developing a detailed understanding of those identified clusters. This report is concerned primarily with cluster identification. It is driven by specific regional interests or policy concerns, such as the aforementioned NCSI white paper.

This study follows the mixed-method best practices cluster analysis approach described by Cortright (2006), Benneworth and Henry (2004) and Feser (2005). Specifically, there are two general categories of evaluation techniques, bottom-up and top-down. Top-down techniques commonly use location quotient analysis, typically rely primarily on quantitative data and produce more broadly applicable findings. Bottom-up methods, such as expert interviews, generally employ more qualitative sources and consequently tend to generate more detailed, yet, somewhat narrower findings. Each category's strength also tends to be its greatest weakness: top-down methods suffer from a lack of detailed insight and bottom-up methods suffer from a lack of generalization. The mixed method approach taken in this study is expected to yield a more balanced understanding of the interdependences and various forces that are shaping activity in the aerospace cluster in North Carolina.

Appendix B: NAICS Traditional U.S. Aerospace Industry Descriptions[21]

334511: Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing

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

336411 Aircraft Manufacturing

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

336412 Aircraft Engine and Engine Parts Manufacturing

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

336413 Other Aircraft Parts and Auxiliary Equipment Manufacturing

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

336414 Guided Missile and Space Vehicle Manufacturing

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

336415 Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing

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

336419 Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing

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

481111 Scheduled Passenger Air Transportation

This industry comprises establishments primarily engaged in providing air transportation of passengers or passengers and freight over regular routes and on regular schedules. Establishments in this industry

[21] Source: U.S. Census Bureau

operate flights even if partially loaded. Scheduled air passenger carriers including commuter and helicopter carriers (except scenic and sightseeing) are included in this industry.

481112 Scheduled Freight Air Transportation
This industry comprises establishments primarily engaged in providing air transportation of cargo without transporting passengers over regular routes and on regular schedules. Establishments in this industry operate flights even if partially loaded. Establishments primarily engaged in providing scheduled air transportation of mail on a contract basis are included in this industry.

481211 Nonscheduled Chartered Passenger Air Transportation
This industry comprises establishments primarily engaged in providing air transportation of passengers or passengers and cargo with no regular routes or schedules.

481212 Nonscheduled Chartered Freight Air Transportation
This industry comprises establishments primarily engaged in providing air transportation of cargo, not passengers with no regular routes and regular schedules.

481219 Other Nonscheduled Air Transportation
This industry comprises establishments primarily engaged in providing air transportation with no regular routes and regular schedules (except nonscheduled chartered passenger and/or cargo air transportation). These establishments provide a variety of specialty air transportation or flying services based on individual customer needs using general purpose aircraft.

488111 Air Traffic Control
This industry comprises establishments primarily engaged in providing air traffic control services to regulate the flow of air traffic.

488119 Other Airport Operations
This industry comprises establishments primarily engaged in (1) operating international, national, or civil airports, or public flying fields or (2) supporting airport operations, such as rental of hangar space, providing baggage and/or cargo handling services.

488190 Other Support Activities for Air Transportation
This industry comprises establishments primarily engaged in providing specialized services for air transportation (except air traffic control and other airport operations).

517410 Satellite Telecommunications
This industry comprises establishments primarily engaged in providing point-to-point telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.

611512 Flight Training
This industry comprises establishments primarily engaged in offering aviation and flight training. These establishments may offer vocational training and/or recreational training.

Appendix C: Community College Degree Program Descriptions

Source: North Community College System

Aviation Management and Career Pilot Technology (A60180)

The Aviation Management and Career Pilot Technology curriculum prepares individuals for a variety of aviation and aviation-related careers with the commercial airlines, general aviation, the aerospace industry, the military, and state and federal aviation organizations.

Course work includes fundamentals of flight, aerodynamics, aircraft performance, meteorology, navigation, federal regulations, aviation management, and instrument and commercial ground training. Optional course work includes flight and simulator training or business management.

Graduates will hold a commercial pilot certificate with an instrument rating or specialize in aviation management. Graduates may find employment as commercial, corporate, and military pilots, fixed base operators and airport managers, flight instructors, and flight dispatchers.

Aviation Systems Technology (A60200)

The Aviation Systems Technology provides individuals with the knowledge and skills to qualify for an aircraft mechanic's certificate with airframe and/or powerplant ratings. The curriculum is approved by the Federal Aviation Administration (FAA) under 14 CFR Part 147, which governs aviation maintenance schools.

Course work includes aviation mathematics, FAA regulations, basic electricity, aircraft drawings; aircraft structures, systems, and components; aircraft engines, theory, systems, and components; and engine inspections and maintenance.

Employment opportunities exist as entry-level mechanics with air carriers, manufacturers, repair stations, fixed base operators, flight schools, and government aviation operations.

Computer-Aided Drafting Technology (A50150)

This curriculum prepares individuals for employment as computer-aided drafting technicians. Graduates should be prepared for a wide variety of jobs that involve managing the hardware and software of a CAD system. Emphasis is placed on developing the student's ability to interface with computer hardware and software in a CAD office.

Students will use CAD workstations to create and manage two and three-dimensional models for a wide variety of fields. Students will link CAD documents to other applications such as a database, GIS maps, spreadsheets, word processing, or CNC machining systems. Course work includes the study of drafting, computer hardware and operating systems, two- and three-dimensional computer models, solid modeling, rendering, and engineering systems.

Graduates should qualify for CAD jobs in a wide variety of fields that use CAD technology. Job titles include CAD technician, CAD manager, CAD drafter and detail drafter.

Computer Engineering Technology (A40160)

The Computer Engineering Technology curriculum provides the skills required to install, service, and maintain computers, peripherals, networks, and microprocessor and computer controlled equipment. It includes training in both hardware and software, emphasizing operating systems concepts to provide a unified view of computer systems.

Course work includes mathematics, physics, electronics, digital circuits, and programming, with emphasis on the operation, use, and interfacing of memory and devices to the CPU. Additional topics may include communications, networks, operating systems, programming languages, Internet configuration and design, and industrial applications.

Graduates should qualify for employment opportunities in electronics technology, computer service, computer networks, server maintenance, programming, and other areas requiring knowledge of electronic and computer systems.

Industrial Engineering Technology (A40240)

The Industrial Engineering Technology curriculum prepares graduates to be technical leaders in manufacturing and service organizations. The curriculum incorporates the study and application of methods and techniques for developing, implementing, and improving integrated systems involving people, material, equipment, and information.

The course work emphasizes analytical and problem-solving techniques for process development and improvement. The curriculum includes systems analysis, quality and productivity improvement techniques, cost analysis, facilities planning, organizational management, effective communications, and computer usage as a problem-solving tool.

Graduates of the curriculum will qualify for positions in a wide range of manufacturing and service organizations. Employment opportunities include industrial engineering technology, quality assurance, supervision, team leadership, and facilities management. Certification is available through organizations such as ASQC, SME, and APICS.

Industrial Management Technology (A50260)

The Industrial Management Technology curriculum is designed to equip students with the knowledge, skills, and abilities to function effectively in staff, front-line leadership, and mid-level management positions in organizations. The program emphasizes team building, TQM, SPC, motivation, continuous improvement, systems, and leadership.

Course work includes the integrated study of quality and productivity improvement, production operations, management, financial analysis, problem solving, and management of resources—human, physical, and information. Course work incorporates a broad understanding of computer applications to analyze and solve problems.

Graduates should qualify for entry-level positions such as front-line supervisor, engineering assistant, production planner, inventory supervisor, or as a quality control technician. With additional training and experience, graduates could become plant or production managers.

Industrial Systems Technology (A50240)

The Industrial Systems Technology curriculum is designed to prepare or upgrade individuals to safely service, maintain, repair, or install equipment. Instruction includes theory and skill training needed for inspecting, testing, troubleshooting, and diagnosing industrial systems.

Students will learn multi-craft technical skills in blueprint reading, mechanical systems maintenance, electricity, hydraulics/pneumatics, welding, machining or fabrication, and includes various diagnostic and repair procedures. Practical application in these industrial systems will be emphasized and additional advanced course work may be offered.

Upon completion of the curriculum, graduates should be able to individually, or with a team, safely install, inspect, diagnose, repair, and maintain industrial process and support equipment. Students will also be encouraged to develop their skills as life-long learners.

Machining Technology (A50300)
The Machining Technology curriculum is designed to develop skills in the theory and safe use of hand tools, power machinery, computerized equipment, and sophisticated precision inspection instruments.

Students will learn to interpret blueprints, set up manual and CNC machines, perform basic and advanced machining operations, and make decisions to ensure that work quality is maintained.

Employment opportunities for machining technicians exist in manufacturing industries, public institutions, governmental agencies, and a wide range of specialty machining job shops. Graduates should qualify for employment opportunities in manufacturing industries and tool, die, and mold making industries.

Machining Technology/Tool, Die, and Mold Making (A5030A)
Tool, Die, and Mold Making is a concentration under the curriculum title of Machining Technology. This curriculum is designed to develop skills in the use of hand tools, computerized equipment, and precision instruments for machine tooling used for the mass production of parts.

Students will learn to interpret blueprints, set up manual and CNC machines, and perform basic and advanced machining operations. Emphasis will be placed on the production of tooling used for punching, stamping, and molding of parts.

Manufacturing Engineering Technology (A40300)
The Manufacturing Engineering Technology curriculum prepares individuals for employment in the fields of manufacturing technology. The curriculum emphasizes the theory and training required to effectively augment manufacturing engineers in industry.

Courses include a background in mechanical and related theory and the use of manufacturing and analytical equipment. Industrial standards such as EPA, OSHA, GD&T, and ISO are discussed. Computer usage for process control and effective communication skills are emphasized.

Graduates of this curriculum qualify for positions as engineering technicians. Some of the responsibilities include drafting, process specification, tooling selection, automation programming, project facilitation, and supervision. Certification is available through organizations such as ASQC, SME, and NICET.

Manufacturing Technology (A50320)
The Manufacturing Technology curriculum provides an introduction to the principles and practices of manufacturing in today's global marketplace. The student will be exposed to valuable high-tech concepts applicable in a variety of industries such as plastics, metals, furniture, textiles, and electronics.

Students will gain real-world knowledge in manufacturing management practices, manufacturing materials and processes, research and development, and quality assurance. Course work will

include machining processes, CAD/CAM, CNC principles, and other computerized production techniques.

Graduates should qualify for employment as a manufacturing technician, quality assurance technician, CAD/CAM technician, team leader, or research and development technician. The student will be able to advance in the workplace and develop with new technologies.

Manufacturing Technology/Quality Assurance (A5032B)

Quality Assurance is a concentration under the curriculum title of Manufacturing Technology that is designed to prepare individuals for employment in a variety of businesses and industries as entry-level quality technicians or to obtain specific skills in quality control/quality assurance.

Course work includes training in communication skills, mathematics, and all areas of quality management. Courses include statistics, statistical process control, quality systems auditing, ISO 9000, and quality manual preparation.

Graduates should be prepared to take the American Society for Quality Control Certified Quality Technician exam. They will have broad knowledge of modern quality systems and techniques as currently practiced today in business and industry.

Mechanical Drafting Technology (A50340)

The Mechanical Drafting Technology curriculum prepares technicians to produce drawings of mechanical parts, components of mechanical systems, and mechanisms. CAD and the importance of technically correct drawings and designs based on current standards are emphasized.

Course work includes mechanical drafting, CAD, and proper drawing documentation. Concepts such as machine shop processes, basic materials, and physical sciences as they relate to the design process are also included. The use of proper dimensioning and tolerance techniques is stressed.

Graduates should qualify for employment in mechanical areas such as manufacturing, fabrication, research and development, and service industries.

Mechanical Engineering Technology (A40320)

The Mechanical Engineering Technology curriculum prepares graduates for employment as technicians in the diversified mechanical and manufacturing engineering fields. Mechanical Engineering (ME) technicians assist in design, development, testing, process design and improvement, and troubleshooting and repair of engineered systems. Emphasis is placed on the integration of theory and hands-on application of engineering principles.

In addition to course work in engineering graphics, engineering fundamentals, materials and manufacturing processes, mathematics, and physics, students will study computer applications, critical thinking, planning and problem solving, and oral and written communications.

Graduates of the curriculum will find employment opportunities in the manufacturing or service sectors of engineering technology. ME technicians may obtain professional certification by application to organizations such as ASQC, SME, and NICET.

Appendix D: Map of North Carolina's Regional Economic Development Partnerships

Source: North Carolina Department of Commerce

Appendix E: Map of Major North Carolina Airport Facilities Locations

Source: North Carolina Airport Association