

May 11, 2005

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P A P P A S

CONSULTING
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Dear Ms. Broad and Dr. Lancaster:

The Pappas Consulting Group Inc. is pleased to present you, your respective Boards and campus leaders with the Interim Report of Preliminary Findings for HB1264. The preliminary results of this ground breaking study, *Staying a Step Ahead: Higher Education Transforming North Carolina's Economy*, are presented to you at this time in fulfillment of the Joint Legislative Education Oversight Committee deliverable deadline of May 16, 2005.

It is clear that the legislators of the state of North Carolina are committed to ensuring that the State's citizens "are academically prepared and equipped for current job opportunities and jobs of the future in North Carolina's growing knowledge economy." To the best of our knowledge this may be the first time a Legislature has called upon its Community Colleges and Public Universities in such a study. Indeed, the Legislature should be lauded for its vision in calling for this study in such an intentional manner.

We want to thank members of the legislative staff for their cooperation and insights as well as the staffs of The UNC and NCCCS for their cooperation as well as the materials they have provided us for our review and consideration. We also want to thank the Boards of both The UNC and NCCCS for their thoughtful questions and suggestions for on-going data gathering and review.

Ms. Molly C. Broad
President,
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Dr. H. Martin Lancaster
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As we embark on this study's next phase of work, we are hopeful that no major program decisions regarding The UNC and NCCCS be made without benefit of the findings as well as the recommendations that will be generated by this study. The momentum for collaborative efforts between these two systems and among their respective institutions is evident as is the will to look creatively at how to address jointly the economic and workforce development needs of the state. We are encouraged by this and intend to drive an outcome that will realize the spirit of HB1264.

The accompanying Interim Report and its appendices are intended to give the reader a high level executive summary as well as details regarding the: Project Background and Study Initiation; The North Carolina Employment Environment; The Current Educational Environment; Preliminary Gap Analysis: State Needs/Academic Programs; A New Community of Learners; Additional Topics; and Other Preliminary Findings. This table of contents parallels the seven requirements of HB1264. Further, there is a section dedicated to the Historically Minority Institutions. Since our initial round of telephone interviews with the HMI Presidents and their chief academic officers that are reflected in this Interim Report, there have been subsequent, thoughtful conversations in person with the same leadership to begin to identify opportunities to address the workforce and development needs from this unique perspective.

As we have collected and analyzed a myriad of data and reports, we make reference to these materials in Attachment 5. Working papers containing these various reports and documents will be made available in hard copy to the system office staff of The UNC and NCCCS should the reader want access to these materials.

Once again, it is a distinct honor to be working on behalf of you and your Boards in this most challenging and exciting Legislative endeavor.

Sincerely yours,



Alceste T. Pappas, Ph.D.
President and CEO
Pappas Consulting Group Inc.

**STAYING A STEP AHEAD: HIGHER EDUCATION
TRANSFORMING NORTH CAROLINA'S ECONOMY**

INTERIM REPORT

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ATTACHMENT 1: State of North Carolina Higher Education System
and Economic Development Regions

ATTACHMENT 2: North Carolina Community College System – Summary

ATTACHMENT 3: University of North Carolina - Summary

ATTACHMENT 4: Issues Regarding Employment Data and Projections

ATTACHMENT 5: Listing of Appendices/URLs

ATTACHMENT 6: Original Language of HB 1264

**STAYING A STEP AHEAD: HIGHER EDUCATION
TRANSFORMING NORTH CAROLINA'S ECONOMY****INTERIM REPORT****1. EXECUTIVE SUMMARY**

North Carolina finds itself at an unprecedented point in its history. With rapidly changing demographics and a dramatically altering economy, North Carolina can either passively let events unfold or can proactively try and shape its future. The 2004 Legislature determined to follow the latter path, calling, as part of HB 1264, for a study “to ensure that the state’s citizens are academically prepared and equipped for current job opportunities and jobs of the future in North Carolina’s growing knowledge economy.” The Legislature called on the University of North Carolina (UNC) and the North Carolina Community College System (NCCCS) to examine jointly, with the assistance of a consultant team, how this could be accomplished for the benefit of the state. (For the full legislative language, see Interim Report, Section 2.)

The legislation had seven requirements:

1. Analysis of state and regional demographic, economic, and educational data. (See Interim Report, Section 3. A, B, C and Section 5. A, B, C, D.)
2. Enrollment projections for UNC and NCCCS. (See Interim Report, Section 4.D and referenced in Attachment 5 of this report as Appendices 4.D.1 and 4.D.2.)
3. Analysis of current academic program offerings. (See Interim Report, Sections 4.A and 4.B and referenced in Attachment 5 of this report as Appendix 4.B.1.)
4. Recommendations on increased effectiveness through collaborations and distance learning. (See Interim Report, Sections 4.C, 4.E, and 4.F. for baseline analysis; recommendations will be in the final report.)
5. Analysis of long-range capital plans. (Will be included in the final report.)
6. Special emphasis on the Historically Black Universities and UNC Pembroke. (See Interim Report, Section 4.H.)
7. An analysis of the role of the liberal arts and of programs aimed at the state’s knowledge-based economy. (See Interim Report, Section 4.G.)

The two systems have responded to the legislation by working closely together in what may be the first such joint study in the nation, and have been assisted by a qualified consulting team (as also called for in the legislation). This Interim Report establishes the baseline and includes findings. It does not include recommendations; those will be included in the Final Report due in December 2005.

The Demographic and Economic Challenges

To respond to the challenges of tomorrow, North Carolina's population must be better educated. The state's population is going to get larger (up 17% from 2000-2010), older (65 and up group will grow over 141% in this period), and more diverse (the Hispanic population in particular will grow rapidly). Both UNC and the Community College systems along with their institutions will have to change to respond to the challenges of North Carolina's tomorrow.

Currently, North Carolina is above the national average in percentage of population without a high school diploma (21.9% vs. 19.0% nationally) and below the national average in percentage of population with a bachelor's degree (22.5% vs. 24.4%). Yet of the fastest growing occupations identified in the targeted industries, most will require postsecondary study and a substantial number of these will require a bachelor's degree.

Even though North Carolina appears close to national averages for education, these and many other measures are deceptive, for there are many North Carolinas. While some areas see rapid population growth, others are actually experiencing population declines. While some areas have a highly educated populace, others do not. The Research Triangle, for example, has more than two times the percentage of college graduates than the Northeast region. Some areas have high household incomes; others have high concentrations of poverty. These demographics demand that the state be considered through the prism of its regions.

North Carolina's economic challenges rival those of its demographic demands. Where once, not so long ago, agriculture (in particular tobacco farming) and manufacturing (in particular furniture and textiles) dominated much of North Carolina's economy (manufacturing was 30% of North Carolina's employment in 1979; now it is 17%), both sectors are in decline today. Indeed, agriculture is projected to decline -2.75% annually.

Yet, North Carolina is still projected to add over 750,000 people to the workforce by 2010. The most growth will occur in the services occupations, ranging from office jobs to janitorial services. At the same time, there is likely to be substantial jobs growth in professional and technical fields (over a 250,000 by 2010), such as education, health, and information technology areas. In addition, there will be considerable growth in management and financial positions (including especially accountants), in construction, and in transportation (See Tables 3.B.1. and 3.B.2. for the top ten growth occupations).

Regional economic development reports and industry reports indicate some emerging areas that have great potential for the state. These include: advanced manufacturing; advanced materials (chemicals and plastics); advanced materials (nanotechnology); biotechnology and pharmaceuticals; computing, software, and the internet; design and arts; and logistics and distribution. While all of these have employment opportunities at all levels of education, the trend is most definitely towards a higher proportion of the jobs requiring a bachelors degree or above. These emerging areas will require many employees with critical thinking skills, strong science and math backgrounds, and interdisciplinary experiences.

At least four distinct groups of potential students for UNC and NCCCS are emerging as changes occur in North Carolina's demographics and economy. By 2010, the traditional postsecondary cohort of 18-24 year olds will reach at least 1 million, a 22.5% increase from 2000.¹ In addition, displaced workers from the traditional industries, who are generally less well educated than their peers, will require retraining to gain employment in growing industries. Third, training in English and math will be required for many North Carolinians not properly prepared for postsecondary education. This could also include a substantial percentage of the over 600,000 North Carolinians who speak a language other than English at home.² Finally, the increasing pace of change in knowledge requires other lifelong or "just-in-time" learning. This suggests that many members of North Carolina's population will come back to UNC or NCCCS during their lives, perhaps more than once, to gain new knowledge and skills.

A Profile of NCCCS and UNC

North Carolina is well positioned to respond to the increased demand for an educated workforce because it has two mature and well-respected higher education systems. NCCCS has 58 comprehensive Community Colleges with College-operated facilities in 90 of North Carolina's 100 counties. These Colleges offer a wide range of programs aimed at preparing North Carolinians for the workforce. The curriculum programs include associate in applied science, diplomas, certificates, and associate in arts and associate in science degrees. Just under a quarter of the Community College students intend to transfer directly for a baccalaureate degree. Those who do transfer benefit from the Comprehensive Articulation Agreement that, with certain conditions, enables the Community College general education core to transfer as a block to any UNC institution or any NCCCS institution.

In addition to curriculum programs, NCCCS institutions offer continuing education programs, basic skills education, training for business and industry (including the Small Business Center Network), and a number of targeted programs. NCCCS provides remedial education to a large number and proportion of its students. (UNC also has to provide remedial programs.) The NCCCS enrollment is projected to increase over 38% between 2004 and 2014.

¹ <http://www.demog.state.nc.us>, accessed 4/18/05.

² US Census 2000, "Language Use and English Speaking Ability: 2000," C2KBR-29, issued October 2003. www.census.gov/population/www/socdemo/lang_use.htm, accessed 4/18/05.

UNC has sixteen diverse institutions; six of the sixteen are historically minority institutions (HMIs). The UNC institutions primarily offer degree programs in 31 different academic program areas with over 300 distinct degree programs, at both the undergraduate and graduate level. They offer continuing education programs and are highly engaged with their local regions. The institutions also host services to small and medium sized businesses through the Small Business Technology Development Center. The UNC enrollment is projected to increase almost 33% between 2002-2012.

Currently, UNC and NCCCS have substantial collaborative activities and plans for many additional ones. These include state level activities such as the Comprehensive Articulation Agreement and many regional consortia. One of the most substantial collaborative initiatives is the Biomanufacturing Training and Education Center and BioNetwork funded by both the Golden L.E.A.F. Foundation and the state. Also of great potential is the development of a number of e-learning “ladder” programs between the two systems.

Distance learning, in fact, will probably need to play a more pronounced role, especially for students who are place bound or working full-time. Both UNC institutions and NCCCS institutions have extensive distance learning programs (although there are considerable variations). Courses and enrollments appear to be above national averages. Both systems have experienced tremendous enrollment growth in such offerings, including those that utilize e-learning, at a far greater rate than their overall enrollment growth. The biggest barrier to further expansion does not appear to be faculty interest, technical support, or training. It is bandwidth capacity. This is an almost immediate problem for NCCCS and could be potentially for UNC in the future.

Regardless of the form of delivery, curriculum will remain key along with the quality of the faculty that teach that curriculum. Employer surveys and business group studies emphasize the importance of “soft skills” such as the ability to work in teams and to have strong problem solving skills. While technical expertise will be important in the knowledge economy, the set of skills and knowledge imparted by the liberal arts may be even more crucial. Both UNC and NCCCS have a liberal arts component, the general education core, in their degree programs. In UNC institutions it ranges from 36-45 credits; in NCCCS institutions it is 44 credits in the transfer programs of its institutions. The NCCCS general education core transfers as a block within the system and to UNC institutions. Both systems, however, may need to reexamine their liberal arts core to insure they include the skills and knowledge needed to respond to an ever-changing environment. By so doing, they will reinforce the complementary relationship between general education and majors specifically aimed at careers.

Historically Minority Institutions

HB 1264 also highlights the importance of the Historically Minority Institutions (HMIs) and recognizes that a diverse workforce is an economic imperative because of: demographic shifts; the need to break the link between race and poverty; and the increasing role of the HMIs in meeting the overall enrollment and economic development needs of the state. These six institutions (Elizabeth City State University, Fayetteville State University, North Carolina A&T University, North Carolina Central University, Winston-Salem State University, and UNC Pembroke) serve over 50% of the minority students in UNC. The “focused growth institutions” program has begun to transform these universities. Enrollment increases of over 33% between 1999-2004 (ranging from 11.5% - 72.4) have been generated. Well over 50 new academic programs have (with nearly half of those being graduate programs), been added. Almost \$500M has been invested in new and renovated facilities. These institutions will need to continue to grow in size and quality (including improved graduation rates) to serve the economic and other needs of their regions and the state.

A Future of Opportunity

Indeed, all higher education institutions in North Carolina will need to grow in size, in quality, and in responsiveness. The initial gap analysis between the projected occupational openings and the degrees currently produced indicates considerable challenges. **This initial gap analysis in the interim report does not yet reflect some of the most recent national and state data.** For example, the North Carolina Employment Security Commission is currently completing the 2002-2012 forecasts for the regions of the state and many regions continue to update their economic development plans. These will be reflected in our final report. While there are other limitations to the gap analysis (it does not consider, for example, independent colleges nor does it examine in-migration or student intentions), it appears that there will be major shortages in some key areas. These shortages may become even more severe as the national and international marketplace for people with the needed skills and talents becomes even more competitive.

For occupations requiring a bachelors degree, the gaps are projected to be the greatest in **computer related fields, teacher education, and nursing.** The production of associate degree nurses by NCCCS may partially fill the nursing gap. All three are projected to have gaps in excess of 2,000 jobs annually, although the computer science projections will need to be reexamined in light of more recent data. All three currently depend on in-migration to fill available jobs. Over half the nursing licenses, for example, go to out-of-state nurses. Indeed, it is clear that North Carolina can not continue to be as dependent on in-migration in the future as the gaps widen even further.

In high demand occupations, there are also gaps in areas such as **accounting and social work**, although those gaps appear to be modest. Current trends do not show increasing numbers of alumni among UNC institutions in most of the high demand traditional occupations.

At the masters degree level, significant gaps exist for **clinical psychology, rehabilitation counseling, counselor education, audiology** and **speech language pathology**, and **social work**. These are significant because it appears that the masters degree will increase in importance in the knowledge economy. There are also likely gaps for both **medicine** (especially family medicine) and **veterinary science** and for doctorates for future faculty in fields such as: **health specialties; art, drama, and music; computer science; medical science** and; **biology**, although these all function in a national rather than a state marketplace. The national marketplace for faculty may experience faculty shortages as enrollments grow and many of the current faculty retire in the next few years.

There are also many substantial projected gaps in occupations requiring education at a NCCCS institution. The most severe (over 1,000 annually) are for **registered nurses** and **executive secretaries/administrative assistants**. Other occupations with gaps include: **computer programmers; emergency medical technicians; legal secretaries; medical and clinical lab technicians; aircraft mechanics** and **service technicians; surveying** and **mapping technicians** and; **medical transcriptionists**.

These gaps appear in traditional occupations. In two areas, **nursing** (and other health related fields, especially with an aging population) and **teaching**, North Carolina has recognized the impact on economic development: companies want good schools and health care for their employees. Two extensive studies have been recently completed to recommend responses to these severe shortages.

It is also likely that there will be gaps in supplying a workforce for the emerging industries, although those gaps are even harder to quantify as the jobs are not yet well-defined nor are the degrees needed or at least the curriculum within those degrees yet clear. What is clear, however, is that many of these emerging fields (such as biotechnology and nanotechnology) will require many more students with **math** and **science** skills, raising serious questions about the adequacy of the K-12 pipeline. There will also be increased need for **art** and **design** graduates who cannot only contribute to the quality of products, but also to the quality of life.

Both the traditional occupations and the emerging occupations present great opportunities for further collaboration between the two higher education systems and among institutions within regions. Future workers will have no choice but to engage in lifelong learning because they must be more nimble in responding to change either within their existing job or in new jobs. “Ladder” educational programs, where someone could literally move from a G.E.D. to Ph.D. with all the rungs in between over a lifetime, will increase in importance and e-learning will provide new tools to reach students.

In addition to preparing students of all ages for occupations, higher education also has to engage in research, including research that is directly applicable to developing new products or even new industries. North Carolina has earned a favorable national reputation in research, generating over \$1.016 billion in research awards in FY 2004 and having a top ten ranked public research university (UNC Chapel Hill). It also has had success in technology transfer (moving discoveries from the university into the private sector), ranking above national averages and many peer universities in measures such as licenses granted and start-up companies created.

Yet it also appears that higher education in its broadest definition has considerable potential to increase research and development sponsored by North Carolina businesses and industry (currently no more than 1% of total research expenditures). This increase, if accompanied by improved technology transfer processes, targeted state investment, and increased appreciation for the role of research and technology transfer from all higher education institutions in North Carolina, would likely fuel greater innovation, entrepreneurship, and expansion of business and industry in the state.

In Closing

This interim report focuses on the facts and on an analysis of those facts. These “facts” have to be taken within a careful context; predicting future needs for North Carolina’s new economy is both a science and an art. Many of the projected gaps are based on trend data, on industry assessments, and on current degree production. They may or may not prove to be correct. The same is true of regional forecasts. It would be a mistake to get caught up with any particular piece of data or to assume exact precision. Yet, taken together, the trend data and regional visioning do begin to paint a high level picture of North Carolina’s future challenges and opportunities. Ultimately, public policy makers and educational leaders will have to make informed decisions in the best interest of the state.

The interim report also includes preliminary findings. There are no recommendations at this stage. They will be the focus of the final report. While there are a large number of findings included in the interim report (and a number of related issues identified), the overall message is that North Carolina has an opportunity for “Staying a Step Ahead” and “Transforming North Carolina’s Economy” because of its higher education systems. The changing demographics and economy of the state, however, mean that the partnership among the state, its two higher education systems (and K-12), and its businesses and industries will need to be intentional in order to manage and shape those changes. The already existing gaps in the production of graduates for key fields and the projected gaps that could exist for emerging fields call for new approaches and collaborations from the higher education community. These will be among the recommendations in the final report called for by HB1264.

2. PROJECT BACKGROUND AND INITIATION

In the 2004 session of the North Carolina General Assembly, the Legislature initiated a major study of public higher education academic programs. HB1264 called for a joint review by the University of North Carolina (UNC) and the North Carolina Community College System (NCCCS) of the future economic development and workforce needs of North Carolina. Recommendations on academic programs and facilities that would be responsive to those needs were to be developed by a qualified consultant. The goal of the overall study was “to ensure that the State’s citizens are academically prepared and equipped for current job opportunities and jobs of the future in North Carolina’s growing knowledge economy.”

The Legislature specified that the study should include:

1. An analysis of the demographic, economic, and educational data regarding the needs for higher education programming in the State as a whole, as well as in all geographic regions of the State.
2. An updated enrollment projection for each system and each institution that includes adult, noncredit, career, and degree program enrollments.
3. An analysis of current program offerings and majors in undergraduate, graduate, non-degree, and workforce training programs offered by each institution.
4. Recommendations as to how the institutions might better serve current and emerging needs related to existing and new programs; enhanced effectiveness and quality that can be achieved via sharing of resources, and program partnerships and collaborations both within and between higher education systems; and opportunities for online program delivery and other distance technology delivery systems.
5. An analysis of and suggested updates to existing long-range capital plans of both the University and Community College System that will address land acquisition and facility needs to support the program recommendations identified in this study, taking into account opportunities for modernization of and new uses for existing facilities.
6. With regard to the University system, there shall be special emphasis on the development of signature programs for Historically Black Colleges and Universities and the University of North Carolina at Pembroke. [The study] shall take into account that the General Assembly finds the Historically Black Colleges and Universities and the University of North Carolina at Pembroke to be institutions with important historical traditions and equally important contemporary purposes and, as such, are valuable and indispensable assets of the University of North Carolina and the State. The General Assembly intends to encourage the continued growth and development of those constituent institutions and would resist any suggestion to eliminate the historical function and purpose of those institutions.

7. With regard to both the University and the Community College System, there shall be an acknowledgement of the existence and importance of a strong liberal arts education and, at the same time, an emphasis on existing and new programs specifically aimed at meeting business, industry, workforce, and career needs of North Carolina in the State's changing and growing knowledge-based economy, taking into account, as appropriate, State and regional economic strategies.

The legislation further specified that an Interim Report would be submitted to the General Assembly in April 2005, and a Final Report with appropriate recommendations would be submitted no later than December 31, 2005.

Based upon this enabling legislation, efforts were undertaken in the fall of 2004 by UNC and NCCCS to initiate the study by obtaining the services of a qualified Consulting Team to assist as specified under the legislation, and by developing an appropriate work plan for accomplishing the study's objectives. Following these preliminary organizing steps, the study was formally begun in early January 2005.

The first phase of this study has entailed an exhaustive gathering and review of relevant existing data. This review has included data from state workforce projections, regional and other economic planning reports, and educational requirements for expected future jobs. Data from UNC and NCCCS have focused on academic degree programs, workforce training programs, current and projected student enrollments, partnerships and collaborations in place between institutions and across the two systems, special educational and economic development initiatives, and the emerging role of distance learning. In addition, input was solicited from members of the business and economic development community in a variety of public forums, focus groups and interviews.

The result of these various inputs and data reviews is reflected within this Interim Report. This Interim Report establishes a baseline picture of the North Carolina workforce, the projected economic future of North Carolina as envisioned by a variety of planning documents and forecasts, and the current educational programs provided by the University of North Carolina and the North Carolina Community College System. Working from this baseline, initial estimates have been made of the gaps that exist in the State's academic offerings and/or graduation outcomes in order to meet North Carolina's future workforce requirements. The Interim Report includes data, analysis, and findings. From these elements, the next phase of this study will identify opportunities and develop recommendations for how the state, UNC and NCCCS could work together to align its academic and training offerings and their related services so as to ensure that the state's workers are prepared for the jobs that are projected to be available.

3. THE NORTH CAROLINA EMPLOYMENT ENVIRONMENT

Overview

In support of this study, data were collected from a variety of sources to determine the economic development and workforce needs of North Carolina. These include forty-one available studies on economic development and workforce needs in North Carolina, prepared both for the state as a whole and for individual regional economic development partnerships. Data and studies from the North Carolina Employment Security Commission (NCESC) were also analyzed, as were other existing national, state and regional workforce and data studies. A review of demographic data was done to focus on age, economics and educational attainment. These analyses are included in this section.

3.A. THE NORTH CAROLINA ECONOMIC DEVELOPMENT FORECAST

State and Regional Economic Development Strategies

Methodology

Forty-one regional economic planning documents prepared from 1996 to the present were reviewed. Several studies are currently in process and therefore could not be included in this review. They will be included in future documentation. A complete list of the studies is referenced in Attachment 5 of this report as Appendix 3.A.1.

Each study was reviewed for its recommendations for clusters to target and/or to grow in the future. In addition, where workforce skills were mentioned, these were noted. Then, for each region, the list of clusters was combined, resulting in a complete list of cited clusters for each of the seven economic development regions. These reports are referenced in Attachment 5 of this report as Appendices 3.A.2 to 3.A.8.

The last step of the analysis was to consolidate these seven lists into a single list. This was done by taking into account three criteria. First, the age of the report; reports written in the 1990s were discounted as no longer pertinent considering the major changes that have taken place in the North Carolina economy since 2000. Second, several authors have strong national reputations, so their reports were given additional weight. Finally, clusters that were cited the most frequently were given the most credibility.

FINDINGS

Table 3.A.1 on the following page lists all the clusters and industries cited by any regional report written after 2000. This includes the regional partnership vision plans for Advantage West, Research Triangle, Piedmont Triad and Northeast (executive summary) available as of May 1, 2005. All regional vision plans completed later this summer will be incorporated into the final report.

Clusters have been grouped into the following categories for the purposes of the skills analysis.

- Advanced Manufacturing
- Advanced Materials, including Chemicals, Plastics and Nanotechnology
- Biotechnology and Pharmacology
- Computing, Software and the Internet
- Design and Arts
- Logistics and Distribution.

Service industries, particularly those with traditional occupations or not requiring postsecondary education, were not included in this analysis of emerging occupations.

An analysis of the occupations related to these cluster groups is included in Section 3.B.

Table 3.A.1. Industries Targeted by Regional Economic Development Partnerships

	<i>Advantage West</i>	<i>Charlotte</i>	<i>Piedmont Triad</i>	<i>RTRP</i>	<i>Northeast</i>	<i>Eastern</i>	<i>Southeast</i>
Advanced Manufacturing							
Advanced Manufacturing		X	X		X	X	X
Analytical Instrumentation				X			
Electrical Equipment and Components Mfg	X	X	X	X			
Fabricated Metal	X						
Furniture			X		X		
Metalworking		X					
Non-woven Textiles		X	X				X
Optics	X						
Specialized Machinery and Aircraft		X					
Vehicle Parts Manufacturing (including Boat Builc	X	X	X	X	X	X	
Medical Equipment Manufacturing	X		X			X	
Advanced Medical Care							
Homeland Security	X			X			
Hospitals, Labs, Specialized Medical Services	X	X	X	X	X		
Medical Laboratory Services			X				
Arts: Design and Film	X		X				X
Biotechnology, Pharmaceuticals, including Agricultural Biotech							
Agribusiness	X					X	
Agricultural Biotechnology				X	X		
Biologicals Manufacturing			X				
Biomanufacturing		X	X				X
Biotechnology			X			X	
Food Processing/Packaged Foods	X		X			X	X
Pharmaceutical Manufacturing	X	X	X	X		X	X
Value-added Agriculture	X		X				
Computers, Software and Internet							
Computers and Electronics Products Mfg		X	X	X			
Internet-related Activity	X						
Software Development	X						X
Logistics and Distribution							
Logistics and Distribution		X	X	X		X	X
Wholesale Trade		X	X			X	
Materials							
Chemicals and Plastics		X	X	X		X	X
Materials			X				
Nanoscale Technologies				X			
Services							
Back Office Support/Call Centers	X		X				
Banking and Advertising			X				
Construction		X					
Engineering and Architectural Services		X					
Hospitality	X		X				
Tourism	X	X	X		X	X	X
Retirement Services	X	X					
Other							
Entrepreneurship	X	X					
Environmental Technologies	X						
Paper and Wood Products			X				
Printing and Publishing		X	X				X

This includes all sectors mentioned in Regional Strategic Planning Reports published after 2000. It includes the RTRP, Advantage West, Piedmont Triad and Northeast (executive summary only) vision plans, available as of May 1, 2005.

Occupational Forecasts 2000-2010³

Employment Security Commission Methodology

The Labor Market Information (LMI) Division of the North Carolina Employment Security Commission (NCESC) regularly prepares employment projections by industry and occupation reflecting employment growth and trends for North Carolina as a whole and for various geographical regions. The projections are based on an examination of five factors: demography; industry employment; occupational employment; labor force participation; and overall economic outlook. The LMI explicitly states that these projections are only an approximation of the true level of employment and do not take into account such factors as immigration, productivity changes, emergence of new occupations and relocation of employment opportunities.

LMI uses the same set of economic and social assumptions as adopted by the Bureau of Labor Statistics (BLS) at the national level for their biennial employment projections. Specifically, these assumptions are:

- Work patterns will not change significantly over the projection period;
- Broad social and educational trends will continue;
- There will be no major war;
- There will not be any significant change in the size of the Armed Forces; and
- Fluctuations in economic activity due to business cycles will continue to occur.

These assumptions, of course, have already been overtaken by world events, such as the Iraq War. It is beyond the scope of this project to refactor the NCESC forecasts. For these and other reasons, the employment forecasts are best used as trends, not specific targets.

Data collected by the Occupational Employment Statistics group of the Employment Security Commission are the primary source of employment information used in the preparation of the projections. Furthermore, the nomenclature of occupations has changed to correspond with the North American Industrial Classification System (NAICS) and may not correspond directly with the Federal Dictionary of Occupational Titles.

For each industry and each occupation, the analysts at LMI find the best tool to match the trends in the data for the years 1976-2001. This may be a simple shift-share analysis or a more sophisticated OLS model. In any case, the analysts chose a specific model for each industry and occupation to forecast to 2010.

³ The NCESC is currently completing the 2002-2012 forecasts. Although the statewide forecast is completed, the individual regional forecasts are not yet all completed. The new 2012 forecasts will be incorporated into this project when they are available.

Analysis of The Data

The NCESC data were subjected to several analyses. For the North Carolina statewide occupation data, the list of all occupations was sorted by percent change, and by educational levels. Referenced in Attachment 5 as Appendix 3.A.9 are the top 25 occupations sorted by annual percent change and referenced in Attachment 5 of this report as Appendix 3.A.10 are occupations sorted by educational requirements. The change in number of employees between 2000 and 2010 was calculated, and then the list of occupations was sorted based on this metric with educational levels taken into account (referenced in Attachment 5 of this report as Appendix 3.A.11). Only occupations with growth of greater than 500 positions are shown.

The second analysis was to develop projections for the seven economic development regions. This analysis was hampered by the fact that the data are only available for some Metropolitan Statistical Areas (MSAs) and Workforce Development Board regions (WDBs) (referenced in Attachment 5 of this report as Appendix 3.A.12). The MSAs do not cover the entire state. The workforce development boards encompass the entire state, but do not perfectly match the economic development regions. Therefore, a concordance table was created to match each county to its respective WDB region and economic development region. See Table 3.A.2.⁴ Since the relationship is not one-to-one and county-level data were not available, economic development partnership data were created using the best approximation as shown in the table. This is also illustrated in Figure 3.A.3 on the following page.

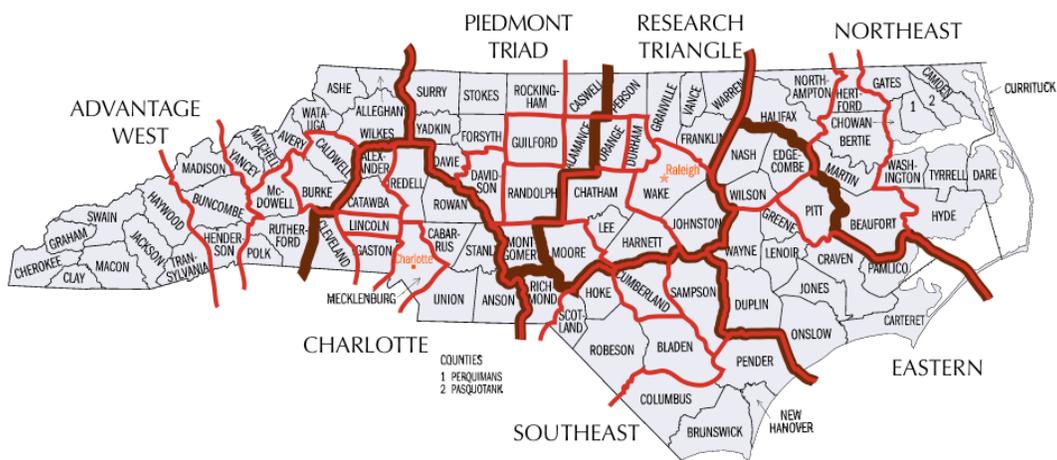
Table 3.A.2 Concordance of Workforce Development Boards and Economic Development Regions

Economic Development Region	WDB(s)
Advantage West	<ul style="list-style-type: none"> • Region A (Southwest) • Mountain Area • Region C • High Country • Western Piedmont
Charlotte	<ul style="list-style-type: none"> • Charlotte-Mecklenberg • Gaston • Centralina
Piedmont Triad	<ul style="list-style-type: none"> • NW Piedmont • Davidson • Guilford • Regional Partnership
Research Triangle	<ul style="list-style-type: none"> • Central Piedmont • Capital Area • Kerr-Tar • Mid-Carolina

⁴ A county by county concordance is included as Appendix 3.A.12.

Economic Development Region	WDB(s)
Northeast	<ul style="list-style-type: none"> • Region R (Northeast) • Region Q (Mid-East)
Eastern	<ul style="list-style-type: none"> • Region L • Eastern North Carolina
Southeast	<ul style="list-style-type: none"> • Cape Fear • Lumber River • PeeDee • Cumberland

Figure 3.A.3 Comparison of Regional Economic Development Regions and Workforce Board Regions



Comparison of Regional Economic Development Regions and Workforce Board Regions

For each economic development region, the projections were added together at the major occupational group level as follows:

- Architecture and Engineering
- Arts, Design, Entertainment, Sports, and Media
- Building and Grounds Cleaning and Maintenance
- Business and Financial Operations
- Community and Social Services
- Computer and Mathematical
- Construction and Extraction
- Education, Training, and Library
- Farming, Fishing, and Forestry
- Food Preparation and Serving Related
- Healthcare Practitioners and Technical
- Healthcare Support
- Installation, Maintenance, and Repair
- Legal
- Life, Physical, and Social Science
- Management
- Office and Administrative Support
- Personal Care and Service
- Production
- Protective Service
- Sales and Related
- Transportation and Material Moving

Referenced in Attachment 5 of this report, Appendix 3.A.13 shows the occupational forecasts for 2000-2010 for all of North Carolina for these major occupational groups. Appendices 3.A.14 to 3.A.20 show the occupational forecasts for 2000-2010 for these major occupational groups for each of the seven economic development regional partnerships.

PRELIMINARY FINDINGS

The NCESC occupational forecasts for 2000-2010 can be sorted by annual percentage change and absolute change for the period. The NCESC data were used to calculate the change between 2000 and 2010. This includes both replacement and new positions. The top ten occupations by annual percent change are shown in Table 3.A.4 on the following page.

Table 3.A.4 Top Ten Occupations by Annual Percent Change 2000-2010

Occupation	Annual Percent Change 2000-2010
Computer support specialists	6.71%
Network and computer systems administrators	6.32%
Computer software engineers	5.92%
Network systems and data analysts	5.31%
Computer software engineers, systems	5.11%
Desktop publishers	5.08%
Special education teachers	4.89%
Social and human service assistants	4.83%
Occupational therapists aides	4.62%
Library science teachers	4.52%

Similarly, the NCESC top ten occupations by absolute change are shown in Table 3.A.5:

Table 3.A.5 Top Ten Occupations by Absolute Change

Occupation	Absolute Change 2000-2010
Retail salespersons	26,770
Cashiers	22,850
Food preparation and serving workers	22,390
Registered nurses	21,840
Waiters and waitresses	20,430
Nursing aides, attendants and orderlies	16,240
Customer service representatives	15,410
Teacher assistants	14,760
Managers of retail sales workers	14,610
Computer support specialists	14,220

Growth by Occupational Category to 2010

According to these projections, total employment in North Carolina is projected to increase to 4.99 million by 2010, adding 778,000 more people to the workforce. This translates into an annual growth rate of 1.71% during the period. Employment growth is expected in all occupational groups except for Farming, Fishing, Forestry and Mining. The agricultural occupations are predicted to decline by -2.75% annually. A slight decline in employment is also expected in Manufacturing.

Over one million replacement jobs are projected to be created during this period. Replacement openings occur when workers change occupations, retire, die or leave the labor force for other reasons.

The most growth is likely to occur in services occupations, growing at an annual growth rate of 1.81%. The largest growth in employment is in the Office and Administrative Support Occupations, adding about 8,000 jobs per year. LMI notes that significant job growth is also expected for Food Preparation and Serving Related occupations, Personal Care and Service, Buildings and Ground Cleaning and Maintenance and Health Support. All of these positions require at least some short-term, on-the-job training and in many cases community college study at either the degree, diploma, or certificate level.

LMI notes that a steady transition from a low-skill labor force to professional and highly technical occupations is likely to continue during the period. Over 240,000 new jobs in professional and technical professions will be added in the ten years as well as another 135,500 replacement jobs. This translates to a growth rate of over 3.0%.

Within this category, the most growth is in Educational and Health Services, (13,610 annually) and in Computer and Mathematical Occupations (4,680), Community and Social Science Occupations (2,170), and Arts, Design, Entertainment and Sports (1,410 annually). Registered nurses are expected to grow at 2,180 new jobs annually, as are elementary school teachers (1,330) and teacher assistants (1,480).

The Management, Financial Operation occupation group is also projected to create 8,270 jobs annually through 2010, a growth rate of 1.44%.

Also notable is the projected growth in Construction, creating 5,490 new jobs annually and another 4,560 replacement jobs in this sector. The Transportation, Communication and Utilities occupations are also expected to generate 5,190 jobs annually. The Transportation and Material Moving occupations will add 12,900 new jobs annually, including growth and replacement.

Growth by Educational Requirements to 2010

When viewed from the perspective of the impact of these projections on the higher education community, the fastest growing sectors were extracted and sorted by educational requirements.

For those occupations requiring a professional degree, the largest growth will be seen in family and general practitioners (560 positions a year); veterinarians (500 growth and replacement positions a year); and clergy (210 positions a year, new and replacement).

For occupations requiring a doctorate, the fastest growing occupations are for post-secondary faculty in the following fields: health specialties (330 annually); art, drama and music (140); math (120); computer science (110); medical science (120); biology (100); and general post-secondary faculty (100).

Occupations requiring masters degrees that are fast growing in North Carolina are: management analysts (430 annually); educational and vocational counselors (320); clinical psychologists (270); rehabilitation counselors (260); speech-language pathologists (180); medical and public health social workers (140), librarians (180); medical and substance abuse social workers (120); graduate teaching assistants (140) and nursing faculty (110).

Numerous management occupations will require a BA plus some work experience. The general management category is projected to grow at 2,670 jobs annually, including both new and replacement opportunities.

Occupations requiring a BA are numerous. A total of 4,830 positions annually are projected to be required in the computer field, spanning six different occupations. This number may be high since the projections were made during the technology “boom” that ended in 2000. However, even if the projection is off by 50%, this is still a significant number.

Another major category of positions requiring a BA are pre-school through high school teachers, totaling 5,470 positions. This category includes special education and vocational teachers.

Other positions requiring a BA are varied: auditors and accountants (690 annually); business operation specialists (790); child, family and social workers (390); construction managers (440); financial analysts (280) and loan officers (350); pharmacists (350); chemists (240); and electrical engineers (140).

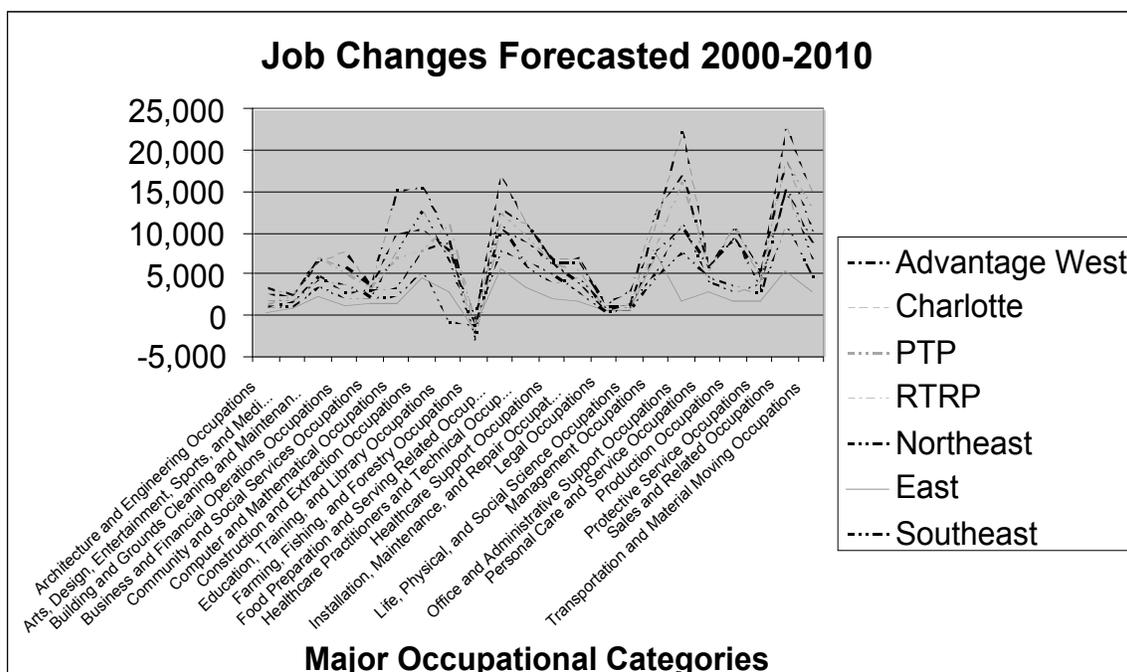
Associates degrees are also in large demand, leading with registered nurses at 3,460 new positions a year. Other significant projections are health related: medical records technicians (310 annually); dental hygienists (220); life, social or physical science technicians (320 annually); respiratory technicians (170) and medical and clinical laboratory technicians (200) and other health practitioners (160). Paralegals (220) and electrical engineering technicians (220) are also in demand.

In the future, most occupations will require lifelong education and training to keep up with rapidly changing job skill requirements. Almost one-half of community college headcount enrollment is comprised of students taking low-cost, non-credit occupational continuing education courses.

Growth by Region to 2010

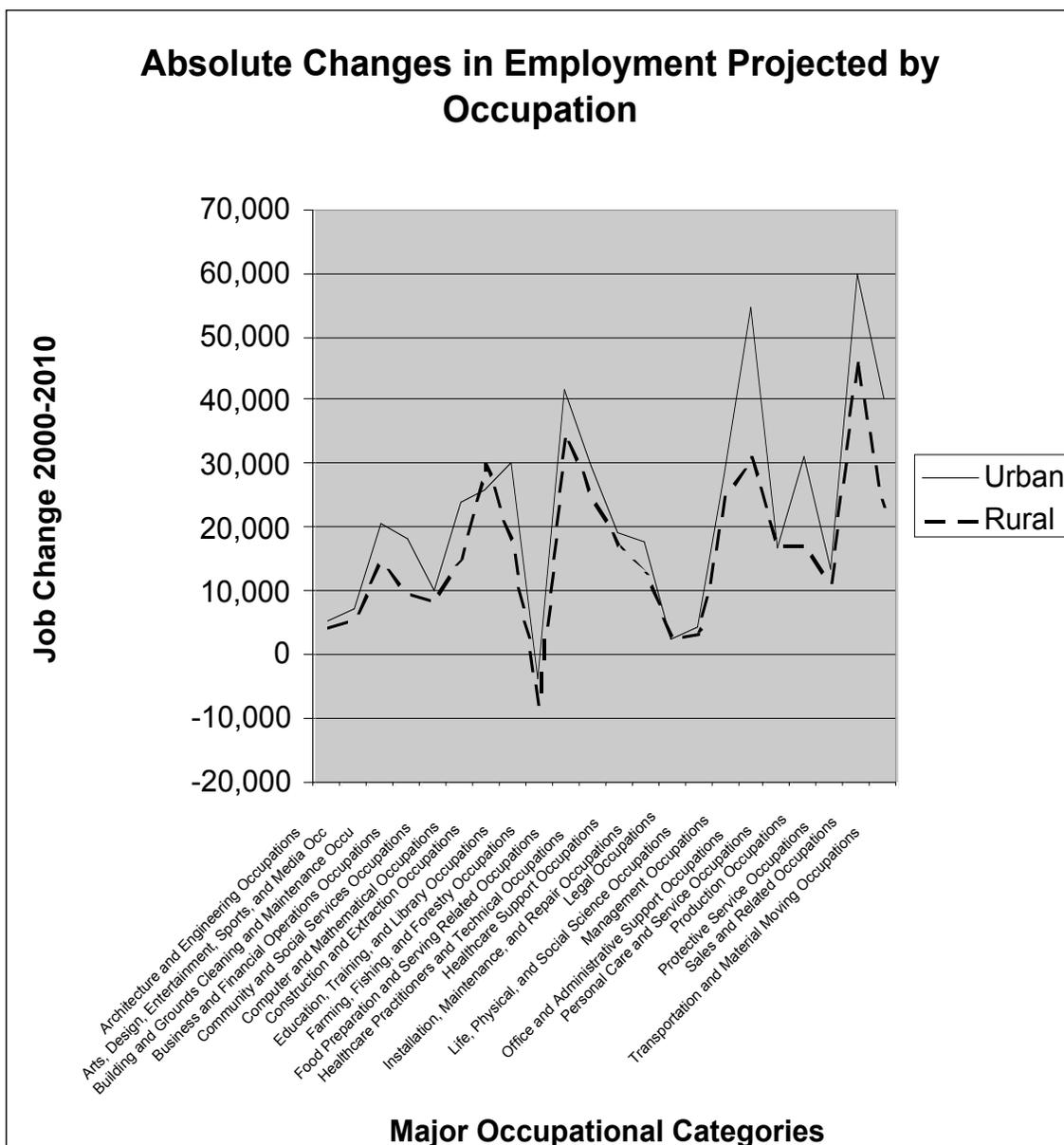
The growth of the various occupations is remarkably similar, especially given the diversity of the seven regional economies. As Figure 3.A.6 demonstrates, the percent change in each occupational grouping is very similar for each region. Figure 3.A.7 on the following page illustrates the differences between the rural and urban regions for the absolute number of jobs projected to be added or replaced. Since the “urban regions” also contain significant rural counties, this distinction may not be particularly meaningful in the final analysis.

Figure 3.A.6 Percent Job Changes by Major Occupational Grouping by Economic Development Regions



Source: RTI calculations based on aggregation of NCESC data

Figure 3.A.7 Absolute Job Changes 2000-2010 by Major Occupational Grouping by Urban/Rural



Source: RTI calculations based on aggregation of NCESC data

These findings, however, do not take into account any changes in the industrial make-up of the regions that may result from policy and/or practice changes in economic development. Therefore, the regional economic development analysis has been combined with the occupational analysis in order to understand potential changes in occupational trajectories that would affect the higher education community.

3.B. JOB PROJECTIONS AND EDUCATIONAL/SKILLS REQUIREMENTS

In this section of the report, the targeted industries gleaned from the regional economic development partnership strategic plans are linked with the occupational forecasts made by the North Carolina Employment Security Commission. Occupations are identified that may have faster growth rates than forecasted by ESC by virtue of the additional strategic initiatives being undertaken at the regional level. Results for all the target industries are summarized in Attachment 5 of this report as Appendix 3.B.1. Referenced in Attachment 5 of this report, Appendices 3.B.2 and 3.B.3 sort the occupations in the targeted industries by rate of growth.

In addition, a number of cross-cutting skills are identified that are required for many, if not all, occupations in the new economy. These cross-cutting skills have been identified through employer interviews and/or surveys done for the regions, for the state or for national associations or policy audiences.

There are several challenges associated with this analysis. The first is that the list of industries targeted by the regions is not parallel. Some are single SIC code industries; others, such as the clusters identified by the Research Triangle Regional Partnership, are groups of companies with strong interdependencies, but not within a single SIC code or even group of SIC codes. Finally, a number of targets are not industries at all, but rather technologies (such as biotechnology or nanotechnology) or skill areas (such as art/design). Therefore, targets have been matched as best as possible to standard industry descriptions such as those included in the Bureau of Labor Statistics (BLS), Career Guide to Industries.⁵

The targeted industries identified by some or all of the regional economic development partnerships in the State include:

- Advanced Manufacturing
- Advanced Materials, including Chemicals, Plastics and Nanotechnology
- Biotechnology and Pharmacology
- Computing, Software and the Internet
- Design and Arts
- Logistics and Distribution.

Based on the analysis, the top ten occupations for the targeted industries are different than for the state overall. Table 3.B.1 compares the top ten occupations by annual percent change.

⁵ <http://www.bls.gov/oco/cg/home.htm>

Table 3.B.1 Top Ten Occupations by Annual Percent Change 2000-2010

General Occupation	Annual Percent Change 2000-2010	Target Industry Occupations	Annual Percent Change 2000-2010
Computer support specialists	6.71%	Computer support specialist	6.71%
Network and computer systems administrators	6.32%	Computer software engineers	5.51%
Computer software engineers	5.92%	Network systems and data analyst	5.31%
Network systems and data analysts	5.31%	Database administrator	4.46%
Computer software engineers, systems	5.11%	Art director	3.40%
Desktop publishers	5.08%	Fine artist	3.31%
Special education teachers	4.89%	Graphic designer	3.25%
Social and human service assistants	4.83%	Multimedia artists and animators	3.04%
Occupational therapist aides	4.62%	Commercial and industrial designer	2.68%
Library science teachers	4.52%	Biomedical engineers	2.46%

Similarly, Table 3.B.2 compares the NCESC top ten occupations by absolute change with those identified through the targeted industry clusters.

Table 3.B.2 Top Ten Occupations by Absolute Change

Occupation	Absolute Change 2000-2010	Target Industry Occupations	Absolute Change 2000-2010
Retail salespersons	26,770	Computer support specialist	14,220
Cashiers	22,850	Computer software engineer	13,110
Food preparation and serving workers	22,390	Truck drivers	11,480
Registered nurses	21,840	Network systems and data communications analyst	2,920
Waiters and waitresses	20,430	Packaging and filling operators	1,940
Nursing aides, attendants and orderlies	16,240	Science technicians, biology	1,930
Customer service representatives	15,410	Assemblers	1,730
Teacher assistants	14,760	Database administrators	1,520
Managers of retail sales workers	14,610	Graphic designers	1,410
Computer support specialists	14,220	Science technicians, all sciences	1,270

In addition, engineers, researchers and technicians are in high demand in several sectors including chemicals and plastics, nanotechnology and computer science. The forecasts are extrapolations of employment in the 1967-2000 period and, therefore, may artificially inflate computer-related occupations. On the other hand, while these computer-related occupations did drop in North Carolina, the losses have been much less severe than in other states and have leveled off where other states are still incurring losses. As occupational forecasts do not take into account initiatives that may be underway in the regions to support these targeted industries, the numbers may, in fact, be significantly low.

Methodology

The objective of this section is to list the occupations associated with the targeted industries identified by the regional economic development partnerships. We first used the Bureau of Labor Statistics Occupational Outlook Handbook⁶ data to identify the occupations that corresponded to the targeted industries. The educational and skills requirements for each of these occupations were then listed. Where possible, the percentage of employment in each occupational category was next shown. The focus was on professional, technical and production positions and did not take into account managerial and office management occupations.

We then matched the occupations with the occupational forecasts completed for 2000-2010 by the North Carolina Employment Security Commission (NCESC). Again, the availability of needed data proved to be a challenge. Data were available for the entire state for each occupation, but only at the major occupational grouping level for the seven economic development regions. Therefore, in some cases where there was a good match between the target area and a major occupational grouping, the NCESC forecasts proved useful on a regional basis. This is true for design and arts, as well as computer and mathematical occupations. For the targets that incorporate some production components, however, it was not possible to sort out which production occupations supported which manufacturing industry.

The last step was to identify the educational and skills requirements for the various occupations. Multiple resources were used for this analysis, including the Bureau of Labor Statistics, Occupational Outlook Handbook,⁷ industry association reports, other secondary data, and original research. Members of the analyst team also utilized their direct experience with some of the targeted industries to make the analysis more complete.^{8,9,10}

⁶ <http://www.bls.gov/oco/home.htm>

⁷ <http://www.bls.gov/oco/home.htm>

⁸ The Teaching Firm: where productive work and learning intersect. A 7-firm empirical study of learning and skill needs in high performing work organizations competing globally in the manufacturing sector, including Boeing, Motorola, Siemens, and a number of SME firms throughout the U.S. Published by EDC Inc. Monika Aring and Betsy Brand, Co-Directors, 1998 (Funded by the USDOL, Pew Charitable Trust, states of NC, MA, WA, CT, FL, IL.)

Advanced manufacturing is defined as sectors where the product being manufactured has a substantial technology base and/or the production processes being employed utilize technology to increase productivity. The targeted industries consistently identified by the seven regional economic development partnerships are:

- Advanced Manufacturing
- Advanced Materials, including Chemicals, Plastics and Nanotechnology
- Biotechnology and Pharmacology
- Computing, Software and the Internet
- Design and Arts
- Logistics and Distribution.

Each target is analyzed using the process described above. The analysis concludes by discussing cross-cutting skills mentioned by most reports and workforce analyses as applying to all sectors and all types of occupations.

3.B1. ADVANCED MANUFACTURING

Although employment in North Carolina’s manufacturing sector declined from 30% to 17% of the workforce over the past ten years, advanced manufacturing, particularly in niche areas, has been targeted for development. The Department of Commerce’s strategic plan calls for such an emphasis by:

“Keeping North Carolina competitive for high-value, technologically competitive industries and companies by actively recruiting and encouraging the expansion in North Carolina of high-value, technologically competitive industries and companies. Targeted companies will include those in industries traditionally considered ‘high tech,’ such as telecommunications and biotechnology, and companies that apply new and innovative technology to remain competitive in traditional industries, such as textiles and furniture.”¹¹

All of the regions identify industry targets that can be classified as advanced manufacturing. Examples of advanced manufacturing technologies are:

- Reconfigurable tools and systems
- Advanced sensors
- Micro-fabrication
- Modeling, simulation and visualization
- Smart systems
- Designer materials.¹²

⁹ National Skill Standards for Entry into the Biotech industry. EDC, Inc. 1995. (Funded by the USDOL and USDOE). Monika Aring, Principal Investigator. Judy Leff Project Director.

¹⁰ National Skill Standards for the Chemical Process Industry. National Chemical Society. Monika Aring, Advisor.

¹¹ <http://www.nccommerce.com/categories/aboutus.htm>, accessed March 28, 2005.

¹² National Coalition for Advanced Manufacturing (NACFAM). 2003. Industrial Transformation: Key to Sustaining the Productivity Boom.” Washington, D.C.

The industry targets identified by region include: vehicle parts (Advantage West, Charlotte, Piedmont Triad, RTRP, and Eastern); electrical equipment and components (Advantage West, Charlotte, Piedmont Triad and RTRP); generic advanced manufacturing (Advantage West, Charlotte, Northeast, Eastern and Southeast); boat building (Northeast and Eastern); metalworking (Charlotte and Piedmont Triad); analytical instruments (RTRP); non-woven textiles (Charlotte and Piedmont Triad) and; optics (Advantage West).

Although the fastest growing job categories in the U.S. will be in low-skills, low-wage employment (mostly in the retail and services sectors), baby-boom retirements and new technologies in the manufacturing sector over the next decade will open up millions of jobs in the advanced, high performance manufacturing sector for workers with the right skills.¹³

Further, North Carolina's competitiveness in advanced manufacturing will require addressing significant skills gaps.

Occupations

Since advanced manufacturing is too broad a category to correlate with Bureau of Labor Statistics industry headings, vehicle parts manufacturing has been used as an example because it is one advanced manufacturing sector being pursued by five of the seven regions.

According to the Bureau of Labor Statistics, roughly 8% of employment in vehicle parts manufacturing is in technical fields such as commercial and industrial designers, mechanical, electrical and industrial engineers, engineering technicians and computer programmers and analysts. Another 70% of the employment is in production and material moving occupations including: assemblers and fabricators; welding, soldering and brazing occupations; machinists; tool and die makers; computer-controlled machine operators; inspectors, testers, sorters, samplers and weighers; and truck drivers. Six percent of the positions are in installation, maintenance and repair with occupations such as electricians, millwrights and industrial machine mechanics.

Employment Forecast

A look at the NCEC forecast for 2000-2010 demonstrates the impact of advanced manufacturing in North Carolina. This forecast does not distinguish between production occupations in manufacturing and advanced manufacturing. These forecasts overlap substantially with production forecasts for other target industries which also have substantial manufacturing components such as chemicals

¹³ National Coalition for Advanced Manufacturing (NACFAM).2003. "The Case for Enhancing American Workforce Skills." Washington, DC.

and plastics, biomanufacturing and nanotechnology. Nevertheless, it is useful to see how the production occupations are expected to fare in the various regions. These forecasts are shown in Table 3.B.3 below.

One puzzle is that the sum of the forecasted changes in the seven regions far exceeds the overall employment reported for North Carolina as a whole. For example, in a time when manufacturing employment trends are down for the state as a whole, manufacturing is forecasted to grow in most of the regions. We believe that this is an artifact of the NCESC methodology used to construct these data as each WDB region is forecasted separately, occupation by occupation, using a trend analysis based on 1976-2000 data.

Table 3.B.3
North Carolina Occupation Trends 2000-2010
Employment in Production Occupations

Region	2000 Employment	2010 Employment	Change	% of total 2000	% of total 2010	% Annualized Change
North Carolina	537,730	528,370	-9,360	12.77%	10.59%	-0.18%
Advantage West	116,810	126,160	9,350	18.61%	16.84%	0.77%
Charlotte	107,680	116,970	9,290	12.00%	10.82%	0.83%
Eastern	41,230	42,790	1,560	10.66%	9.79%	0.37%
Northeast	34,980	37,670	2,690	6.57%	5.82%	0.74%
Piedmont Triad	129,720	140,520	10,800	15.34%	14.03%	0.80%
RTRP	73,560	84,030	10,470	9.26%	8.61%	1.34%
Southeast	50,190	53,740	3,550	11.65%	10.59%	0.69%

Source: NC Employment Security Commission

Since almost all of the regions identify vehicle parts manufacturing, the NCESC forecasts are broken down for some of the occupations that support this industry in Table 3.B.4 on the next page.

Table 3.B.4.

North Carolina Occupation Trends 2000-2010

Employment in Vehicle Parts Manufacturing Related Occupations

	2000 Employment	2010 Employment	Change	% Annualized Change
Commercial and Industrial Designer	660	860	200	2.68%
Mechanical Engineer	4,830	5,460	830	1.23%
Electrical Engineer	4,230	4,730	1,330	1.12%
Industrial Engineer	4,870	4,690	-180	-0.38%
Computer Programmer	14,810	15,390	580	0.38%
Assembly and Fabricators	12,550	14,280	1,730	1.3%
Welding, Soldering and Brazing	11,380	13,890	2,510	2.01%
Machinists	11,690	12,670	980	0.81%
Tool and Die Makers	2,480	2,590	110	0.43%
CNC Operators	5,170	6,150	980	1.75%
Inspectors, Testers, etc.	27,120	22,100	-5,020	-2.03%
Truck Drivers	58,220	69,700	11,480	1.82%
Electricians	3,300	3,520	220	0.65%
Millwrights	2,400	2,650	250	1.00%
Industrial Machine Mechanics	12,780	11,080	-1,700	-1.42%

*Source: NC Employment Security Commission***Educational and Skills Requirements**

The technical fields generally require a four-year degree with a specialty in engineering. Advanced degrees are required for R&D positions. The technician positions require a 2-year associates degree in engineering technology with a solid grounding in science and math. The production, material moving and installation, repair and maintenance positions require a high school diploma and either vocational or community college training leading to an apprenticeship.

Skills Gaps: Skills Gap 2001,¹⁴ a study by the National Association of Manufacturers, Center for Workforce Success, found persistent skills gaps in the manufacturing workforce. Among the specific findings:

- 26% of manufacturers report that workers lack basic math skills;
- More than 30% report that workers are deficient in basic comprehension and writing skills; and
- 59% say employees lack work readiness skills such as arriving on time and staying at work all day.

¹⁴ Reported in NACFAM, 2003. "The Case for Enhancing American Workforce Skills." pages 12-13.

3.B2. ADVANCED MATERIALS: CHEMICAL AND PLASTICS

Five of the seven regions identified chemicals and/or plastics as a target industry; the cluster already has a significant presence in the state. Feser and Renski¹⁵ identified chemicals and plastics as an emerging general industry cluster with a location quotient of 1.04 and a growth rate of 3.9% from 1989-1998. This growth rate exceeds the national growth rate for the cluster. According to Feser and Renski, the cluster is very strong in Charlotte, the Northeast, Triad, Southeast and Advantage West regions.

A study for the Triad conducted in 2002¹⁶ details the strengths of the cluster in the Triad to service the textile and furniture industries (e.g., wood coatings).

Chemicals and plastics constitute advanced manufacturing industry. However, since the field is process-oriented, and requires a higher percentage of engineers than the average manufacturing industry (13% compared to 8%), it is treated separately. Many classify biotechnology and pharmaceuticals as a subset of the chemical industry as well.

Occupations

In these industries, about one-half of all employees work in production, 9% in transportation and material moving, 22% in managerial positions and office support and another 13% are professionals such as computer programmers, engineers and technicians.

Production positions in chemicals and plastics are diverse, but generally fall into one of several categories. Chemical plant and system operators monitor the production process. Industrial machinery installation, repair, and maintenance workers repair equipment, install machines, or practice preventive maintenance in the plant. Inspectors, testers, sorters, samplers, and weighers assure that the production process runs efficiently and that products meet quality standards. Packaging and filling machine operators and tenders wrap products and fill boxes to prepare the final product for shipment or sale to the wholesaler or consumer. Transportation and material-moving workers move materials around the plant using industrial trucks or deliver finished products to customers by truck. Most workers in research and development have at least a college degree and many have advanced degrees. These positions include chemists and material scientists, chemical engineers, engineering and science technicians.

¹⁵ Feser, Edward and Renski, Henry. 2000. High-Tech Clusters in North Carolina. North Carolina Board of Science and Technology.

¹⁶ MIT Sloan School of Business. 2002. "Industry Cluster Analysis for Forward Greensboro Economic Development Partnership."

Employment Forecast

Total employment forecasts for this sector are included in the overall production forecast shown previously under Advanced Manufacturing. Forecasts for employment in selected occupations are shown in Table 3.B.5 below. These occupational forecasts are for all industries, not just chemicals and plastics.

Table 3.B.5.

North Carolina Occupation Trends 2000-2010

Employment in Selected Advanced Materials-Related Occupations

	2000 Employment	2010 Employment	Change	% Annualized Change
Chemical plant and system operators	2,030	2,320	290	1.34
Industrial machinery install, repair and maintenance	12,780	11,080	-1,700	-1.42
Inspectors, testers, sorters, etc.	27,120	22,100	-5,020	-2.03
Packaging and filling operators	17,400	19,340	1,940	1.06
Chemical engineers	1,040	1,130	90	0.83
Material scientists	690	680	-10	-0.15
Chemists	4,370	5,390	1,020	2.12
Science technicians	5,050	6,320	1,270	2.27
Chemical technicians	2,820	3,050	230	0.79

Source: NC Employment Security Commission

Educational and Skills Requirements

The trend in this and other major manufacturing industries is toward increased automation. As a result, workers need a combination of math, reading and documentation skills, as well as mechanical aptitude. Many production workers now interact with computers and robots that drive the production machines, so workers must be able to analyze data presented on computer screens and to deal with breakdowns in the production machines. They need to troubleshoot problems, utilizing analytical and quick problem-solving skills. Since machinery is becoming more complex, largely driven by computer-controlled processes, good communication skills and interpersonal abilities are increasingly required as workers are organized in teams to support certain production operations. The SPI Certification is a *de facto* standard, and the technical curriculum taught in high school tech prep courses and leading to an associates degree provides the most opportunity for advancement.

The general skills required in the production occupations are:

- Operation and control of equipment or systems
- Monitoring equipment
- Quality analysis – conducting tests and inspections
- Reading comprehension
- Equipment maintenance
- Mathematics
- Troubleshooting
- Equipment selection

As might be expected, the managerial ranks in plastics and chemicals require a four-year degree with expertise in business and specialties such as marketing and accounting. The professional staff require a B.S. as well with some masters programs, especially in chemical engineering. Engineers in the field are expected to have skills in material science, mechanical design and manufacturing processes. In addition, newly minted chemists and chemical engineers are expected to have an emphasis on process chemistry, especially polymers because more than 90% of available positions involve the manufacturing, processing or use of polymer additives. In addition, basic courses in business, marketing and finance are suggested.¹⁷ Engineers and chemists with responsibility for research and development more often will have advanced degrees.

Technicians are required to have a 2-year applied science degree or a B.S. The trend is for technicians to be part of interdisciplinary teams with more responsibility for administration, troubleshooting, implementation and presentation of projects. Therefore, in addition to the traditional technical preparation, technicians should also have coursework in planning, designing and conducting experiments, problem-solving, communications skills, as well as technical skills in polymers and material science.¹⁸

3.B3. ADVANCED MATERIALS: NANOTECHNOLOGY

Nanotechnology is not an industry. Rather, nanotechnology refers to a set of platform technologies that involve the assembly or manipulation of objects at a very small scale — micro (millionth) or nano (billionth) meters. These objects can create or use structures, devices or systems that have novel properties and functions because of their size. Figure 3.B.6. shows the wide variety of industries that may be impacted by these emerging nanotechnologies.

¹⁷ Salek, Jeffrey. “How to Prepare for a Career in Industry.” Chemical and Engineering News. <http://pubs.acs.org/cen/125th/pdf/7913salek.txt.pdf>. Accessed March 18, 2005.

¹⁸ Wesemann, Jodi. 2004. “The Role of Chemical Technicians in the Chemical Industry and ACS: Celebrating Contributions and Identifying Opportunities. www.chemistry.org, accessed March 18, 2005.

A trillion dollar global multi-industry market is predicted to emerge in the next ten years. The evidence is already extant. The National Science Foundation and other federal agencies have been funding substantial R&D over the past five years. The NSF estimates that federal funding has risen from \$464 million in 2001 to \$1240 million in 2005, with a 2006 budget request just for the National Nanotechnology Initiative at \$1052 million. In 2003, it is estimated that over \$1.2 billion of venture capital was invested in the technologies.¹⁹

Nanotechnologies are emerging into products at a rate faster than biotechnology products did, given the amount of R&D and patents.²⁰ Nanoscale technologies are already being used in electronic, magnetic and optoelectronic, biomedical, pharmaceutical, cosmetic, energy and material applications.

Figure 3.B.6. Nanotechnology's Impact on Traditional Industries

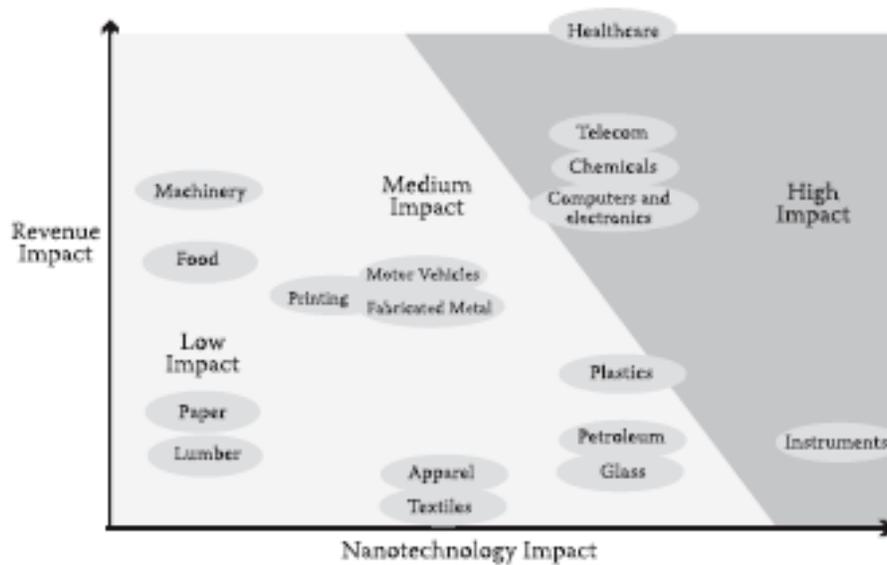


Figure 5.1: Nanotechnology's Probable Business Impact in 2007

Source: Larta, 2003

At present only the Research Triangle Regional Partnership has identified nanoscale technologies as a cluster of interest; pharmaceutical and biotechnology applications appear to be the most promising for the region. However, Figure 3.B.6. suggests that other industries in the state such as apparel, textiles, motor vehicles, chemicals, plastics, computers and electronics and instruments may also be affected by these emerging technologies.

¹⁹ California Council on Science and Technology. 2004. "Nanoscience and Nanotechnology: Opportunities and Challenges in California: A briefing prepared for California Legislative Joint Committee on Preparing California for the 21st Century.

²⁰ Zucker, Lynne and Darby, Michael. 2005. "Socio-economic Impact of Nanoscale Science: Initial Results and Nanobank. Waltham, MA: National Bureau of Economic Research. Working Paper No. 11180. www.nber.org.

NSF further estimates that 2 million workers will be needed to support nanotechnology worldwide within the next fifteen years. Currently it is estimated that 20,000 are employed in nanotechnology related occupations.²¹

Nanotechnology will affect a wide variety of occupations, especially engineers, researchers and technicians in those industries. According to Mihail Roco of NSF, “A grand challenge for nanotechnology is education, which is looming as a bottleneck for the development of the field, and particularly for its implementation. . . . In 10-15 years we may have the research results for the new technology without having the workers to take advantage of them.”²² Roco further identifies the challenge of attracting students to science and engineering careers and then making available the specific training needed to have the skills to deal with the application of nanotechnologies to existing industries.

Employment Forecast

The Bureau of Labor Statistics and the NCESC do not have any occupations specifically related to the advent of nanotechnology. The occupations of engineers and technicians will not change in their definition, but the education required to perform these jobs in the future will certainly require experience at the micro and nano scale.

Table 3.B.7. on the next page arrays the employment forecast for scientists and engineers. This table may overstate the potential for nanotechnology, as some occupations such as architectural engineers are included that will, in all likelihood, not be affected by this technology. On the other hand, the table omits biotechnology engineers and technicians. Simply put, this table provides an indication of the possible order of magnitude of the impact of nanotechnology in the state and on the regions.

²¹ Roco, M.C. and Bainbridge, W. (eds.) 2001. “Societal Implications of Nanoscience and Nanotechnology.” Arlington, VA: National Science Foundation.

²² Roco, M.C. 2003. “Converging Science and Technology at the Nanoscale: Opportunities for Education and Training.” *Nature Biotechnology*, 21 (10).

Table 3.B.7.

North Carolina Occupation Trends 2000-2010

Employment in Life, Physical and Social Science Occupations Plus Architectural and other Engineers

Region	2000 Employment	2010 Employment	Change	% of total 2000	% of total 2010	% Annualized Change
North Carolina	100,920	117,620	16,710	2.40%	2.36%	1.54%
Advantage West	11,360	13,390	2030	1.81%	1.79%	1.66%
Charlotte	20,370	24,240	3,870	2.27%	2.24%	1.75%
Eastern	7,630	8,430	800	1.97%	1.93%	1.00%
Northeast	16,880	20,010	3130	3.17%	3.09%	1.72%
Piedmont Triad	15,390	18,220	2830	1.82%	1.82%	1.70%
RTRP	29,830	36,030	6200	3.76%	3.69%	1.91%
Southeast	9,220	10,880	1660	2.14%	2.14%	1.67%

Source: NC Employment Security Commission

This table shows that roughly 2.4% of all North Carolina occupations fit into this field, and are potentially growing between 1.00% and 1.91% a year. This trend is not as significant as some other targeted industries, but as these are typically very high wage, high-value jobs, and carry economic development multipliers of 2-5 times, the impact of this growth to the state could be rather significant. As expertise in nanotechnology may become a prerequisite for many scientists and engineers that support a wide variety of industries, nano expertise among the North Carolina science and engineering workforce may soon become a competitive advantage issue for the state.

Educational and Skills Requirements

Almost all of the occupations which will be affected by nanotechnology will require a BS in engineering with a broad, interdisciplinary and multi-disciplinary approach. Nanotechnology will require an understanding not only of electrical, mechanical and civil engineering, but biology, physics and chemistry as well. This is a challenge for current science and engineering educational offerings since they have been historically segregated by discipline.

Nanotechnicians will require 2-year degrees with a multi-disciplinary approach to science and engineering. Fonash²³ states the need for a revamping of traditional science and engineering curricula to emphasize the broad and integrative nature of the

²³ Fonash, Stephen. 2001. "Education and Training of Nanotechnology Workforce." Journal of Nanoparticle Research. 3:79-82.

field. A recent California study further suggests the importance of technician training that: (1) includes various applications; (2) is hands-on; and (3) does not trap a worker in any one industry.²⁴

NSF is funding many experimental programs to develop new curricula for nanotechnology at universities around the country. China, Korea and the UK are developing similar experimental programs. Pennsylvania, Texas, Virginia, California, and New York have already made significant investments in this area.

3.B4. BIOTECHNOLOGY AND PHARMACEUTICALS

Biotechnology *per se* is not an industry. Rather, biotechnology is a collection of technologies. All of the seven regions identify biotechnology and pharmaceuticals as target industries for the future. This is a broad category that includes agribusiness and agricultural biotechnology (Advantage West, RTRP, Northeast, Eastern); pharmaceuticals (Advantage West, Charlotte, Piedmont Triad, RTRP, Southeast and Eastern); biological agents and infectious diseases (RTRP); biomanufacturing (Charlotte, Piedmont Triad and Southeast); and food processing (Advantage West, Piedmont Triad, Southeast and Eastern).

The state of North Carolina is recognized worldwide as a leader in biotechnology and pharmaceuticals. The Milken Institute reports that North Carolina employs over 25,000 in the biopharmaceutical industry, and another 100,000 in related positions²⁵. The Institute characterized North Carolina as one of the five top research clusters in biotechnology, along with San Francisco, San Diego, New York, and Boston. Milken's ten-year projection for biopharma in North Carolina exceeds 7,200 new positions. Further, Milken notes that 61.5% of current (2003) economic activity generated by biopharma in North Carolina occurred in manufacturing. The rest of the employment in the industry is in research and development.

In 2002, the Emerging Issues Forum reported that North Carolina is among the top 5 places for biotechnology, second only to California in agricultural biotechnology, fourth in pharmaceuticals and the national leader in clinical research organizations.²⁶

The 2003 North Carolina Biotechnology Center highlights the overlap between biotechnology, pharmaceutical and biomanufacturing, noting that as biotechnology companies mature, they become defined by the type of products they manufacture (e.g. agricultural, pharmaceutical or chemical). Therefore, the type of workforce

²⁴ California Council on Science and Technology.

²⁵ Milken Institute, 2004. *Biopharmaceutical Industry Contributions to State and US Economies*.

²⁶ Institute for Emerging Issues. 2004. *Program Report: Biotechnology and Humanity at the Crossroads of a New Era*. http://www.ncsu.edu/iei/pastforums2002/2002_iei_forum_report.pdf. Accessed March 21, 2005.

skills required by biotechnology, pharmaceutical and biomanufacturing companies are emerging as are the skills required by other, related industries.²⁷

Occupations

According to the Bureau of Labor Statistics, 28% of the positions in the pharmaceutical and biomanufacturing fields are in professional and related occupations.²⁸ The five major categories arrayed below, include a variety of biological and medical scientists, physical scientists (especially chemists), science technicians, engineers (who are primarily involved with quality and process control), and biotech entrepreneurs.

- 1) Life scientists
 - a) *Biological scientists e.g., biologists, biochemists, pharmacologists*
 - b) *Medical scientists*
- 2) Physical scientists
 - a) *Chemists, e.g., physical chemists, organic chemists*
- 3) Science technicians
 - a) *Biological technicians*
 - b) *Chemical technicians*
- 4) Engineers
 - a) *Chemical engineers*
 - b) *Bioprocess engineers*
 - c) *Industrial engineers*
- 5) Biotech Entrepreneurs

Production occupations are similar to other manufacturing, especially chemical manufacturing, and include assemblers and fabricators; machine setters, operators and tenders; inspectors, testers, sorters, samplers and weighers; and material movers.

²⁷ North Carolina Biotechnology Center (March 2003). *Window on the Workplace 2003. A Training Needs Assessment for the Biomanufacturing Workforce*. Accessed on March 1, 2005 from <http://www.ncbiotech.org/ouractivities/spproj/workplace03.cfm>

²⁸ <http://www.bls.gov/oco/cg/cgs009.htm>, accessed March 21, 2005.

Employment Forecast

The North Carolina Biotechnology Center estimates the following annual job openings per year in the Biopharmaceutical Industry: ²⁹

	Biomanufacturing	Pharmaceutical
New job creation	490	500-1,400
Turnover	490	1,720-1,890
Total	980	2,220-3,290
Scientific Technical	830	1,440-2,140
Overall total scientific/technical job openings in Pharma		2,270-2,970
Entry level job openings in Pharma		790-1,040

In 2003, Regional Technology Strategies estimated that 6,000 employees with less than baccalaureate degrees would be required by the biomanufacturing firms, not including firms in the biotechnology and life sciences.³⁰

The NCESC occupational forecasts for this field are somewhat difficult to calculate as many occupations in biotechnology and the pharmaceutical industry also appear in manufacturing. However, Table 3.B.8. on the following page provides a snapshot of the 2000-2010 forecast for selected professional occupations for the state as a whole. This forecast shows that the 25,000 positions represented in biotechnology and pharmaceuticals in North Carolina in 2000 correspond with the Milken report of 25,000 positions in 2003. Further, the NCESC forecasts 6,232 new positions in these fields by 2010, a number that is fairly consistent with the Milken forecast of 7,200. Finally, if these positions represent 28% of employment in these industries and there is another 30% in production, the RTS forecast of 6,000 new positions in the manufacturing field (non-baccalaureate) appears consistent.

The NCESC forecasts indicate that technician occupations represent 14,000 jobs out of a total of 27,150. As the educational and skill requirements for most technician occupations does not require the B.A., more than half of the job growth will require training from the community/technical colleges.

²⁹ North Carolina Biotechnology Center (March 2003). *Window on the Workplace 2003. A Training Needs Assessment for the Biomanufacturing Workforce*, page 13. Accessed on March 1, 2005 from <http://www.ncbiotech.org/ouractivities/spproj/workplace03.cfm>

³⁰ Regional Technology Strategies, 2003. "Meeting the Long-term Skills Needs of North Carolina's Biomanufacturing Industries and Biotechnology Cluster."

Interestingly, the NCESC forecasts significantly understate the forecasts made by the North Carolina Biotechnology Center in 2004 and those reported by Duke University.³¹ This is likely due to the differences in the way in which the segments of the biotechnology industry are reported. For example, the North Carolina Biotechnology Center includes agricultural biotechnology and contract research organizations in its total, indicating that the industry “should create about 48,000 new jobs in the biotechnology sector in the next decade and about 125,000 total jobs by the year 2023.”

Table 3.B.8.

North Carolina Occupation Trends 2000-2010

Employment in Biotechnology and Pharmaceutical-Related Occupations

	2000 Employment	2010 Employment	Change	% Annualized Change
Biomedical Engineer	150	220	70	2.46%
Chemical Engineer	1,040	1,130	90	0.83%
Industrial Engineering Technician	2,220	2,260	40	0.18%
Industrial Engineer	4,870	4,690	-180	-0.38%
Agricultural and Food Science Technician	730	900	170	2.12%
Biological Technician	1,350	1,670	220	2.15%
Chemical Technician	2,820	3,050	230	0.79%
Chemists	4,370	5,390	1,020	2.12%
Life Scientists, all other	1,340	1,680	340	2.29%
Life science, other Technicians	5,050	6,320	1,270	2.27%
Medical Scientists	2,280	2,970	690	2.68%
Microbiologists	360	480	120	2.92%

Source: NC Employment Security Commission

Educational and Skill Requirements

Scientific and technical occupations: All of the scientist and engineering occupations require at least a B.S. or B.A. degree. Technician positions require at least an associates degree. The US Department of Labor, Bureau of Labor Statistics notes that 60% of current workers nationally in pharmaceutical and medicine manufacturing have a bachelors, masters, professional or Ph.D degree.³² This equates to a rate of advanced degrees nearly two times as high as all other industries combined. The technician positions require graduation from a technical institute or community college with course work in biology, chemistry, math or engineering. Some entry level positions require a baccalaureate level degree.

³¹ http://www.soc.duke.edu/NC_GlobalEconomy/biotech/, accessed March 28, 2005.

³² <http://www.bls.gov/oco/cg/cgs009.htm>

The North Carolina Biotechnology Center reports that all scientific and technical employees require a broad set of knowledge and skills including biology and chemistry. Specialty fields within those disciplines, as well as engineering, statistics, process instrumentation and control, and an array of other technologies specific to pharmaceutical manufacturing and biomanufacturing are also essential.³³ Another, and, perhaps, most significant area of knowledge is the body of practices required to implement the FDA regulations that govern every aspect of pharmaceutical manufacturing. These are the so-called “Good Manufacturing Practices.” The North Carolina Biotechnology Center estimates that 85% of the employees in biomanufacturing firms require elements of this kind of training. About 65% of employees in the broader pharmaceutical manufacturing group are considered scientific and technical.

Biomanufacturing occupations: Roughly 30% of the occupations in this industry cluster are in production. These production occupations are similar to other advanced manufacturing occupations in their requirements. There are, however, significant additional requirements for production workers.

Biomanufacturing is a highly regulated industry which tends to depend on FDA approvals. These regulations require workers who can follow strict manufacturing practice requirements *and* FDA requirements. These include: detailed and step-by-step documentation skills; skills in judgment as to health and safety requirements (for example, samples are at times bio-hazardous); the ability to perform precise analytical functions; and to measure and capture various data sets. Production workers need laboratory skills, and need to understand the “culture” of work given the strict regulations governing every step in the biomanufacturing process.

Table 3.B.9. Analysis of Skills Requirements for Biopharmaceutical Workforce

Broad Occupational Category	Level of Education required	Gaps	Skill and Training Needs	Other
R&D workforce	BS or post-graduate AA	No data		All researchers need to understand production processes and the federal regulations governing pharmaceutical manufacturing in order to move new products out of the laboratory and into manufacturing.

³³ NC Biotechnology Center. 2003. Windows on the Workplace: A Training and Skills Assessment for the Biomanufacturing Workforce.

Table 3.B.9. Analysis of Skills Requirements for Biopharmaceutical Workforce (continued)

Broad Occupational Category	Level of Education required	Gaps	Skill and Training Needs	Other
<p>Manufacturing workforce (skills needed for biomanufacturing are highly transferable to other industries, such as chemicals, pharmaceuticals, food processing, and cosmetics. Close link between the bio manufacturing industry and the rest of the pharmaceutical industry.)</p>	<p>High School plus one year or work experience</p>	<p>Grads do not understand how the industry works (cultural and technical). Unaware of work habits for this environment (cultural and technical). Lacking in interpersonal and team skills and project management abilities to design experiments. Lacking in practical laboratory experience, problem-solving skills and ability to design experiments.</p>	<p>Tendency of employers to hire each others' workforce because of the above (in 2002 pharmaceutical companies filled less than 15 percent of entry level jobs with new college grads). Need for more workplace (internship) or simulation experiences by finding incentives for companies to offer more internships or developing alternative experiences, such as job shadowing. Making it a priority for the biomanufacturing and pharmaceutical training consortium pilot plant at NCSU to create as many internships as possible. Making the classroom more like the workplace by incorporating industry orientation, GMP training, and career skills practice into science and technology curricula.</p>	<p>GMP guidelines cover every phase of the production process, usually FDA approval hinges on it. Requires a mind-set and behavior consistent with compliance.</p>

Source:1. Creating a Bio-science Workforce: National Skills Standards for Entry into the Bioscience industry. EDC 1995. Monika Aring and Judith Leff. Funded by the US Department of Labor and US Department of Education.

2. Windows on the Workplace 2003: A Training Needs Assessment for the Biomanufacturing Workforce. March 2003. NC Biotech Center Education and Training Program.
<http://www.ncbiotech.org/pdffiles/goldenleafprt.pdf>

Industry respondents to a survey conducted by the North Carolina Biotechnology Center noted several issues critical to the workforce:

- Poor literacy and math skills of high school graduates;
- Lack of proficiency with basic office software;
- B.S. graduates without basic laboratory skills; insufficient experience with analytical instrumentation;
- Poor understanding of general manufacturing processes and specific processes in pharmaceutical manufacturing;
- Lack of knowledge of constraints of regulated environment;
- Poor problem-solving skills; and
- Lack of interpersonal/team skills and project management.

This has obvious implications at the K-12 level, as well as the Community College and the University levels.

3.B5. COMPUTING, SOFTWARE AND THE INTERNET

All but two of the regions identified segments of the information technology industry as targets. Specifically, Advantage West is targeting the Internet and software. The Research Triangle is targeting informatics and pervasive computing.

In both cases, these are narrow targets within the broad field of information technology, which generally includes computer hardware, software and telecommunications (voice, video and Internet). None of the North Carolina regions is a national leader in any of these fields, although the Research Triangle region is home to several major telecommunications manufacturers whose employment declined substantially starting in September 2001. However, this decline appears to have leveled off. Indeed, the Monthly Labor Review³⁴ reports that North Carolina's employment in the information industry was largely unchanged at 75,800 in March 2004, while eleven other states reported losses. Washington was the only state that reported an increase over the previous year.

Seventy-nine percent of information technology positions are in non-IT companies.³⁵ This accounts for the fact that although the information technology industry is not growing at the rate prevalent in the 1990s, the top six fastest growing occupations in North Carolina are in information technology.³⁶ Technology-enabled organizations see an increasing need for information technology workers (such as health care,

³⁴ Perrins, Gerald. 2004. Employment in the Information Sector in March 2004. Monthly Labor Review. <http://www.bls.gov/opub/mlr/2004/09/ressum1.pdf>, accessed March 22, 2005.

³⁵ Information Technology Association of America, 2004. "Adding Value...Growing Careers: The Employment Outlook in Today's Increasingly Competitive IT Job Market. <http://www.ita.org>, accessed March 22, 2005.

³⁶ National Workforce Center for Emerging Technologies, 2004. "Applications of Information Technology: Trends Assessment for 2004." www.nwcet.org/products/trends2005.asp, accessed March 22, 2005.

government, insurance, banking, finance and e-commerce). The difference between non-IT jobs and those in the IT field is that non-IT employers expect IT workers to have a higher level of knowledge about specific applications and their (non-IT) industry and business.

Occupations

According to the Bureau of Labor Statistics, the occupations included under computers, software and the Internet are encompassed in three industries: software publishers; telecommunications (voice, video and Internet); and computer hardware manufacturing.

Software publishers, the fastest growing industry in the economy, have 58.7% of their positions in professional and related fields. 23% of the positions are computer software engineers; the next largest occupation is computer programmer. Computer support specialists are also an important occupation in this industry.

In contrast, telecommunications has only 14% professional positions, including computer software engineers, network systems and data communications analysts, engineers and engineering technicians. 26% of the positions in telecommunications are in installation, repair and maintenance, including line installers and repairers and equipment installers and repairers.

Computer and electronic product manufacturing is roughly 31.3% professional occupations, led by computer programmers, computer software engineers, computer support specialists and computer hardware engineers. Other engineering occupations represented include electrical, industrial and mechanical engineers with 6% of the employment being engineering technicians. 34% of the occupations in this industry are in production, with occupations that include electrical assemblers, inspectors, machinists and semiconductor processors.

Employment Forecast³⁷

The employment forecast for selected information technology occupations in North Carolina is shown in Table 3.B.10. The high growth rates are notable. These correspond to six of the top ten growing occupations in the state. Table 3.B.11. shows the overall levels of employment forecast by the seven regions in the state.

³⁷ For this employment forecast, it is important to consider that the forecasts listed in the tables below were made based on historical projections from data covering 1976-2000 and therefore do not include the downturn that began in 2001.

Table 3.B.10: Selected Information Technology Occupations: North Carolina Employment Projections 2000-2010

Selected Occupation	Employment 2000	Employment 2010	Annual Change %
Computer Software Engineers (applications and systems software)	18,390	31,500	5.51%
Computer Support Specialist	15,550	29,770	6.71%
Network and Computer Systems Administrators	7,330	13,530	6.32%
Network Systems and Data Communications Analysts	4,310	7,230	5.31%
Database Administrators	2,780	4,300	4.46%
Computer Systems Analysts	12,100	18,300	4.22%
Computer Scientists	380	450	1.71%

Source: NC Employment Security Commission

Table 3.B.11.
North Carolina Occupation Trends 2000-2010
Employment in Computer and Mathematical Occupations

Region	2000 Employment	2010 Employment	Change	% of total 2000	% of total 2010	% Annualized Change
North Carolina	80,840	127,600	46,760	1.92%	2.56%	4.67%
Advantage West	5,700	9,050	3,350	0.91%	1.21%	4.73%
Charlotte	19,820	29,800	9,980	2.21%	2.76%	4.16%
Eastern	3,590	5,020	1,430	0.93%	1.15%	3.41%
Northeast	15,620	23,420	7,800	2.94%	3.62%	4.13%
Piedmont Triad	12,510	19,500	6,990	1.48%	1.95%	4.54%
RTRP	29,450	44,590	15,410	3.71%	4.57%	4.24%
Southeast	4,250	6,640	2,390	0.99%	1.31%	4.56%

Source: NC Employment Security Commission

Education and Skill Requirements

The professional occupations in information technology generally require a 4-year degree. The U.S. Department of Commerce³⁸ estimates that by 2010, 75% of all professional level information technology jobs will require a bachelors degree. The Commerce report states:

“Jobs in the IT field are varied, complex and specialized, as are the knowledge, skills and experience required to fill them...Employers seek workers with specific combinations of technical skills and experience, often coupled with a college degree, soft skills, and business or industry knowledge.”

Computer software engineers require a bachelors degree in computer science, software engineering or computer information systems. An advanced degree is required to teach or to hold research and development positions. Certification is offered by IEEE – Certified Software Development Professionals.

Computer programmers increasingly require a 4-year degree to enter the field, although some positions require a 2-year program. Knowledge of a programming language, with certification in a particular language, is important to the 2-year degree holder. College degrees related to specific application areas are an asset, such as a business degree for MIS applications, or an engineering or science degree for scientific or engineering applications. Object-oriented programming is a minimum requirement, but increasingly 4th or 5th generation languages require experience with GUI and systems programming.

For systems programmers, a 4-year degree with knowledge of operating systems such as DB2, Oracle or Sybase, along with appropriate certifications, is required.

Computer support specialists have no specific formal path for training and education, but some formal college is preferred. Either a 4-year or 2-year program in a computer related field is helpful. Certification is essential with a 2-year program. Industry standard certifications include Microsoft, Oracle, Cisco and Novell.

On the hardware side, 4-year degrees in engineering are required for entry into such professional occupations as electrical, mechanical or industrial engineering, and computer hardware engineering. Engineering technicians require a 2-year degree in engineering technology, usually with a specialization.

³⁸ U.S. Department of Commerce, Office of Technology Policy. 2003. “Education and Training for the Information Technology Workforce.” [www.technology.gov/reports/IT Workforce/ITWF2003.pdf](http://www.technology.gov/reports/IT%20Workforce/ITWF2003.pdf), accessed March 22, 2005.

Industry certification plays a major role in the IT occupations. A 2000 study conducted for the National Academy of Sciences concluded that for the IT industry, learning on the job is the widely preferred method. Since the content of knowledge in the industry changes so quickly, few educational institutions are able to keep relevant.³⁹

Production and installation and maintenance occupations are filled with high school graduates, often with additional on-the-job training. Postsecondary training in electronics is an asset, especially in the installation of telecommunications equipment.

Skills Gaps: The 2000 NCEITA competitiveness study concludes that the lack of qualified workers is one of the major limitations for North Carolina's Information Technology companies to stay competitive, although it does not provide any details on required skills.⁴⁰

On a national level, the study "Bridging the Gap: Information Technology Skills for a New Millennium,"⁴¹ administered by the Information Technology Association of America in 2000, provides detail regarding the industry's biggest needs and existing, major skills gaps:

- Smaller companies (50-99 employees) across the U.S., had a need for about 70% of the total demand for new IT workers
- The same company segment reported the highest rate of unqualified workers and the greatest difficulties to fill positions
- Highest ranked skills needed were:⁴²
 - Troubleshooting
 - Facilitation/Customer Service
 - Hardware/Software installation
 - Configuration upgrades
 - Systems operations, monitoring and maintenance
- More than 30% of the key skills for IT jobs are non-technical:
 - Good communication skills
 - Problem-solving
 - Analytical skills
 - Flexibility
 - Ability to learn quickly

³⁹ Salzman, Harold 2000. "The Information Technology Industries and Workforces: Work Organization and Human Resource Issues. Washington, DC: National Academy of Science Committee on Workforce Needs in Information Technology.

⁴⁰ NC Electronics & Information Technologies Association (2000). *North Carolina Information Technologies Industry. Competitiveness Study.*

⁴¹ ITAA (2000). *Bridging the Gap: Information and Technology Skills for a New Millennium.* Accessed March 1, 2005 from <http://www.ita.org/workforce/studies/hw00execsumm.htm>

⁴² Ibid. Executive Summary.

3.B6. DESIGN AND FILM

Three of the seven regional economic development partnership regions have identified design and arts as target industry sectors: Advantage West; the Piedmont Triad; and the Northwest. Indeed, the 2003 Target Industry Analysis performed for the Northwest North Carolina Comprehensive Economic Development Strategy by Angelou Economics, identified the design industry as a target. According to Angelou, “Arts and design have a rich history in the region, ranging from traditional arts and crafts to furniture design.” The Piedmont Triad came to a similar conclusion through its Targeted Industry Analysis conducted by Hillwood Strategic Services in 2001. In both cases, these regions want to build upon the historical excellence in arts and crafts (for example, Seagrove pottery), as well as the North Carolina School of the Arts located in Winston-Salem. In addition, film has a foothold in Wilmington as well as other areas of the state.

Stuart Rosenfeld of Regional Technology Strategies has noted that the new competitiveness is the incorporation of art or design into products and services, where the art or design is the distinguishing feature or creates the competitive advantage. He cites examples including furniture, and industrial products where companies have succeeded based on their design capabilities. This is particularly relevant for the Advantage West and Piedmont Triad regions where the traditional competitive advantage of low cost manufacturing is no longer viable.

Occupations

Richard Florida’s *The Rise of the Creative Class* states that “human creativity is the ultimate economic resource,” and notes that the number of people doing creative work has continued to grow. Further, Florida argues that creativity is the underpinning of economic growth. Among those ranked low by Florida on the “tolerance of creativity,” is Greensboro.⁴³

Florida also defines two groups of creative occupations: the creative professionals and the super-creative core.⁴⁴ The creative professionals, include managers and administrators, financial, legal and sales professionals as well as community and social service professionals. The super-creative core includes computer professionals, architects, physical and social scientists, library professionals, arts, design, entertainment sports and media occupations.

⁴³ Florida, Richard. 2002. *The Rise of the Creative Class*. Basic Books, page 356.

⁴⁴ *Ibid*, page 328.

Others⁴⁵ have further refined these definitions to suggest that these occupations could be regrouped into three categories: Artists for Arts Sake; Commercial Art; and Art Facilitators. Artists for Arts Sake includes: architects; landscape designers; art directors; fine artists; directors; dancers; choreographers; writers; photographers; music directors; musicians; singers; writers and authors. Commercial Art includes occupations such as: multimedia artists and animators; commercial and industrial designers; fashion, floral, graphic and interior designers; editors; technical writers; film and video editors; tailors, dressmakers, fabric and apparel patternmakers; etchers and engravers; jewelers and; cabinet makers.

According to the Bureau of Labor Statistics, there are several occupational groupings that correspond to the Arts and Design industries as noted by the regions. First are artists and related workers, a category similar to the Artists for Arts Sake category cited above. Within this grouping are three subcategories: *fine artists* — those who create original artwork through a variety of methods and materials; *multimedia artists and animators* — those who employ film, video, computers or other electronic media; and *art directors* — those who design concepts and approaches for the visual communications media.

The second major grouping is designers. This includes a wide variety of occupations where practical knowledge is combined with artistic ability. This corresponds well to the Commercial Artists group cited earlier. Some occupations included in the BLS listing are: commercial and industrial designers of manufactured products; fashion designers; floral designers; graphic designers; and interior designers.

Employment Forecasts

As shown in Table 3.B.12., the NCESC projects strong growth in these occupations through 2010. The 2.85% annualized change for North Carolina as a whole is the sixth fastest growing occupational grouping in the state. The NCESC also projects stronger growth in the Arts and Design occupations in the Advantage West region compared to the rest of the state, but also projects stronger growth in these occupations in five other regions. Since these projections are based on linear projections from past data, a concerted effort in the Triad region in the Arts and Design occupations might produce results different from those forecasted. Table 3.B.13. on the next page shows the forecasts for selected Arts and Design occupations statewide.

⁴⁵ Coursey, Don L. "The Arts and Culture Workforce Project: Documents Prepared for Advancing Chicago's Civic Agenda through the Arts: 2003-2004." <http://culturalpolicy.uchicago.edu/pdfs/artsworkforceproject.pdf> , accessed March 14, 2005.

Table 3.B.12.

North Carolina Occupation Trends 2000-2010

Employment in Arts, Design, Entertainment, Sports and Media Occupations

Region	2000 Employment	2010 Employment	Change	% of total 2000	% of total 2010	% Annualized Change
North Carolina	41,980	55,590	13,610	1.00%	1.11%	2.85%
Advantage West	4,860	6,520	1,660	0.77%	0.87%	2.98%
Charlotte	9,120	11,450	2,330	1.02%	1.06%	2.30%
Eastern	3,040	3,950	910	0.79%	0.90%	2.65%
Northeast	5,980	7,730	1,750	1.12%	1.19%	2.60%
Piedmont Triad	8,620	10,920	2,300	1.02%	1.09%	2.39%
RTRP	8,300	10,730	2,430	1.05%	1.10%	2.60%
Southeast	3,580	4,610	1,030	0.83%	0.91%	2.56%

Source: NC Employment Security Commission

Table 3.B.13.

North Carolina Occupation Trends 2000-2010

Employment in Selected Arts and Design Occupations

	2000 Employment	2010 Employment	Change	% Annualized Change
Fine Artists	390	540	150	3.31%
Multimedia Artists and Animators	1,060	1,430	370	3.04%
Art Directors	780	1090	310	3.40%
Commercial and Industrial Designers	660	860	200	2.68%
Graphic Designers	3,740	5,150	1,410	3.25%

*Source: NC Employment Security Commission***Educational and Skills Requirements**

Both the artist and designer occupations require two different types of skills. First, each occupation requires technical ability in a particular medium, whether it is oil, fabric, wood or clay. This technical ability needs to be complemented by creativity, design and the ability to sketch, as well as design on a computer. The second set of skills is business and managerial.

More than one-half of artists and related workers are self-employed. One-third of designers are self employed.⁴⁶ This suggests that possessing the necessary business knowledge to own and operate a successful business is also an important skill. Artists and designers who are employed by others require communication and problem-solving skills necessary to translate client needs into creative solutions.

Increasingly, both design and art occupations are becoming technology-based professions. Industrial designers in particular require knowledge of Computer-Aided Design (CAD) or Computer-Aided Industrial Design (CAID). Training in computer techniques, computer graphics and visual display software is often essential in the fine arts. Nowadays, multimedia artists by definition operate in a largely computerized environment.

According to the U.S. Department of Labor, Bureau of Labor Statistics, design occupations, except floral design and merchandising, tend to require a B.A. A masters level is usually required in industrial design. Further, interior design is subject to government regulation and a qualification exam (which can be taken after at least 6 years of combined education and experience in the field). There are some 2- and 3-year certificates or associate degrees in design, while the Bachelors of Fine Arts is a 4-year degree including art, art history, principles of design, designing and sketching as well as specialized studies in particular fields.

The Arts occupations are somewhat different. Formal training is not required to be a fine artist, but it is difficult to be skilled enough to make a living without training. Fine artists often earn a Bachelors of Fine Arts or a Masters of Fine Arts, and/or postsecondary studio training leading to an Associates of Arts degree or BFA. For those who want to teach in the arts, a teaching certificate is required along with a BFA degree.

Some computer-related occupations, such as computer software engineers and desktop publishers also require art skills. Further, Rosenfeld advocates the integration of arts and design into technical programs leading to careers in industrial design.

3.B7. LOGISTICS AND DISTRIBUTION

Five regions have identified logistics and distribution in addition to wholesale trade as targeted industries. This reflects a historical prevalence of the industry in North Carolina, as noted in the statewide cluster study done in 2000.⁴⁷ This study identified transportation, shipping and logistics as an emerging general industry cluster. This means that the cluster is at least as well represented in the state as in the nation (location quotient of 1.06), and that there is strong growth relative to national trends (2.6% annually in 1998).

⁴⁶ Bureau of Labor Statistics, www.bls.gov.

⁴⁷ Feser, Edward, and Renski, Henry. 2000. High-tech Clusters in North Carolina. North Carolina Board of Science and Technology.

A vibrant logistics cluster is critical for economic competitiveness and requires a skilled workforce. A recent national commission found that one of the most critical issues facing the U.S. trucking industry is a major shortage of qualified drivers. Another interesting characteristic of this industry is that the percentage of immigrant workers in the past decade has nearly doubled nationally, growing from 1.5 to 2.5%.⁴⁸

Occupations

The objective of the transportation and logistics industry is to deliver the right products to the right place at the right time at the lowest possible cost. This is a growth industry, with new services including international, value-added warehousing and dedicated contract carriage. Customers are demanding more services such as: just in time (JIT) deliveries; full visibility of the location of products at any time; the addition of technologies such as RF, RFID, voice recognition and GPS; as well as quality targets. Technologies to manage the logistics of global distribution, a multitude of legal, regulatory, safety and security issues, and customer requirements make this industry dynamic.

However, the complexities of the industry do not necessarily translate into high-wage jobs. According to the BLS, only 5% of the employment in this industry is in the management, business and financial occupations which are responsible for planning and logistics, including specialized transportation, storage and distribution managers. Another 17.6% of the positions are office and administrative support and 66.2% are transportation and material moving positions, the majority being truck drivers and material movers. Installation, maintenance and repair occupations represent 4.6% of the total positions. Sales (2.3%) and production (1.9%) constitute the remainder of the occupations in the industry.

Employment Forecast

The NCESC occupational forecasts (See Table 3.B.14. on the next page) show that the transportation and material moving occupations are well represented in the state, with over seven percent of total employment in 2000. The annualized change projected for these occupations is positive, but not as fast as some other sectors. The RTRP region is forecasted to have the most growth in this set of occupations, with the Eastern region experiencing the least growth. Table 3.B.15. on the next page shows the forecast for selected occupations related to logistics and distribution.

⁴⁸ <http://www.aifl.org/>, accessed March 24, 2005.

Table 3.B.14.

North Carolina Occupation Trends 2000-2010

Employment in Transportation and Material Moving Occupations

Region	2000 Employment	2010 Employment	Change	% of total 2000	% of total 2010	% Annualized Change
North Carolina	327,400	377,300	49,900	7.77%	7.56%	1.43%
Advantage West	49,430	58,100	8,670	7.88%	7.75%	1.63%
Charlotte	76,510	91,210	14,700	8.53%	8.43%	1.77%
Eastern	28,130	30,960	2,830	7.27%	7.08%	0.96%
Northeast	37,070	43,960	6,890	6.97%	6.79%	1.72%
Piedmont Triad	71,870	84,720	12,850	8.50%	8.46%	1.66%
RTRP	53,210	63,450	10,240	6.70%	6.50%	1.78%
Southeast	31,100	35,870	4,770	7.22%	7.07%	1.44%

Source: NC Employment Security Commission

Table 3.B.15.

North Carolina Occupation Trends 2000-2010

Employment in Selected Transportation and Material Moving Occupations

	2000 Employment	2010 Employment	Change	% Annualized Change
Transportation, storage and distribution managers	3,860	4,890	1,030	2.39%
Truck drivers	58,220	69,700	11,480	1.82%
Installation, maintenance and repair	4,900	5,400	600	1.05%

Source: NC Employment Security Commission

Educational and Skill Requirements

The majority of occupations in this industry are low-skill, low wage. Some truck drivers, for instance, need only a commercial driver's license to be hired. Others who drive long-haul tractor trailer rigs, are paid high annual salaries and good job benefits and attend Community Colleges. Many of the other occupations in this industry require a high school diploma, but the increasing complexity of operating a warehouse involves computers and information management. Those involved in installation, maintenance and repair will benefit from diesel mechanics programs or training as automotive service technicians with resulting certifications at the Community Colleges.

An important emerging skill requirement for truck drivers is the use of telematics. Telematics is a high priority topic among truck fleet managers, with 50% of all survey participants reporting that their companies use some kind of logistics or wireless communications device on board their trucks to increase productivity. An additional 37% of those surveyed also plan to install these boxes within a year. Interestingly, while these devices were originally intended for truck location and/or recovery of stolen property, only 13% reported using telematics for this purpose. The majority (81%) use the systems to monitor driving patterns and equipment specifications in order to develop fuel-saving, equipment maintenance and specification strategies.⁴⁹

At the management level, logistics is an increasingly specialized field requiring a B.A. in business, marketing, accounting, industrial relations or economics. There are a number of certification programs available that provide specialized training in logistics. These programs include coursework in distribution management, discreet math, finance and accounting applications in logistics, facilities planning, and logistics management. The Certified Professional Logistician Program (CPL) operated by the International Society of Logistics offers a certificate with similar courses as the CTL (Certified in Transportation and Logistics) offered by the American Society of Transportation and Logistics. Several universities such as MIT, and Georgia Tech offer masters degrees and/or short course in logistics management.

Gammelgaard and Larson define the new skill sets required to succeed in the logistics industry⁵⁰. They include:

- a. “Multi-tasking” and learning how to deal with problems and interruptions in the industry cluster
- b. Flexibility and pro-activity
- c. Service orientation
- d. Collaborative planning, forecasting and replenishment (CPFR)
- e. New quality standards in logistics and distribution (such as ISO and Six Sigma)
- f. Logistics training to set up supply chains that not only respond to existing situations but also are able to change and adapt.

⁴⁹ <http://www.fs5.info/logistics/JobHunts/jannews2.html>, accessed March 24, 2005.

⁵⁰ Gammelgaard, Britta and Larson, Paul D., 2001. “Logistics Skills and Competencies for Supply Chain Management.” *Journal of Business Logistics*. 22 (2):27-53.

3.B8. CROSS-CUTTING SKILLS

There are at least four major cross-cutting skills sets that are mentioned in many of the regional strategies, workforce studies and national discussions of workforce. These include:

- “Soft skills”
- Computer literacy
- Science and math fundamentals
- Entrepreneurship.

Soft Skills

The American workplace has changed substantially over the last generation. The changes include: more collaborative work environments; more linkages between/among customers/clients and workers; and more responsibility driven deeper into the organization and onto the production floor. Workers at all levels are expected to understand more about their company’s business and to be able to contribute to their company’s success, whether through process, product or productivity improvements or through interaction with customers/clients. These changes require that workers at all levels in industry possess “soft skills”.

In production environments, workers increasingly work in small teams, often cross-training and sharing the responsibility for the productivity and quality of the outputs of their work stations. In most competitive production environments, workers are responsible for operating the computer that operates a machine. Workers are often responsible for operating a machine, while problem-solving when the machine breaks. Workers are now held responsible for quality, requiring them to take and record measurements, and often calculating quality statistics.

In professional and production environments, a focus on the customer/client (the production cell in a production environment) is an ongoing requirement, requiring high levels of interpersonal skills, the ability to listen, understand, analyze and problem-solve.

In virtually all work environments, the following four types of skills are required for entry and upward progression:⁵¹

1. *Cultural skills*: Understanding “how work gets done” is the most valuable and most transferable attribute required across industries. This includes knowing how to ask questions and how to learn.

⁵¹ Aring, Monika and Brand, Betsy. 1998. *The Teaching Firm: Where Productive Work and Learning Intersect.* Washington, D.C.: EDC, Inc.

2. *Interpersonal skills*: Knowing how to listen, speak, and present information. Training in English as a Second Language is, therefore, becoming an increasing requirement in North Carolina with its significant percentage of workers whose first language is not English.
3. *Intrapersonal skills*: How to manage difficult emotions; how to prioritize; how to manage time, money, and data.
4. *Technical skills*: How to operate specific equipment, tools, and so on.

North Carolina employers (as captured in various reports) expressed a need for employees with the following “soft skills”:

- Interpersonal skills
- Oral and written communications
- Teamwork
- Professionalism
- Organizing and planning
- Problem-solving

Table 3.B.16. Cross-cutting skills identified by North Carolina Employers as Reported in Various Specific Regional Strategy and Workforce Studies arrays such soft skills below.

REPORT	SKILL REQUIREMENTS EXPRESSED
10(2003)	Math skills, measurement skills, computer skills, reading and writing. Verbal communication
32 (2001)	Basic work skills and work ethic
28(2001)	Leadership, communication, self-initiative, perseverance, listening, acquiring and using information, attitude toward supervisor
28(2001)	Writing, phone skills, communication, listening, acquiring and using information, efficient use of resources
28(2001)	Teamwork, professionalism, self-initiative
10(2003)	Reading, writing, math, verbal communications
35(2004)	Hands-on technical and mechanical experience
35(2004)	Selling, management, information systems
35(2004)	Electrician skills, basic knowledge of electronics, math, work ethic, engineers
2003, NACFAM The Case for Enhancing American Workforce Skills	<p>New skills :</p> <p>Using information and communications technology; gathering and analyzing information; analyzing and solving problems; organizing and planning, working in teams; making decisions and judgments;</p> <p>Reacting quickly to customers; effective communications; rapid assimilation of new technologies – rapid and ongoing learning; workers who are self-motivated and have a sense of ownership.</p>

REPORT	SKILL REQUIREMENTS EXPRESSED
Skills Gap 2001: National Association of Manufacturers	78% say public schools not teaching basic academic and employability skills; 26 percent say workers lack basic math skills; 30 percent report deficiencies in basic comprehension and writing skills; 59 percent say workers lack readiness skills such as arriving on time and staying all day.

In the North Carolina biotechnology industry, for example, leaders expressed the need for employees to understand how their particular business works, including:

- Professional advancement
- Social and professional norms
- Company goals
- Business operations
- Quality standards, GMP, ISO, 6 Sigma, Industry specific (FDA)
- Company expectations
- The role of regulators (FDA).

They further indicated that employees needed to have presentation skills and a grasp of teamwork dynamics.

Another characteristic of many industries is that the technologies that underpin them are changing rapidly. Therefore, a career will require frequent updates to skills. This, in turn, creates a cross-cutting need for the ability to be agile, constantly learning new technologies, techniques and processes.

Computer Literacy

Today, most occupations, especially those that are professional, managerial or technical require employees to interact with computers. Therefore, computer literacy is increasingly an issue. While many children have strong computer skills, they are not necessarily proficient with commonly used office software. Older workers transitioning in the workplace may not have the required computer expertise and need retraining. Further production positions require such skill sets as well.

Science and Math Fundamentals

The competitive position of the U.S. is being threatened by poor performance in science and math in K-12 as well as a low production of science and engineering degrees in colleges and universities with native born students. This is the message of three reports released in early 2005. All echo the sentiment of the Business-Higher Education Forum:

“At a time when the demand for mathematics and science is at an all time high, American elementary and secondary students are not achieving the level of skills and knowledge needed for an internationally competitive scientific and technological workforce.”⁵²

The Business-Higher Education Forum notes that jobs requiring science, engineering or math training are growing at over 51 percent, four times faster than overall job growth. This is reflected in many of the positions that will be needed to support the targeted industries in North Carolina. In fact, occupations that require less than a 4-year degree often require a high level of general science or engineering.

This is a particular challenge as the basic preparation for this post-secondary education is lacking in K-12. The performance of students currently in K-12 science and math is lagging significantly behind counterparts in many countries, and current 12th graders are ranked at the bottom.

A corresponding challenge is the lack of qualified K-12 science and math teachers. Approximately 250,000 science and math primary and secondary teachers will be required in the U.S. by 2008. The troubling fact is the pipeline does not begin to approach these numbers.⁵³ (Please note the NCESC occupational forecast does not distinguish between elementary school teachers and math and science primary and secondary teachers.)

The American Electronics Association goes even further to express concern about the number of engineering degrees awarded in the U.S. The AEA reports that the U.S. is the 4th largest nation by population, but ranks 6th in the number of engineering degrees awarded. Further, the number of engineering degrees grew by just 6% in 1990-2002, while high tech employment grew 50% in the same period. The number of computer science degrees, however, grew 41% in the same period.⁵⁴

The Taskforce on the Future of American Innovation reinforces the trend of rapidly increasing retirements in science and engineering fields. More than one-half of those currently in the workforce with science and engineering degrees are over 40.⁵⁵

⁵² Business-Higher Education Forum, 2005. “A commitment to America’s Future: Responding to the Crisis in Mathematics and Science Education.” www.bhef.com, accessed March 23, 2005.

⁵³ Ibid.

⁵⁴ American Electronics Association, 2005. “Losing the Competitive Advantage: The Challenge for Science and Technology in the United States. www.aeanet.org/publications/IDJJ_AeA_Competitiveness.asp, accessed March 23, 2005.

⁵⁵ Taskforce on the Future of American Innovation, 2005. “The Knowledge Economy: Is the U.S. Losing its Competitive Edge?” www.futureofinnovation.org/PDF/Benchmarks.pdf, accessed March 23, 2005.

These issues also characterize North Carolina. The majority of positions identified by the regional economic development groups as targets require science, engineering and math backgrounds at both the 2-year and 4-year degree levels.

Entrepreneurship

Entrepreneurship has been identified as an important skill. Entrepreneurship is broadly defined to encompass self-employment and small business ownership, as well as high-growth technology-based start-up. Further, an entrepreneurial attitude (defined as the ability to creatively solve problems) is believed to be an asset in many occupations.

Indicative of this trend is the Arts and Design sector where business skills will be as important for artists as their technical abilities because over one-half will be self-employed.

By nature, economic development entities such as the regional economic development partnerships spend considerable time to recruit and retain large businesses. It is not surprising, then, that their targets are industries dominated by larger businesses. However, there is a small business component to many of these industries as well as an entrepreneurial, start-up component to the technology-based industries such as biotechnology, nanotechnology and computer software.

Therefore, entrepreneurship, (that is the business, marketing and operational skills to run a smaller, emerging company, and the knowledge of the technology commercialization process in particular), is a critical support to technical training in many fields.

3.C. THE NORTH CAROLINA LABOR FORCE

Several important demographic trends continue to impact the demand for education and training in North Carolina. First, the North Carolina population is growing and aging. Second, structural changes in the North Carolina economy, notably the decline in traditional manufacturing employment, have yielded a large number of displaced workers not appropriately trained for the jobs now available. Third, North Carolina is an increasingly diverse place with significant gains in the number of Hispanic residents. Further, the disparities on many measures between urban and rural North Carolina appear to be widening. Finally, North Carolina as the state is behind the South overall (although not behind all Southern states) in workforce preparedness and the rest of the nation in educational attainment.

Age of the Workforce and Population

The North Carolina population is projected to increase by over 17% from 2000-2010, compared to 12% for the U.S. as a whole.⁵⁶ As shown in Table 3.C.1 on the following page, the biggest change is the aging of the population. This is driven in part by the “baby-boom” generation (those born between 1946 and 1964). In 2010, this cohort will be ages 46-64. More importantly, in the ten years between 2010 and 2020, a significant proportion of this cohort will retire, leaving shortages in many fields, especially in science and engineering.

More than one-half of those in the U.S. with science and engineering degrees today are over 45 and 25% are over 55. Only the computer scientists are younger, with the majority of them under 45.⁵⁷

Of the North Carolina population, 12% is currently over 65, a joint result of the aging of baby boomers and an influx of retirees.⁵⁸ As a result, older North Carolinians live in rural counties with the greatest concentration in the mountain region. This is partially a function of “negative selectivity” where younger residents leave and older residents stay. However, in some places, there is in-migration of retirees to such coastal communities as Moore County (Pinehurst and Southern Pines) and Henderson County in the west.⁵⁹

⁵⁶ Fullerton, Howard N and Toossi, Mitra. 2001. “Labor Force Projections to 2010: Steady Growth and Changing Composition.” Monthly Labor Review. <http://www.bls.gov>. Accessed March 30, 2005.

⁵⁷ National Science Board, Science and Engineering Indicators 2004. www.nsf.gov/statistics/seind04/c3/c3s3.htm, accessed 4/18/05.

⁵⁸ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁵⁹ www.ncatlasrevisited.org, accessed 1/31/05

Table 3.C.1 Population Forecasts for 2010 by Age

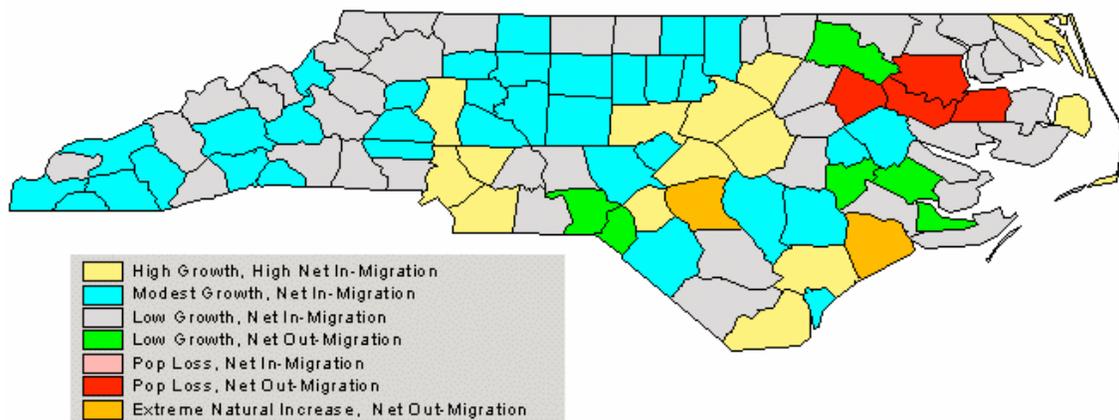
Cohort	Population in 2000	Forecasted Population in 2010	Change	Percent Change
0-9	1,102,076	1,267,264	165,188	14.9%
10-17	767,774	995,852	228,078	29.7%
18-24	804,143	983,096	178,953	22.5%
25-34	1,213,439	1,257,068	43,629	3.5%
35-44	1,287,129	1,351,347	64,218	4.9%
45-54	1,085,143	1,351,828	266,685	24.6%
55-64	723,751	1,089,179	365,428	50.5%
65+	489,112	1,179,719	690,607	141.2%
Total	8,046,807	9,475,353	1,428,546	17.7%

Source: <http://demog.state.nc.us>

The population of college-age North Carolinians in 2010 will reach almost 1 million, growing 22.5% over the ten-year period. This reflects significant growth over the current college-age population.

The population growth is not uniform in the state however. As of July 1, 2004, North Carolina had a population of 8.5 million, 50% in the rural counties and 50% in urban areas.⁶⁰ Figure 3.C.2 below shows the distribution of population growth projected through 2010.

Figure 3.C.2 Growth 2000-2010 by County



Source: <http://demog.state.nc.us>

North Carolina experienced rapid growth (21%) in the 1990s. In 1990-2000, only 2 counties lost population (East and Northeast Regions). Most parts of the state shared in population growth, although most rural Eastern and Northeast counties grew significantly more slowly (10% and 8% respectively).⁶¹ Overall, North Carolina's growth was fueled

⁶⁰ www.ncatlasrevisited.org, accessed 1/31/05.

⁶¹ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

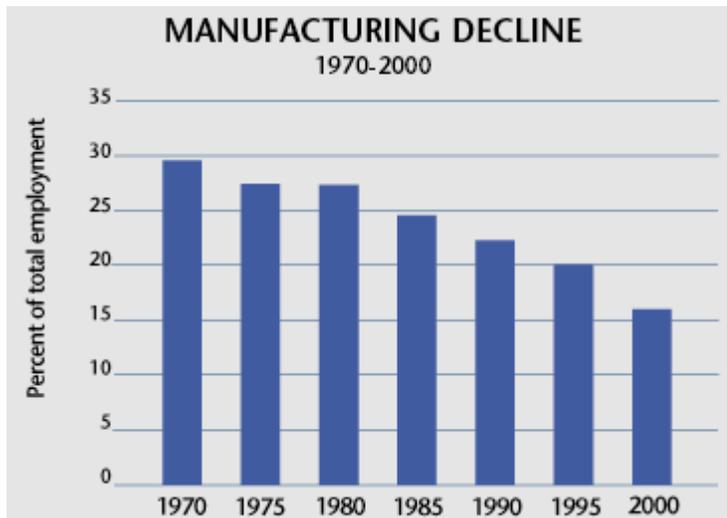
by in-migration from other states and countries, accounting for 70% of the increase. Urban adjacent and high amenity counties grew the fastest.⁶²

However, population growth slowed dramatically in 2000-2003. Nineteen counties either lost population or had no growth, all of them on the coast and all rural. Urban shift is apparent⁶³ with out-migration of younger and more educated/trained people. Some of the decline is associated with military facilities. Some is associated with decline in jobs in furniture. In some other Northeastern counties this trend has been apparent for some time, mostly from a lack of in-migration.

Structural Change and Displaced Workers

North Carolina is in the midst of a major restructuring of its economy. For many years, North Carolina and other southern states have competed for branch offices and manufacturing plants, citing low labor costs and low cost of living. In the past ten years, the weaknesses of this strategy have become apparent with the acceleration of a three-decade long decline in manufacturing due to international competition and the impact of NAFTA. As shown in Figure 3.C.3, manufacturing accounted for almost 30% of North Carolina employment in 1970. Now it accounts for only 17%.⁶⁴

Figure 3.C.3 Manufacturing Decline



Source: www.ncruralcenter.org/databank/trendpage_employment.asp

⁶² NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁶³ www.ncatlasrevisited.org, accessed 1/31/05.

⁶⁴ Bureau of Economic Analysis, www.bea.gov, accessed 1/31/05.

Textiles, apparel and furniture manufacturing have been the hardest hit in North Carolina. One hundred ninety textile and apparel mills closed during the three year period 2000 to 2003 and an additional 125 mills laid off workers.⁶⁵ According to the North Carolina Employment Security Commission, there have been a total of 2,613 announced closings in North Carolina since 2000 affecting over 115,000 people and 1,161 cutbacks affecting another 85,757 people.⁶⁶ Layoffs have occurred all over the state, but 34% have impacted the Piedmont Triad region.⁶⁷

In North Carolina, workers displaced by the layoffs in the traditional manufacturing sectors are disproportionately less educated than their peers. According to the Commerce study, 20.3% of workers displaced between January 1999 and June 2001 had less than a high school education; 59% had completed high school; and only 18% had some college or had completed college. This is because the declining industries offered low-skill and low-wage jobs. Displaced workers “tend to have lower education levels than are minimally required in more technically advanced manufacturing and higher level service industries.”⁶⁸

Displaced workers are more than 1.7 times as likely to be Black, and although an equal number of men and women are laid off, men were able to regain employment at a rate more than 10% higher than women. Displaced workers are also older: 41.6% are 30-44; 23.1% are 45-55 and; 13.1% are over 55.⁶⁹

Another structural change affecting North Carolina is the decline in tobacco production and manufacturing. The overall number of farms has dramatically decreased, but this has been particularly pronounced for tobacco production.⁷⁰ As recently as 1997, North Carolinians raised over 700 million pounds of tobacco. Although still leading the nation, North Carolina saw its tobacco production drop to 310 million pounds in 2003. The tobacco buy out will further decrease this production. Those moving from farm occupations to other industries will require additional training.

North Carolinians now work more predominantly in service industries. 43% work in service, 20% in trade, transportation and utilities, and 17% in manufacturing.⁷¹ This is a major change from 1990 when manufacturing, construction, natural resources and mining accounted for 40% of employment.

⁶⁵ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁶⁶ www.ncesc.gov, accessed 1/31/05.

⁶⁷ Watt, Graham, North Carolina Displaced Workers Study, Department of Commerce, May 2002.

⁶⁸ Center for Regional Economic Competitiveness, “Situation Analysis of the Future Forward Study Region: 10th and 11th Congressional Districts of North Carolina,” February 2003, page 46.

⁶⁹ Watt, Graham, North Carolina Displaced Workers Study, Department of Commerce, May 2002.

⁷⁰ USDA, NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁷¹ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

Against these structural decreases in the economy come signs of new economic growth. New industries, particularly those fueled by innovation in information technology, health care and pharmacology spurred growth in employment from 1990 to 2002 at 28% in urban areas, but only 16% in rural North Carolina.⁷²

The biopharmaceutical industry is highly concentrated in the Research Triangle Region, and is one of the fastest growing sectors of the North Carolina economy, growing 28.2% in the past ten years. Nationwide, this industry employed over 25,000 Ph.D. and other highly trained workers directly in 2003 and over 127,700 jobs were attributable to this sector that year.⁷³

North Carolina is increasingly split between the prosperity of the urban areas and rural counties and between white North Carolinians and other minorities. With a labor force of over 4.2 million in February 2005, North Carolina has an overall unemployment rate of 5.9%. Thirteen rural counties had unemployment rates above 8%. Most of these counties were in the Southeast and near Charlotte, areas most affected by textile, apparel and furniture closings.⁷⁴

Diversity and Poverty

North Carolina has a diverse population: 72.1% White; 21.6% Black; 1.2% American Indian; 1.4% Asian; 4.7% Hispanic.⁷⁵ Blacks continue to be the largest minority group, with over 30% of the population along the coast. The Hispanic population is growing very quickly, up 333.1% or over 300,000 new residents from 1990-2000. About half of these Hispanics settled in rural counties.⁷⁶

The median household income in North Carolina was \$39,184 in 2000,⁷⁷ compared to the U.S. median of \$41,994 for the same year.⁷⁸ Again, there was a major disparity by race: the median household income for Whites was \$42,530; Blacks: \$27,845; Asians: \$49,497; and Hispanics: \$32,353.⁷⁹

⁷² NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁷³ Milken Institute, "Biopharmaceutical Industry Contributions to State and US Economics," October 2004.

⁷⁴ www.ncesc.com/lmi/laborstats/LaborStatsMain.asp, accessed 4/18/05.

⁷⁵ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁷⁶ <http://demog.state.nc.us/demog/hisp9000.html>, accessed 1/31/05.

⁷⁷ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁷⁸ www.factfinder.census.gov, accessed 1/31/05.

⁷⁹ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

Almost 1 million people lived in poverty in North Carolina in 2000.⁸⁰ The poverty rate in North Carolina, 12.3%, is approximately the same as the U.S. average of 12.4%⁸¹. However, 23 rural counties, basically on the coastal plain and far west, have poverty rates over 18%. And, 22.9% Black, 21% American Indian, and 25.2% Hispanic residents live in poverty in North Carolina.⁸²

The Bureau of Labor Statistics projects that the national Hispanic labor force will be larger than the Black labor force by 2010,⁸³ primarily because of faster population growth due to immigration and increased labor force participation rates. These trends are likely to be reflected in North Carolina. However, historically, the Hispanic population is among the least well-educated, and therefore is an important target for upgrading educational levels and job skills.

Education and the Workforce

Education and workforce preparedness continues to be an issue in North Carolina. As shown in Table 3.C.5 on the next page, the percent of North Carolina population 25 and older with a high school diploma or bachelors degree is lower than the rest of the South overall and the nation as a whole.

But, North Carolina's population is becoming more educated. Table 3.C.4 below shows the higher percentage of high school graduates among those 25-44 compared with older North Carolinians. A similar trend is evident for bachelors degrees. The educational attainment among the 25-44 year old cohort approaches the national averages, suggesting that the younger members of North Carolina's workforce are almost as well educated as the U.S. as a whole.

Table 3.C.4 North Carolina Educational Attainment, 2004, Percent of Population 25 and Older

	Population (thousands)	Percent high school graduate or higher	Percent bachelor's degree or higher
North Carolina	6,171	80.2%	21.1%
South	76,900	82.1%	23.1%
National	186,877	85.2%	27.7%

Source: www.census.gov/population/www/socdemo/education/cps2004.html. Tables A, 12 and 14, accessed 4/12/05.

⁸⁰ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁸¹ www.factfinder.census.gov, accessed 1/31/05.

⁸² NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁸³ Fullerton, Howard N and Toossi, Mitra. 2001. "Labor Force Projections to 2010: Steady Growth and Changing Composition." Monthly Labor Review. <http://www.bls.gov>. Accessed March 30, 2005.

Table 3.C.5 North Carolina Educational Attainment, 2004, Percent of Population 18 and Older

Age	Population (thousands)	Percent high school graduate or higher	Percent bachelor's degree or higher
18-24	857	75.5%	6.5%
25-44	2339	85.8%	24.7%
45-64	2019	83.5%	27.7%
65 and over	956	63.9%	11.4%
All over 18	6171	80.2%	21.1%

Source: www.census.gov/population/www/socdemo/education/cps2004.html. Table14, accessed 4/12/05.

Another challenge is that educational attainment by different race and ethnic groups varies widely. Table 3.C.6 shows that 76.5% of Blacks and 46.8% of Hispanics have completed high school, while 40% of Asians have a B.A. or higher contrasted to just 8% of Hispanics.

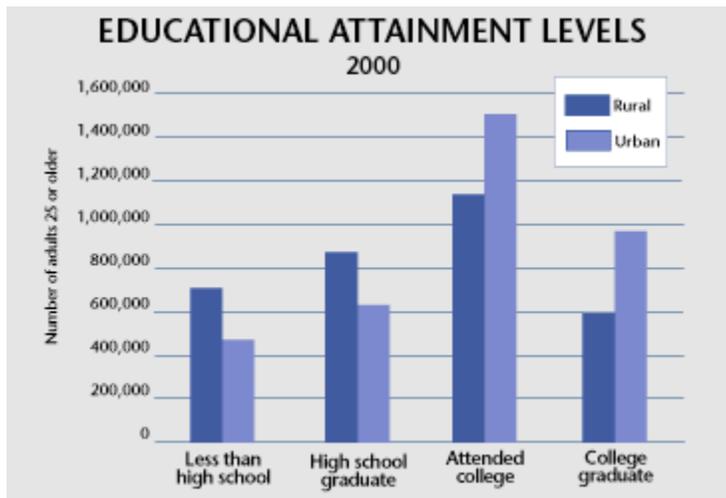
Table 3.C.6. North Carolina Educational Attainment, 2004, Percent of Population 25 and Older

	Population (thousands)	Percent high school graduate or higher	Percent bachelor's degree or higher
Male	2,556	79.6%	24.3%
Female	2,757	82.2%	22.6%
White	4,044	81.9%	24.4%
Black	1,029	76.5%	18.5%
Asian	114	87.4%	40.0%
Hispanic	318	46.8%	8.0%

Source: www.census.gov/population/www/socdemo/education/cps2004.html. Table14, accessed 4/12/05.

There is a big difference in educational attainment between rural and urban areas of the state. However, the rural populations are also older and have a higher percentage of minorities, both of which also have lower levels of educational attainment. This is illustrated in Figures 3.C.7 and 3.C.8 on the two following pages.

Figure 3.C.7. Educational Attainment Levels



Source: www.ncruralcenter.org/databank/trendpage_education.asp

Of the fastest growing occupations identified in the region's targeted industries, most will require postsecondary study and a substantial number of these will require a bachelor's degree.⁸⁴ As shown in Figure 3.C.5 on page 64, 20.5% of North Carolinians have attended college and 22.5% have a B.A. or higher (only 15.1% in rural areas, however).⁸⁵ The Research Triangle Region has more than two times the percent of college graduates as the Northeast region. Once again, North Carolina is below the national average; nationally, 24.4% have a bachelors degree or higher.

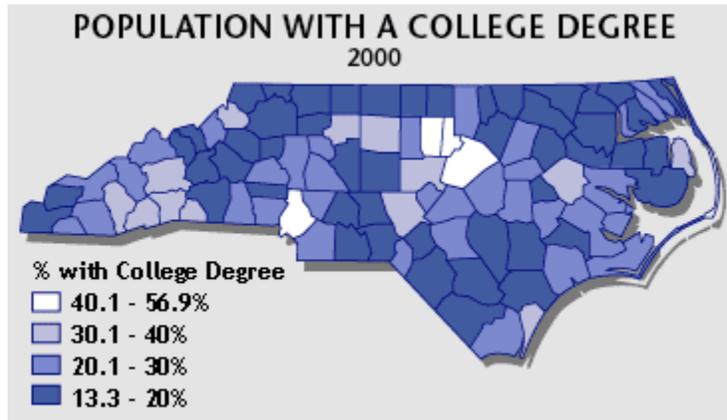
The differences in educational attainment by different race and ethnic groups are also a concern for diversity throughout the occupations. The National Center for Educational Statistics reports that in North Carolina, 78.1% of adults over 25 have completed high school, but only 70.7% of Blacks, 44.5% of Hispanics and 62.7% of American Indians.⁸⁶ This differential also applies to post-secondary education. Retention and graduation rates for minority students consistently lag those of all students. This "achievement gap" is a major economic development and workforce preparedness issue.

⁸⁴ www.factfinder.census.gov, accessed 1/31/05.

⁸⁵ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.

⁸⁶ Digest of Educational Statistics, 2003. www.nces.ed.gov.

Figure 3.C.8 Population with a College Degree by County



Source: www.ncruralcenter.org/databank/trendpage_education.asp

Summary

With the changes occurring in North Carolina's demographics and economic situation, at least four distinct groups of potential students for UNC and NCCCS are emerging. By 2010, the traditional postsecondary cohort of 18-24 year olds will reach at least 1 million, a 22.5% increase from 2000.⁸⁷ In addition, displaced workers from the traditional industries, who are generally less well educated than their peers, will require retraining to gain employment in growing industries. Third, training in English and math will be required for many North Carolinians who are underprepared for postsecondary education. This could also include a substantial percentage of the over 600,000 North Carolinians who speak a language other than English at home.⁸⁸ Finally, the increasing pace of change in knowledge requires lifelong or "just-in-time" learning. This suggests that many members of North Carolina's population will come back to UNC or NCCCS during their lives, perhaps more than once, to gain new knowledge and skills.

⁸⁷ <http://www.demog.state.nc.us>, accessed 4/18/05.

⁸⁸ US Census 2000, "Language Use and English Speaking Ability: 2000," C2KBR-29, issued October 2003. www.census.gov/population/www/socdemo/lang_use.htm, accessed 4/18/05.

4. CURRENT EDUCATIONAL ENVIRONMENT

4A. NORTH CAROLINA COMMUNITY COLLEGE SYSTEM

Overview of System

The North Carolina Community College System (NCCCS) is comprised of 58 comprehensive community colleges and one specialized textile technology center (See Attachments 1 and 2 of this report, and referenced in Attachment 5 of this report as Appendix 4.A.1). The 21-member State Board of Community Colleges provides state-level governance and each College has a local board of trustees. The current governance and administrative structure was approved by the 1963 General Assembly. To increase access, the Community College Statutes authorize and encourage the use of off-campus facilities and thus Community Colleges are for commuting students. Therefore, there are no residence halls at any of the Colleges. Further, 45 of the Colleges have off-campus facilities that are approved by the State Board of Community Colleges. Of North Carolina's 100 counties, 90 have facilities operated by the Community Colleges. In 2003-2004, total funding for the System originated from the following sources: state 67.3%, local 13.4%, tuition and fees 15.7%, federal 3.2%, and other 0.4%.

The "Statement of Purpose" section of the community college law states: "The major purpose of each and every institution.... shall be and shall continue to be the offering of vocational and technical education and training, and of basic, high school level, academic education needed in order to profit from vocational and technical education" (for students who have left the public schools). This wording was included in the law to allay the concern that liberal arts offerings might overshadow vocational and technical training.

2003-2004 System enrollment was 779,132 (unduplicated headcount). During this enrollment period, approximately one-third of the students were in curriculum programs that led to a degree, diploma, or certificate. Converting the unduplicated headcount to full-time equivalents (FTE) yields the following breakdown: 192,693 total full-time equivalent students, with 77% of the FTEs being earned in curriculum or credit programs. Over the past five years, total headcount enrollment has increased by 3.2% and FTE enrollment by 21.7%. In 2003-2004, minority students comprised slightly over one-third of curriculum students and about the same proportion in continuing education programs.

The State Board of Community Colleges has designated service areas for each College, so as to assign specific geographic areas for each institution. These assignments also include a coordination procedure, whereby a College may offer courses in another College's service area when there is mutual consent and written agreement (Section 2C.0100, North Carolina Administrative Code).

Current Academic Programs

The North Carolina Community College System offers a comprehensive array of academic programs for students. All 58 Colleges offer workforce education and training, liberal arts or general education, and continuing education ranging from basic literacy skills to advanced training for business and industry. Due to the number and location of Community Colleges, including off-campus facilities, offerings are very accessible for commuting students.

Curriculum Programs

Curriculum programs are offered in over 290 areas, with most leading to an associate in applied science, a diploma, or a certificate. Referenced in Attachment 5 of this report, Appendix 4.A.2 is a program matrix for the curriculum offerings by College. In 2003-2004, a total of 27,994 completions (graduations) were recorded by Community College students. Referenced in Attachment 5 of this report, Appendix 4.A.3. lists completions by program area. These completions are recorded for associate degrees, diplomas, and certificates.

All curriculum programs in the Community College System were revised in 1996-1997. This intensive process involved numerous faculty committees and System Office staff who revised program standards and graduation requirements. Simultaneously, a common course library was adopted for the System and curriculum courses of study were converted from quarter hours to semester hours. The end result was more uniformity across the System, making it easier for students to move from one Community College to another and making it easier to develop the Comprehensive Articulation Agreement with UNC and its constituent institutions (please see page 100).

Certificate programs range from 12 to 18 semester hour credits and can usually be completed within one semester for a full-time student. Associate degree level courses within a certificate program may also be applied toward a diploma or an associate of applied science degree.

Diploma programs range from 36 to 48 semester hour credits and can usually be completed within two semesters and one summer term for a full-time student. Associate degree level courses within a diploma program may also be applied toward an associate in applied science degree.

Most curriculum programs lead to an associate in applied science degree, though there are diploma and certificate tracks. Associate in applied science degree programs range from 64 to 76 semester hour credits. A full-time student can typically complete one of these programs within two years. In addition to technical/major course work, associate in applied science degree programs require a minimum of 15 semester hour credits of general education, and include course work in communications, humanities/fine arts, social/behavioral sciences and natural sciences/mathematics.

Curriculum programs are grouped into the following instructional clusters: Agricultural and Natural Resources Technologies; Biological and Chemical Technologies; Business Technologies; Commercial and Artistic Production Technologies; Construction Technologies; Engineering Technologies; Health Sciences; Industrial Technologies; Public Services Technologies; Transport Systems Technologies; and the College transfer degrees (Associate in Arts, Associate in Fine Arts, and Associate in Science).

In 2003-2004, a total of 16,134 students received degrees, 7,996 received diplomas, and 3,864 received certificates. All of these completions were in curriculum programs.

Programs with high completions (250 or more) in combined degrees, diplomas, and certificates in 2003-2004 include: Accounting – 653; Air Conditioning, Heating, Refrigeration – 670; Associate Degree Nursing – 1,531; Automotive Systems – 292; Basic Law Enforcement – 1,029; Business Administration – 1,094; Computer Programming – 356; Cosmetology – 549; Criminal Justice – 552; Dental Assisting – 276; Early Childhood Associate – 1,669; Electrical/Electronics – 589; Industrial Maintenance – 258; Information Systems – 924; Medical Assisting – 448; Medical Office Administration – 819; Network Administration and Support – 521; Office Systems – 789; Paralegal – 282; Phlebotomy – 267; Practical Nursing – 730; Radiography – 321; Truck Driver Training – 406 (all certificate level); and Welding – 318. In 2004, The State Board of Community Colleges: approved five curriculum programs that were new to the System; approved 41 existing curriculum programs for delivery by the Colleges (new to the Colleges, but not new to the System); and terminated 57 curriculum programs due to a lack of enrollment for at least a two-year period.

New programs are established as a response to local and regional labor market needs and student demand. Each program is approved by the State Board of Community Colleges following a regular curriculum approval process for applications submitted by individual Community Colleges. Curriculums are designed and developed by the applying College with input from employers and advisory committee members. Many programs being offered are of regional interest and may be offered by only one or a small number of Colleges within the System. The State Board has a policy that requires Colleges to formally terminate low enrollment or inactive programs.

Community Colleges offer college transfer programs through the Associate in Arts, Associate in Fine Arts, and Associate in Science degrees. In 2003-2004, completions or graduations in these program areas were: Associate in Arts—2,685; Associate in Fine Arts—34; and Associate in Science—394. Over the past five years, college transfer (AA, AS, AFA) enrollment has consistently been at about 22% of total curriculum enrollment.

Forty-three of the Colleges offer the Associate in General Education degree. General education programs are designed for individuals wishing to broaden their education, with emphasis on personal interest, growth and development. The program is not principally designed for College transfer. A total of 478 students completed this program in 2003-2004.

Curriculum enrollment by College, System, and major program area (associate, certificate, diploma, and transitional) is referenced in Attachment 5 of this report as Appendix 4.A.4. Transitional students used to be designated special credit students. These special credit students are: high school students enrolled under the dual enrollment program; part-time students who have not selected a program of study; students on waiting lists to get into selective admissions programs (for example, nursing); and University or College students taking a few summer courses.

The funding for Community College programs is enrollment driven, and it has a one-year lag with funding in any given year being based on the prior year's enrollment. With few exceptions, new programs have to be planned and implemented within these funds. In essence there are no start-up funds to assist a College in starting a new program. This makes it difficult to start new programs, particularly those with high start-up and operational costs. A recent study of the funding formula has recommended changes to the General Assembly that, if approved, would address some shortcomings of the formula. However, it does not address the need for start-up funding for new programs, particularly those to support the education and training needs of emerging industries that will emerge from this study.

Cooperative programs with public school systems enable high school students to enroll in selected college-level courses on a tuition-free basis. In 2003-2004, a total of 20,664 high school students took tuition-free Community College courses through Huskins and dual enrollment programs. The Huskins Bill (named after the legislator who sponsored the legislation allowing enrollment of high school students) and concurrent enrollment policies provide for educational programs and services to foster the effective utilization of available resources and to provide for more comprehensive educational opportunities. Cooperative programming is intended to enhance educational choices for high school students without duplication of services. Students may not take remedial or developmental courses under these policies.

Continuing Education Programs

Continuing education programs include all non-credit offerings, ranging from teaching basic skills (literacy education, English as Second Language, and so on) to a variety of instructional services for business and industry. Approximately two out of every three Community College students are enrolled in continuing education programs, with the majority in basic skills and occupational education and training. Referenced in Attachment 5 of this report, Appendix 4.A.5. gives continuing education enrollment by College, System, and major program area. We next provide descriptions of the various Continuing Education programs.

Basic Skills Education

Providing basic skills education is a major part of the Community College System's mission. This program assists adults to: become literate and obtain the knowledge and skills necessary for employment and self-sufficiency; obtain the educational skills necessary to become full partners in the educational development of their children; and complete a secondary school education. This program provides educational opportunities for adults to improve their reading, writing, mathematics, and communication skills through the five major program components enumerated below.

1. Adult Basic Education (ABE)—A program of instruction designed for adults who lack competence in reading, writing, speaking, problem solving, or computation at a level necessary to function in society, on a job or in the family. Enrollment was 77,509 in 2003-2004.
2. General Educational Development (GED)—A program of instruction designed to prepare adult students to pass the GED tests that lead to a high school equivalency. Enrollment was 16,774 in 2003-2004. In 2003-2004, a total of 10,776 students completed the GED program.
3. Adult High School (AHS)—A program of instruction offered cooperatively with local public school systems to help adults earn an Adult High School Diploma. Enrollment was 7,661 in 2003-2004. In 2003-2004, a total of 2,432 students completed the AHS program.
4. English Literacy/English as a Second Language (ESL)—A program of instruction designed to help adults who have limited English proficiency achieve competence in the English language. Enrollment was 36,708 in 2003-2004.
5. Compensatory Education (CED)—A program for adults with mental retardation who have not had an education or who have received an inadequate education. Students enrolled in the CED program are tested and placed in one of the above programs/skills levels.

Note: During this reporting period 2,237 high school graduates with skills below the high school level enrolled in the ABE and GED programs (included in the above enrollment figures).

Training for Business and Industry

A major part of the continuing education program provides training for business and industry. This is a priority area for the Community College System. The System Office organization has most services for business and industry located in the Economic and Workforce Development Division. Educational services are provided through four major program areas.

1. Occupational Continuing Education: Students enroll in occupational or workforce continuing education courses to develop skills for a new job or to improve their skills for their current job. In 2003-2004, 221,741 (about 40%) of the total continuing education students took classes in this program area. Most of these classes are short-term, and cost the student \$50-65 (\$65 is the maximum fee for these classes, with the exception of a limited number of high cost offerings, which are operated on a self-supporting basis). Approximately three-fourths of these students worked while attending training. Enrollments are clustered primarily in business/industry training (35%), health and safety (36%), and public safety (39%).

Even though the cost of instruction is comparable in both curriculum and occupational continuing education, there is a significant difference in the FTE reimbursement rate. Because of differences in funding formulas, occupational continuing education is funded at about three-fourths of the funding of curriculum offerings. System-wide, this differential amounted to a little over \$20 million in 2003-2004.

2. New and Expanding Industries Training (NEIT): North Carolina pioneered free, customized job training for new and expanding businesses in 1958 and it continues to be one of the nation's most recognized state-supported customized job training programs. The General Assembly has placed the responsibility for this training in the Community College System. Workforce and economic development staff at the System Office and the Colleges work closely with the North Carolina Department of Commerce and local economic developers in economic development activities. Referenced in Attachment 5 of this report, Appendix 4.A.6. gives summary data for this program since 1986. Activity in this program has fluctuated over the years based largely on the economic cycles and expansion demands from the business community. In 2003-2004, Community Colleges provided NEIT services to 121 new and expanding industries and trained 10,117 workers. Funds for this program are managed at the System level and are allotted to specific training projects after application by a sponsoring College and the business for which the training will be done.
3. Focused Industry Training (FIT)—This program was initiated in the 1980s in response to the training needs of existing businesses. Rapid changes in the workplace and in the economy placed pressure on existing businesses to retool their production facilities and retrain their workers. Most of these needs could not be met by the NEIT program. In 2003-2004, FIT offerings were provided by 37 Colleges to 701 companies. A total of 10,559 workers were trained in 1,071 classes.
4. Small Business Center Network (SBCN): Each of the 58 Community Colleges has a Small Business Center that provides services to local businesses. The Centers provide a wide variety of seminars and workshops, one-on-one counseling, library resources, and referrals to other sources of assistance. Each College receives a flat allotment of \$70,462 (2004-2005) to operate its SBC and

most Colleges supplement this allotment with funds from other parts of their budgets (over \$1 million in 2002-2003). In 2003-2004, the 58 Centers provided the following services: seminars/workshops—2,979 for 44,475 participants; counseling services—18,493; and referrals—5,831. Except during the height of the recent recession when counseling and referrals showed a significant increase, activity over the past five years has been relatively flat.

In early 2005, the SBCN entered into partnership with the legislatively created North Carolina Military Business Center that has as its purpose increasing private sector business with military bases in the state. The Colleges' Small Business Centers serve as a point of contact for those seeking information on defense contracts with these facilities.

Funding over the 20-year history of the SBCN has only increased an average of approximately \$1,000 per year for each of the Colleges.

Human Resource Development

The Human Resources Development (HRD) program provides skills assessment services, employability skills training, and career development counseling to unemployed and underemployed adults. Its courses address six core components: (1) assessment of an individual's assets and limitations; (2) development of a positive self-concept; (3) development of employability skills; (4) development of communication skills; (5) development of problem-solving skills; and (6) awareness of the impact of information technology in the workplace. Historically, the majority of students in this program are unemployed and enroll because they need basic job-seeking skills training courses. HRD programs link to traditional skills training courses in the occupational continuing education area such as clerical skills, customer service, and so on.

Enrollment in the HRD program was 63,573 in 2003-2004. The recent recession caused dramatic increases in enrollment, with the 2003-2004 enrollment being 90% greater than the 2000-2001 enrollment.

Public Safety Training and Education

In 2003-2004, the Community College System provided training to 148,070 paid and volunteer fire fighters and members of emergency medical services units (rescue squads). Training is delivered at Community Colleges and in local fire departments. Service certification is provided in some areas and specialty programs are offered in selected skill areas. Enrollment has increased by 19% over the past five years.

Basic Law Enforcement Training (BLET) is designed to give students essential skills required for entry level employment as law enforcement officers with state, county, or municipal governments, or with private enterprise. This curriculum (for credit) program utilizes State commission-mandated topics and methods of instruction. General subjects include, but are not limited to, criminal, juvenile, civil, traffic, and alcoholic beverage laws; investigative, patrol, custody, and court procedures; emergency responses; and ethics and community relations. Students must successfully complete and pass all units of study which include the certification examination mandated by the North Carolina Criminal Justice Education and Training Standards Commission and the North Carolina Sheriffs' Education and Training Standards Commission to receive a certificate. This curriculum, which is offered at 47 Community Colleges, enrolled 1,637 students in 2003-2004. . A significant amount of education and training for law enforcement personnel is also offered through the continuing education program (non-credit).

Correctional or Inmate Education

In 2003-2004, instruction was provided to inmates in a prison setting by 48 Community Colleges. Programs offered range from basic skills to curriculum courses and programs. Inmate education provided by Community Colleges operates under a special Correctional Education Plan that takes into account high inmate mobility and low student completion rates. This plan was jointly adopted by the State Board of Community Colleges and the Department of Correction that operates the state's prisons and was designed to increase student completion rates by ensuring that course and program lengths are appropriate for the inmate population at any given prison. In 2003-2004, 3,659 inmates were enrolled in Community College classes and 22,964 took continuing education classes.

Special Initiative: BioNetwork

The Community College System BioNetwork is a new statewide initiative to help meet the specialized workforce training needs of the growing biomanufacturing and pharmaceutical industry in North Carolina. In late 2003, the System, along with UNC and the North Carolina Biosciences Organization secured more than \$60 million in funding from the Golden LEAF Foundation and industry to launch a major biotechnology training and education initiative. Working together as the North Carolina Biomanufacturing and Pharmaceutical Training Consortium (BPTC), UNC and NCCCS will provide an integrated system of workforce training and educational opportunities to prepare North Carolina's workforce for employment in the biomanufacturing, pharmaceutical, and related industries.

BioNetwork's portion of new funds was \$8.7 million of startup funding for early implementation. With these funds, a biotechnology office was established in the System Office, six Community Colleges were selected for BioNetwork Competitiveness Centers, and 65 grants were made to colleges for innovation, equipment/facility enhancement, and distance learning. The Centers serve as hubs of expertise and are located in six of the

state's seven economic development partnership regions. Each Center has a specific area of responsibility: Bioprocessing; General Pharmaceutical Manufacturing; Agricultural Biotechnology; Continuing Education; Biotechnology Enterprise Catalyst; and Capstone Center.

BioNetwork capstone training will occur in dedicated space in the Biomanufacturing Training and Education Center being constructed on North Carolina State University's Centennial Campus. This facility will enable Community College students to receive specialized training (for example, clean room/aseptic techniques) which individual campuses cannot afford or justify.

To promote collaboration among Colleges, distance learning will be a significant part of the program. Also, a self-contained, advanced scientific mobile laboratory will travel the state, providing specialized hands-on training to incumbent workers and accelerated lab courses for Community College students in remote areas.

PRELIMINARY FINDINGS - NCCCS

1. The North Carolina Community College System through its 58 colleges and numerous off-campus facilities provides accessible education opportunities for students. Ninety of North Carolina's 100 counties have Community College facilities of some sort, approved by the State Board of Community Colleges.
2. Academic programs are comprehensive at all 58 Colleges, ranging from basic literacy education through the first two years of a baccalaureate degree.
3. There is a State Board-approved process Colleges use to plan and develop new programs. There is also a State Board policy on terminating low enrollment or inactive programs.
4. Curriculum programs are organized around system-wide standards and include ladder opportunities (i.e., certificate, to diploma, to degree) for students. This gives more students the opportunity to earn a credential and facilitates the transfer of students from one Community College to another.
5. College transfer or liberal arts programs have not negatively impacted the statutorily required emphasis on workforce education and training (technical and vocational) and adult education. For the last five years, college transfer enrollment has consistently been about 22% of total curriculum enrollment. Conversion from the quarter system to the semester system several years ago has not negatively impacted workforce education and training.
6. The basic skills offerings in the Community Colleges are structured so as to allow progression to the next level within the same institution (i.e., educational ladder).

7. The Community College System provides a significant amount of education and training for business and industry through its continuing education programs. In addition, most of the training for public safety agencies at the local level—fire, emergency rescue, and law enforcement—is provided by Community Colleges.
8. The BioNetwork initiative, the Community College System’s component of North Carolina’s focus on biotechnology, has been rapidly organized at the System level and among participating Colleges over the past year. Collaboration with UNC and particularly NCSU and NCCU is a key part of this initiative. This collaboration has great potential for both systems and could serve as a model for future initiatives.
9. The funding process for Community Colleges is enrollment driven and has a one-year lag. Special funding to start new programs is usually not provided. This will continue to have a negative impact on planning and implementing new programs, particularly high cost offerings that will be needed to support the education and training needs of emerging industries.

4B. UNIVERSITY OF NORTH CAROLINA

Overview of System

North Carolina’s Constitution (1776) directed, in part, that “all useful learning shall be duly encouraged and promoted in one or more universities.” In 1789 the General Assembly chartered the University of North Carolina. Until the late 1800s, the University at Chapel Hill was the only state-supported institution of higher education in North Carolina. Between 1867 and 1963, the other 15 institutions now in UNC were created or acquired.

In 1971, the Higher Education Reorganization Act restructured the public senior institutions in North Carolina. The 32-member Board of Governors (BOG) was established to govern all public senior institutions in the state and a student was designated to serve, *ex officio*, on the board. The BOG is the policy-making body legally charged with "the general determination, control, supervision, management, and governance of all affairs of the constituent institutions." It elects the President, who administers the University. The 32 voting members of the BOG are elected by the General Assembly for four-year terms.

Each of the 16 constituent institutions has a board of trustees. Each board has 13 members, with eight members being elected for four-year terms by the BOG and four being appointed for four-year terms by the Governor. The SGA president serves as an *ex officio* member. (See Attachments 1 and 3 to this report.)

UNC and its constituent campuses are considered to be agencies of the State of North Carolina. UNC funds come from state appropriations, tuition receipts, federal grants and contracts, and other non-state funding sources.

Current Academic Programs

The UNC provides accessible academic program information to prospective students and others. A program matrix is available from UNC, by program area, by institution, and by degree level (Referenced in Attachment 5 of this report as Appendix 4.B.1.).

In the case of UNC, there are approximately 31 different academic degree program areas and over 300 distinct degree programs; however, no UNC institution offers academic programs in all areas. For example, programs in agriculture are only offered by the state's two land grant institutions: North Carolina A&T and North Carolina State University. Also, a limited number of institutions offer high cost, relatively low demand engineering programs. For example, only North Carolina State University has a comprehensive engineering program (16 different majors, 12 of which include bachelors, masters, and doctoral programs). North Carolina A&T offers an extensive engineering program with 8 majors, 3 of which include bachelors, masters, and doctoral programs. UNC Charlotte offers 6 engineering majors, 2 of which include bachelors, masters, and doctoral programs. A number of other institutions either have niche programs or joint programs. For example, UNC Chapel Hill offers masters and doctorates in biomedical engineering (joint with North Carolina State University), material science, as well as in operations research. East Carolina University has a baccalaureate engineering program. Western Carolina University offers a bachelors in electrical engineering jointly with UNC Charlotte. UNC Asheville offers mechatronics jointly with North Carolina State University.

There are a number of program areas for which all institutions offer degrees (with the exception of North Carolina School of the Arts, which has a distinct and unique mission). These include: biology; accounting; business administration; computer science; English; mathematics; chemistry; psychology; history; political science; and sociology.

In areas of high demand such as teacher education, nursing, and computer science, UNC institutions offer a significant number of degrees at most, if not all, UNC institutions (with the exception of North Carolina School of the Arts). Education degrees are offered everywhere except North Carolina School of the Arts. Not all institutions offering teacher education do so in all fields or at all degree levels. Nursing is offered at eleven of the institutions, with masters programs at six of those institutions, and doctoral degrees at three. Computer science is offered at the bachelors level at all institutions, masters at eight institutions, and doctoral degrees at two.

In areas of relatively low demand, such as philosophy, physics, and classics, a number of UNC institutions provide access to degrees in those areas. Six institutions offer a bachelors in philosophy and only UNC Chapel Hill offers masters and doctoral degrees. In physics, twelve institutions offer a bachelors degree, six a masters, and two provide doctorates. And in classics, only three institutions offer a bachelors and only one (UNC Chapel Hill) also offers both the masters and doctorate.

In emerging fields, such as bioengineering and biomedical engineering, nanotechnology, and food safety, UNC has limited (one bachelors, two masters, and two doctorates in bioengineering and biomedical engineering) or no apparent programs (nanotechnology and food safety), although there may be such programs incorporated in other existing degrees and in research activities.

The liberal arts are well represented in the program offerings. (See separate section on the liberal arts on pages 104-107 of this report). All institutions offer a number of the key liberal arts majors (such as English and History) and most offer an extensive array of liberal arts majors. In addition, North Carolina has made a commitment to supporting a public liberal arts college, UNC Asheville, which has many of the characteristics of an elite private liberal arts college.

Remediation is extensive in NCCCS and, to a lesser extent, in UNC, responding to gaps in high school preparation and to the needs of adult learners who also have a time gap from their previous academic preparation. In UNC, each institution determines placement in remedial activities; these activities include not just remedial courses, but also skill labs, tutoring, and summer bridge programs (although not all of those students will enter remedial programs). Some UNC institutions contract with a local community college to provide remediation (East Carolina University with Pitt Community College and UNC Wilmington with Cape Fear Community College). Most of the remediation offered is in mathematics and English, with the greatest demand being for the former. Remedial courses count in a student's load but do not count towards a degree.

Enrollment in duplicated remedial instruction (that is, formal classes) in UNC institutions appears to have declined over an eleven-year period, from 9,043 in 1991-92 to 6,724 in 2002-03, a 26% reduction. The latest data suggest further reduction to 4,454 in 2003-04. A similar reduction has occurred in unduplicated enrollment, which appears to have declined 29% from 7,802 in 1991-92 to 5,516 in 2002-03. (Duplicated enrollment counts students twice if they need both math and English remediation; unduplicated counts such students only once.)

The overall percentage of freshman students in UNC institutions needing remediation is not reflected in the reports, which are not disaggregated by type of student (for example, new freshman, transfer, returning student). If all of the students needing remediation had been new freshmen (which they would not have been but that category makes up the majority of remedial students) then the percentages would have been 38.1% in 1991-92 and 20.7% in 2002-03. Of those needing remediation, 70.7% require remediation in math.

Remediation in NCCCS includes not just English and math, but also developmental reading. Community Colleges select from an approved list of placement tests and their policy calls for the adoption of a minimum test score to exempt a student from developmental studies courses. The need for remediation has increased from 33.2% of the students requiring one or more developmental courses in 1992-93 to 49.2% in 2003-04. As with UNC institutions, math is the area of greatest demand (39.8%), followed by

English (26.4%), and then reading (18.9%). The need for math has more than doubled since 1992-93. Although these data raise serious questions about the readiness of students to engage successfully in higher education, a significant proportion of NCCCS students are adults returning to education after an extensive absence from academic study.

All UNC institutions offer continuing education programs, which range from general interest courses to targeted skills development. While not as extensive or as focused as the continuing education programs in the Community Colleges, the UNC continuing education programs play a key role in the lifelong learning opportunities for the people of North Carolina and in providing access to the University for people in the local community who are not necessarily seeking a degree.

UNC institutions also engage their communities in other ways, especially in the arena of applied policy research. For example, the Appalachian State University Energy Center rates how involvement with the broader community can lead to a policy support role for the University. The Energy Center was established as a program in the Appalachian Regional Development Institute about four years ago in response to the needs of a group of faculty from various disciplines who were all involved in research on alternative energy. Because of the expertise of two faculty members, the Center received a contract to assist the North Carolina Energy Policy Council and the State Energy Office with development of the State Energy Plan in 2001. That contract, and subsequent contracts for implementation, brought the Energy Center into contact with energy policy leaders, the business community and the economic development community, resulting in multiple opportunities for additional involvement with energy policy issues. One subsequent activity has resulted in formation of a fuel cell group consisting of large corporations, innovative small businesses, environmental organizations and others to encourage a focus on fuel cell research and development as an economic development engine for the state.

Partnerships with communities can provide universities not just direct links to regional economic development, but also to quality of life issues that increasingly, albeit indirectly, play a significant role in economic development. UNC is a strong supporter and leader in multidisciplinary policies and partnerships that address community engagement, cooperative ventures, and public service activities. UNC has 168 centers and institutes that serve regional and state needs, 17 of which have been established since 1999. Within North Carolina, 22 Colleges and Universities are now members of the North Carolina Campus Compact (NCCC), a consortium established to encourage and support campus engagement in the community. “NCCC member campuses seek to involve students, faculty, and the entire campus in community service in order to fulfill higher education’s most noble goals of educating citizens, preparing tomorrow’s leaders, and contributing to the life of America’s communities.” (<http://www.elon.edu/nccc>). Universities across North Carolina are establishing new and significant partnerships with community and regional partners. In 2004, the University of North Carolina at Pembroke entered into a university-community partnership as co-founder and collaborating partner

in a public-private partnership organized and coordinated by the Center For Community Action. The *Jobs For the Future Project* has initiated extensive research, policy development, and economic development projects, including annual conference on Job Loss and Recovery in Rural America.

In addition to these general engagements with their communities, UNC institutions have targeted efforts to the small business community through the Small Business Technology Development Center (SBTDC) program. With eleven regional centers and seventeen offices, this program has a budget of approximately \$5M and a staff of 80, with 350 graduate and professional students working with clients annually. The focus market segments are:

1. entrepreneurship development services for start-ups and young companies (up to three years old);
2. survival and growth support for traditional small businesses (less than \$1 million in sales, over three years old);
3. growth and competitiveness strategies for small and mid-sized companies (more than \$1 million in sales); and
4. support for communities and agencies to help them develop more effective economic development strategies and tools.

The program provides: in-depth business counseling to about 7,000 clients a year; management education services to approximately 6,000 attendees; strategic action training for nearly 1,000 owners and managers each year; and service to public agencies and organizations.

States with governing boards for their universities, like North Carolina, have the ability to manage the array of academic programs in the best interests of the state and to facilitate non-credit and other services to communities. With program approval authority, a governing board can insist on distinctive missions for its institutions and on no unnecessary academic program duplication. While at times the exercising of this authority can frustrate campus boosters, including legislators and Chancellors, if a fair and reasonable process is followed for program approval then the appropriate balance between institutional ambitions and state needs can be achieved. UNC includes external reviewers to provide an objective analysis of need in complex cases. (A recent example would be the engineering need study conducted by NCHEMS for the system). This level of state overview probably helps explain why North Carolina has been able to prevent over-expansion of extremely expensive professional programs like medicine (East Carolina University and UNC Chapel Hill), law (North Carolina Central University and UNC Chapel Hill), and veterinary medicine (North Carolina State University).

PRELIMINARY FINDINGS - UNC

1. UNC makes its academic program array readily accessible to prospective students.
2. UNC institutions provide a wide range of academic offerings in all the major, traditional areas. These programs seem to be appropriately distributed across the institutions with relatively clear mission differentiation. For example, UNC includes a School for the Arts and a public liberal arts university (UNC Asheville).
3. UNC institutions all offer a broad range of liberal arts majors.
4. UNC appears to have largely minimized unnecessary and expensive duplication of specialized academic programs.
5. UNC institutions offer extensive academic programs in areas of current high state need.
6. UNC appears to offer a reasonable number of low demand academic programs that are desirable for offering a full academic array in the state.
7. UNC institutions may not be offering identified academic programs in emerging fields as quickly as some other states, although such programs may indeed be imbedded in existing programs.
8. The UNC appears to have provided appropriate leadership in balancing the needs of the state in academic programs with the ambitions of the universities. It has a clearly defined formal academic program review process that includes, where appropriate, external reviewers. It also has informal processes to work with institutions on academic program development that is consistent with institutional missions, including assistance in developing cooperative degree programs and collaborative efforts (including distance learning consortial academic programs).

PRELIMINARY FINDINGS – REMEDIAL EDUCATION - UNC/NCCCS

9. While remedial education *appears* to have declined in the UNC, it is difficult to draw a definitive conclusion as each UNC institution sets its own placement standards. Also, some do not offer formal remediation instruction (UNC Asheville and UNC Charlotte offer skill labs; UNC Chapel Hill provides summer bridge programs) as a consequence, remedial programs are not reflected in the enrollment data.
10. It is likely that a significant percentage of freshman students in UNC require formal remedial instruction (at least double digits and perhaps as high as one in five). When non-formal remedial activities are included, an even higher proportion of students require remediation. This adds to the cost of UNC and to the time to degree of such students. It also reduces their chances of being successful. It is unlikely that North Carolina can build a workforce for the knowledge economy without significantly decreasing the proportion of students who enter higher

education requiring remediation instruction. Particularly disturbing is the increasing proportion of students who require remediation in math since much of the knowledge economy, with its technology and science emphasis, requires strong math skills.

11. The trends for students requiring remediation in the NCCCS are disturbing. Since 1999-00, the range of students needing remediation has been between 48.6% (2000-01) and 54.3% (2001-02) with no real pattern of decline.
12. Approximately half of the students in the NCCCS require formal remedial instruction. As with the UNC students, the highest proportion of NCCCS students require remediation in math. This is equally troubling because more and more community college programs require increased levels of skill and knowledge in technology and math.

PRELIMINARY FINDINGS – OTHER SERVICES - UNC

13. UNC institutions offer an extensive array of non-credit programs that include some activities to assist lifelong learning and career changes.
14. UNC has a robust Small Business Technology Development Center, dispersed throughout the state that provides services to small and medium businesses and provides a substantial return on investment for the state.

4C. JOINT PROGRAMS AND PARTNERSHIPS

Role of the Governing Boards

Both UNC and NCCCS have state-level governing boards. From a state-level perspective, this has facilitated the development of joint programs and of partnerships. In addition, over a decade ago the General Assembly created the Education Cabinet, which operates within the Governor's Office and includes the Governor, the Chair of the State Board of Education, the Superintendent of Public Instruction, the President of the North Carolina Community College System, the President of the University of North Carolina, and the President of the North Carolina Association of Independent Colleges and Universities. Annually, the three public education governing boards—public schools, community colleges, and public universities—meet to review policy issues and to share information about public education in North Carolina.

In 2004, the UNC Board of Governors and the State Board of Community Colleges appointed the Task Force on UNC/NCCCS Partnerships to make recommendations on partnerships between the public universities and the community colleges. Late in 2004, the task force submitted its report to the two governing boards with twenty-five

recommendations, addressing annual reporting and communication, joint legislative action, academic programming partnerships, and transfer issues. The Board of Governors and the State Board of Community Colleges have presented identical budget proposals to address five of the recommendations:

1. Place UNC counseling/advising services on each Community College campus: These transfer offices would provide information to prospective transfer students, advise these students, coordinate course/program offerings between the two systems, and serve as a proctored test center to support online learning.
2. Jointly establish the North Carolina Teacher Center Network: This network would serve prospective teachers and support area school districts by enhancing teacher quality initiatives. These centers would complement the transfer centers and be co-located on a smaller number of geographically distributed Community College campuses.
3. Further develop the 2+2 E-learning initiative: This initiative would provide additional faculty support to develop courses. Emphasis will be on students being able to earn a BSN, or teaching certificate, or to advance from the RN to a BSN by distance learning from any county in North Carolina. The NCCCS Virtual Learning Community and more than 60 UNC baccalaureate completion programs can be combined to ensure that students anywhere in the state can have access to a degree program.
4. Expand the College Redirection Program: The College Foundation of North Carolina (CFNC) will expand its current program that matches not-yet-accepted students to colleges or universities with available space, so that community college students seeking to transfer are included. Students will be directed to the CFNC website and telephone number.
5. Expand the responsibilities of the Transfer Advisory Committee: The recently completed study of the Comprehensive Articulation Agreement between UNC and the NCCCS includes recommendations to expand the Committee's responsibilities. Permanent staffing is needed to do the work of the Transfer Advisory Committee, including revising the CAA document and developing a communications plan for the benefit of the institutions and students seeking transfer information.

SELECTED PARTNERSHIPS AND COLLABORATIVE INITIATIVES

The UNC Office of the President published a report in August 2004 listing the numerous partnerships now in place between Community Colleges and the UNC institutions. All UNC institutions listed ways they are working with Community Colleges. Selected examples from the extensive listing of UNC and NCCCS partnerships are briefly described below because of their uniqueness or their potential for replication.

Appalachian Learning Alliance

In 1999, Appalachian entered into a formal alliance with 10 Community Colleges in its traditional service region to deliver more advanced educational offerings than the respective Community Colleges were able to offer. The current program offerings are a mixture of both graduate programs and undergraduate degree completion programs. In the undergraduate programs, the Community Colleges typically offer much of the lower division course work consistent with the Comprehensive Articulation Agreement, and Appalachian offers upper division and other course work as needed to allow students to complete the degree. The principal delivery mode of most of these programs is face-to-face, but interactive video and web-based modes are sometimes used as parts of courses or programs. Appalachian delivered instruction at these sites as part of 27 graduate programs and 20 undergraduate programs during the Fall 2004 semester. Teacher preparation programs receive special emphasis in the Learning Alliance offerings.

East Carolina University's Wachovia Partnership East

With financial assistance from Wachovia Bank, the East Carolina University College of Education has established a regional consortium partnerships with the Community Colleges and public schools. Five consortia partnerships have been formed and are designated by geographic proximity to ECU—Pitt Consortium, Coastal Consortium, Northeast Consortium, South Central Consortium, and North Central Consortium. Each consortium serves the Community Colleges and school systems in that region. Students are able to complete the first two years of a baccalaureate degree at their community college (associate degree), using faculty from the Community College. After completing the associate degree, students move to the hub Community College in that region for the remainder of the course work for the baccalaureate degree. The upper level courses are taught by ECU faculty, either face-to-face or by distance learning. Each hub site has a full-time coordinator that serves as a resource to students and the local partners (community colleges and school systems).

Elizabeth City State University's Teacher Preparation Partnership Program

Elizabeth City State University (ECSU) and College of The Albemarle (COA) have an articulation agreement that focuses on the preparation of elementary school teachers. Students who participate in the program are provided a set of coursework and services offered through the two institutions. The first two years are offered by COA on their Elizabeth City campus and the second two years on the ECSU campus. Students in Dare County attend COA's Dare County Campus and ECSU also offers its courses on that campus. ECSU has committed to a full-time liaison to coordinate this program on COA's campuses.

ECSU has implemented a similar partnership with Halifax Community College (HCC), located a two-hour drive to the west of Elizabeth City. ECSU and HCC have an articulation agreement allowing students to pursue an elementary education degree. The University offers its courses on the Community College campus and provides a full-time liaison for on-site coordination.

North Carolina State University's Biomanufacturing Training and Education Center and BioNetwork

The North Carolina Biomanufacturing Training and Education Center (BTEC) is a new initiative funded by the Golden L.E.A.F. Foundation and by the North Carolina legislature to provide in-depth, hands-on training and education for students and prospective employees of the biomanufacturing, pharmaceutical, and related regulatory industries in North Carolina. Much of the training and education will focus on the unique skills needed that are not typically covered in traditional college and university curricula: hands-on experience on large-scale reactors and downstream processing equipment, clean-room training, aseptic processing, regulatory issues, validation, quality assurance and control, scale-up engineering, and related technologies. The Center will also provide education in emerging knowledge areas that will centrally impact the future of applied biotechnology, including advanced expression platforms, molecular discovery, and systems biology. The hands-on training will involve a close partnership with the North Carolina Community College System in which Community College and University instructors, lecturers, and professors will work side by side developing courses and curricula and by teaching jointly. Community Colleges will have designated space in the BTEC to offer capstone education and training for Community College students in biotechnology-related programs. This facility is projected to be occupied in late 2006.

NCSU, through the Cooperative Extension Service, Johnston Community College, and others, worked on a proposal that led to the funding and construction of the Johnston County Biotechnology Training Center. This collaborative initiative will focus on biopharmaceutical education and training.

University of North Carolina Charlotte's Transfer Initiatives

UNC Charlotte has the largest transfer student population of all UNC institutions. Fifteen percent (871 of 5,365) of all Community College transfers to UNC institutions in Fall 2003 went to UNCC. UNCC has a long history of closely working with Central Piedmont Community College and other Community Colleges in the region, including conducting workshops and frequent visits to Community College campuses by counselors and recruiters.

Western Carolina University

Western Carolina University has numerous collaborative arrangements with Community Colleges in western North Carolina. These include the following:

- Articulation agreements with eight Community Colleges that allow the transfer of AAS graduates into several baccalaureate programs in the School of Applied Sciences.
- BSN and MSN programs that are held on the Enka campus of Asheville-Buncombe Technical Community College.
- Baccalaureate EMS program delivered by distance learning at several Community College campuses. Cohorts of students meet once each month, with the remainder of class sessions being offered online.
- Teacher preparation program at Tri-County Community College.

PRELIMINARY FINDINGS

1. Both UNC and the Community College System have state-level governing boards. They have shown a strong interest in developing partnerships and collaborative initiatives that lead to improved educational opportunities for students.
2. The two governing boards in late 2004 accepted the recommendations of the Task Force on UNC/NCCCS Partnerships and have started implementing the recommendations.
3. One set of recommendations led to the submission of identical budget requests to the General Assembly to support enhanced partnerships and a better transfer process for Community College students. This may be the first time that the two governing boards have submitted coordinated budget requests totaling approximately \$6.5M, for the same items to the General Assembly.
4. The Office of the President of UNC recently conducted an inventory of partnership activities by UNC institutions with Community Colleges. Included in the inventory are brief descriptions of hundreds of partnership and outreach activities by the two systems. Some, such as the biotechnology initiative are very substantial and have attracted external funds.
5. Many collaborative activities between UNC institutions and the Community Colleges are quietly going on behind the scenes. However, many of them have great potential for students in both systems. One example is the development of 2 + 2 online collaborative programs in selected disciplines or majors. Students will be able to take the first two years online from a Community College and the upper division work online from a UNC institution.

4D. ENROLLMENT PROJECTIONS

Both the NCCCS and UNC maintain enrollment projections. In the case of NCCCS, those projections are at the system aggregate level, not by individual campus, and include data on Curriculum (regular credit programs), Continuing Education, Basic Skills, and Summer Term enrollments. The current projections go out through the 2013-2014 academic year. (Referenced in Attachment 5 of this report as Appendix 4.D.1) In the instance of UNC, those projections are by campus, disaggregated by undergraduate and graduate, and totaled for the system; the projections are headcount credit seeking students for each fall semester. The current projections go out through fall 2012 and will be updated this summer through fall 2015. (Referenced in Attachment 5 of this report as Appendix 4.D.2).

NCCCS uses some basic assumptions (See footnotes to Appendix 4.D.1 referenced in the previous section) and examines five year rolling averages in making its projections. UNC has been examining multiple models, looking at high school graduation rate projections (for undergraduate projections) and census data (for graduate projections). It also plans to look at projected high school graduates by race and ethnicity by county.

The enrollment projections for NCCCS show an overall increase of 38.37% between 2004 and 2014. Greatest percentage growth is predicted in the Continuing Education enrollment at 44.20% (from 20,831 to 30,037), followed by Basic Skills at 43.25% (from 17,808 to 25,511), Summer Term at 40.32% (from 18,730 to 26,282). The lowest predicted growth comes from the Curriculum area at 36.64% (from 142,056 to 194,104 FTEs). The annual growth in every area is largely incremental (ranging from 2.32% to 4.18%), with no area showing a decline in any year.

The enrollment projections for UNC show an overall increase of 32.89% between 2002-2012 (the current ten-year plan period), increasing from a total of 176,967 students in 2002 to a projected 235,180 students in 2012. The increase in graduate students is projected at 43.38% (from 36,635 to 52,528), significantly higher than the projected increase for undergraduates at 30.16% (from 140,331 to 182,652).

Enrollment projections (as opposed to enrollment caps) are somewhat unreliable, especially in the further out years. They rely on predicting human behavior without full knowledge of a multitude of variables. For example, the economy often influences higher education enrollment, especially at Community Colleges (For example, during economic downturns enrollment pressures increase as people seek to improve their marketability). Also, policy decisions such as admission standards and tuition rates can impact enrollments. National and international events can further impact enrollments (For example, a decline in foreign student enrollment because of greater difficulty in getting student visas; or the relative attractiveness of a military career as an alternative to college). Nevertheless, even though enrollment projecting is an inexact science, it is a worthwhile and necessary part of higher education and state planning.

PRELIMINARY FINDINGS

1. Both the NCCCS and UNC maintain ten-year enrollment projections. However, the NCCCS does not disaggregate its data by institution, although it does incorporate all elements of its instruction (not just the credit producing programs); the absence of individual campus projections may inhibit regional planning for workforce production. While the UNC does disaggregate by institution, it does not provide projections for continuing education.
2. While both systems project significant enrollment increases, the current models do not anticipate major shifts in current enrollment patterns (for example, major changes in age cohorts participating in higher education; significant changes in retention rates). The UNC models could be easily adapted to examine these changes at the appropriate time and do examine such items as changing demographics by county.
3. The increase in the projected graduate student enrollment has positive implications for the new economy, which will require a more highly educated workforce.
4. The projected increases in overall higher education participation may not be sufficient to fuel the economy that North Carolina seeks to build.

4E. DISTANCE LEARNING

Overview

Distance learning has a long history in American higher education beginning with correspondence courses. Now the internet has provided new tools to bring e-learning to students at any time and at any place. This mode of instruction is of particular benefit to place bound students and students already in the workforce. This demand for e-learning will inevitably increase in importance as a greater proportion of the population seeks to increase education levels. In analyzing distance education, it is important to look at issues such as:

- Enrollment and Academic Data
- The Percentage of Faculty Participation In Distance Learning
- Organizational Responsibility for Distance Learning
- Distance Learning Modes
- Content Sources
- Support
- Software Platforms
- Evaluation

It is also critical to examine such infrastructure issues as bandwidth capacity and the reliability/flexibility of the present systems to insure the infrastructure is robust enough to support the increasing demands for this type of instruction.

4.E.1A. DISTANCE LEARNING DATA: UNIVERSITY OF NORTH CAROLINA

Enrollment and Academic Data

There has been substantial growth in distance learning in UNC: in course sections (from 646 in 1999 to 1,909 in 2004); headcount enrollment (from 6,929 in 1999 to 26,031 in 2004); and in student credit hours (from 38,998 in 1999 to 173,410 in 2004). The graphs on the following pages summarize key enrollment and academic data. Figures 1-3 are updated versions of corresponding graphs in the 2004 *Report on Expanding Access Through State-Funded Distance Education Programs*.

Figure 1: Growth in UNC Distance Learning Course Sections: Fall 1999—Fall 2004

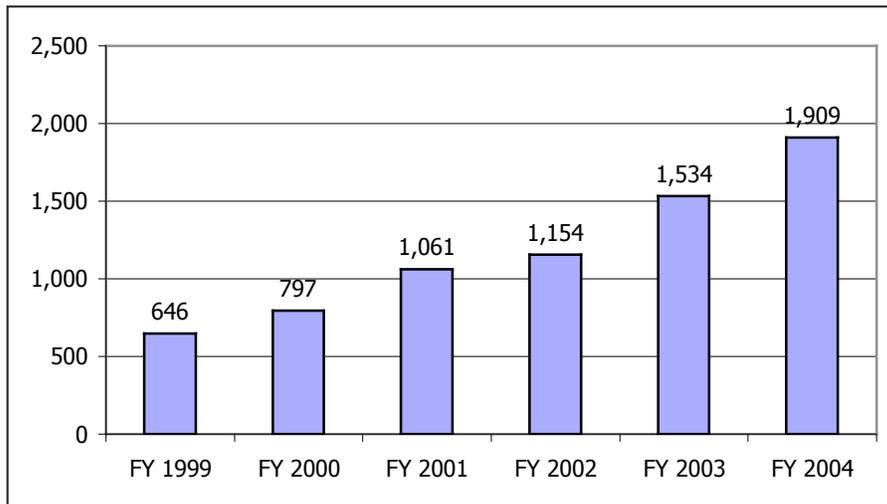
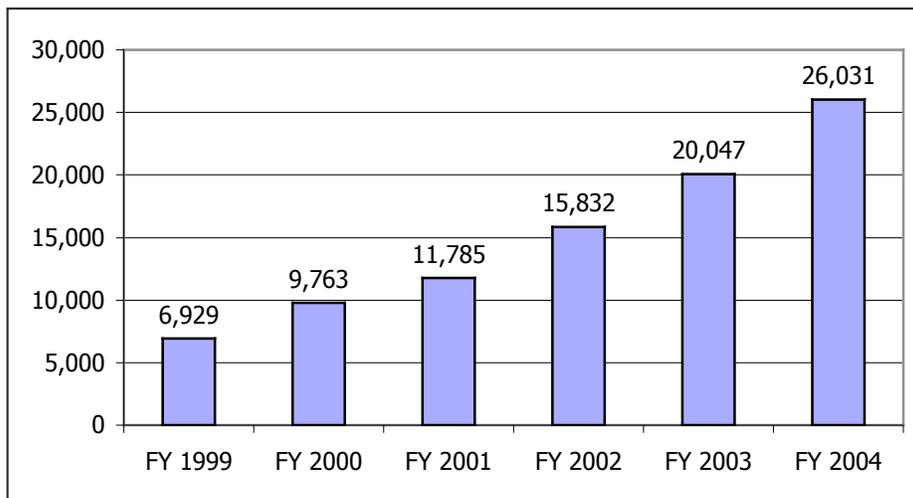
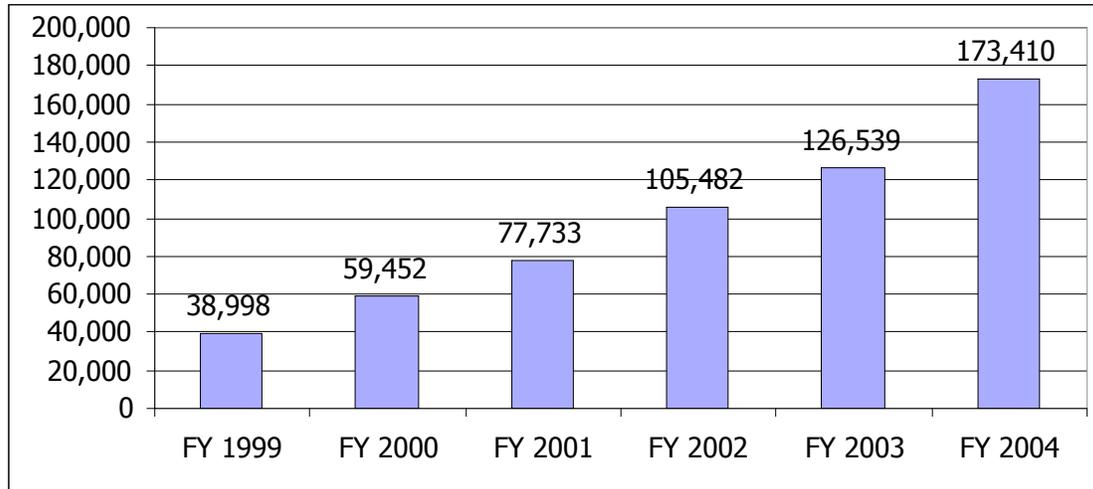


Figure 2: Growth in Unduplicated Headcount Enrollment in UNC Distance Learning Programs, FY 1999 – FY 2004



* Note: UNC reports unduplicated headcount enrollment (that is, a student taking more than one course is only counted once) for distance learning; NCCCS reports duplicated headcount enrollment (that is, a student who takes more than one course is counted for each course taken) for distance learning (see p. 89).

Figure 3: Growth in Student Credit Hours in UNC Distance Learning Programs, FY 1999 – FY 2004



According to a survey conducted by EDUCAUSE, it appears that UNC institutions offer a higher percentage of distance learning courses than average and a slightly lower percentage of UNC students take such courses than the average.

Figure 4: Fall 2004: Distance Learning Percentages for Students and Courses vs. Educause* Benchmarks

	Percent of Courses Offered	Percent of Students Taking a Course
UNC Fall 2004	9.1%	4.5% (unduplicated)
Educause 2003 Survey	7.5%	5.0%

* *Evolving Campus Support Models for E-Learning Courses*, Paul Arabasz and Mary Beth Baker, Educause 2003.

Thirteen UNC institutions offer distance degree programs, two currently offer only courses (Elizabeth City State University and UNC Asheville), and North Carolina School of the Arts does not offer distance programs. Through an agreement with the North Carolina Community College System, UNC institutions do not offer lower division (100-200 level courses) in distance programs.

In spring 2005, UNC has 234 authorized distance learning programs in 83 CIP (Classification of Instructional Programs) disciplinary areas. Degree levels of these programs are: 97 baccalaureate; 118 masters; 15 intermediate (for example, EdS); 3 doctoral; and 1 first professional. Of these, 160 are site-based (compared to 131 in spring 2002), including 11 that are at more than one site. A total of 118 UNC degree programs are taught at 28 Community Colleges, with the remaining site-based programs taught at locations such as public schools, health care settings, military bases, and graduate centers.

Growth has been steeper in online degree programs (from 6 in Spring 2000 to 86 in Spring 2005), including a number of site-based programs that have been converted to online delivery. Development of online degree programs and inter-institutional collaborations has been encouraged by annual e-learning grants made by the UNC President's Office.

The percentage of faculty participation in distance learning varies greatly from campus to campus. Six campuses report participation rates between 10%-16%, and four campuses report participation rates below 10%. Six campuses did not include rates in their reports, while East Carolina University placed the rate at 10%, adding that all courses include e-learning content.

Organizational responsibility for distance learning differs greatly from campus to campus. In general, distance learning is overseen by the Vice Presidents for academic affairs. Some campuses place distance learning with continuing education; some place it under the auspices of individual departments; and some have established departments specifically devoted to teaching technologies.

Distance Learning Modes: All but one of the 16 campuses offer asynchronous learning via Blackboard or WebCT. Very few courses use simultaneous live/online content.

Content Sources: Of the campuses responding, all but Elizabeth City State University devote on-campus development resources to distance learning, although five do so only at the departmental level. The number of full-time employees devoted to courseware development varies greatly from campus to campus, from none at UNC Asheville to 27 at East Carolina University. Similar to the percentage of faculty participation rates, there are plateaus of FTE between these extremes, with four devoting 2-7 FTEs, and three devoting 14-18 FTEs to learning technology development. The use of outsourced or third party content also varies, with about 30% of campuses using this type of resource.

Support: All campuses use online, phone, email and face-to-face support for faculty and students. Some include outsourced help desk, online manuals or self-proficiency courses.

Across the 15 campuses offering distance education, the number of FTEs per campus working in the area of distance learning technical support ranges from 1.0 to 9.0. The number of distance learning faculty members providing technical support averages approximately twenty per campus. The number of FTEs working in the area of distance learning technical support has doubled or tripled on most campuses over the past five years.

Pedagogical support: All campuses offer faculty a modest amount of pedagogical support, either in the form of instructional design personnel or workshops and other forms of professional development opportunities in the area of online instructional design. In addition, all professional development activities of the UNC Teaching and Learning with Technology Collaborative are available to all campus faculty and staff members.

Software platforms for learning management and course delivery: Ten campuses use *Blackboard*, and six use *WebCT*. Individual faculty also utilize *MS Frontpage*, *Centra*, *Netmeeting*, *Edufolio*, *Wimba*, *Impatica*, *Camtasia*, *WolfWare*, and others. There is no overall learning content management system, but pilot projects using Blackboard and WebCT are underway. Four campuses outsource their content hosting. Purchasing standards for distance learning technology are currently shared among campuses, with development ongoing throughout UNC.

Collaboration: As part of the 1999 UNC Information Technology Strategic Project, the UNC Office of the President formed three new offices within the Division of Information Resources: the Office of Coordinated Technology Management; the Shared Services Alliance; and the Teaching and Learning with Technology Collaborative:

- Coordinated Technology Management identifies common IT products and services used by UNC campuses and negotiates group acquisitions and system-wide contracts to contain costs.
- The Shared Services Alliance ("Alliance") provides a forum for UNC's 16 campuses to explore new and better ways to collaborate on administrative IT issues. The Alliance spearheads a number of projects to bring new applications to UNC's campuses.
- The Teaching and Learning with Technology Collaborative (TLTC) provides faculty and staff development opportunities, vision, and shared resources in support of teaching and learning with technology programs and initiatives on the 16 UNC campuses. The TLTC supports campus distance learning initiatives, as well as all campus efforts to promote technology-enhanced instruction.

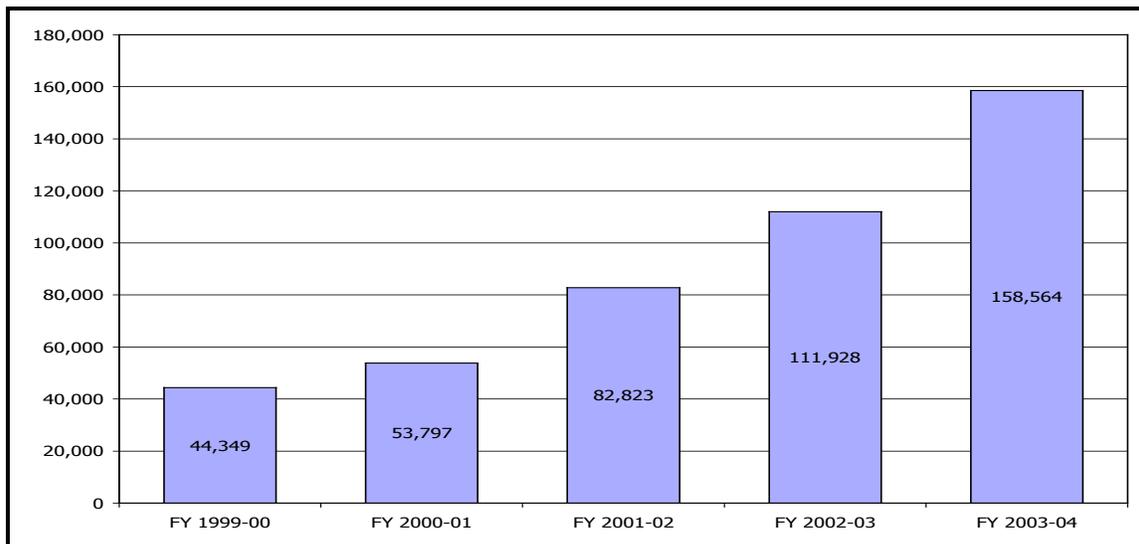
Evaluation: Online learning is evaluated differently on each campus, but most conduct surveys of students and/or faculty regularly. Faculty are often asked to review the quality of material being taught, while the students are more often asked to review the quality of the delivery methods.

In general, the evaluation processes for course and instructor quality used on campus are also used for distance programs. Program assessment is typically done on a course-by-course basis. Some approaches to ensuring quality include: student surveys on quality of course and instructor; analysis of student performance and demographic data; surveys of satisfaction with services such as registration and library access; peer evaluation of teaching; program advisory councils; use of evaluation specialists; and feedback from employers and internships. (Ref: *Report on Expanding Access Through State-Funded Distance Education Program*, page 12.)

4.E.1B. DISTANCE LEARNING DATA: NORTH CAROLINA COMMUNITY COLLEGE SYSTEM

Distance learning enrollment has also grown rapidly in the NCCCS, from 44,349 duplicated headcount enrollment in 1999 to 158,564 in 2004. The annual growth has ranged from 17.6% to 35.0%.

Figure 5: Growth in Duplicated Headcount Enrollment in NCCCS Distance Learning Programs, FY 1999 – FY 2004



* Note: UNC reports unduplicated headcount enrollment (that is, a student taking more than one course is only counted once) for distance learning; NCCCS reports duplicated headcount enrollment (that is, a student who takes more than one course is counted for each course taken) for distance learning.

Academic year	% Increase
1999-2000 to 2000-01	17.6%
2000-01 to 2001-02	35.0%
2001-02 to 2002-03	26.0%
2002-03 to 2003-04	29.4%

According to the EDUCAUSE survey, it appears that NCCCS institutions offer a higher percentage of distance education courses than average and a substantially higher percentage of NCCCS students take such courses than the average.

Figure 6: FY 2003-2004: Distance Learning Percentages for Students and Courses versus Educause* Benchmarks

	Percent of Courses Offered	Percent of Students Taking a Course
NCCCS	9.5%	11.0% (duplicated)
Educause 2003 Survey	7.5%	5.0%

* *Evolving Campus Support Models for E-Learning Courses*, Paul Arabasz and Mary Beth Baker, EDUCAUSE 2003.

The percentage of faculty participation in distance learning:

No data available.

Organizational Responsibility for Distance Learning: In 2003, two Associate Vice President (AVP) positions were created to support distance learning at the system level. One is charged with distance learning content, and the other is responsible for infrastructure and support. Both do not work solely with distance learning. One AVP is assisted by two staff (one part-time, one full-time), and the other has five (four in Library Resources and one in Video Services). The two AVPs and staff collaborated to develop the NCCCS Distance Learning Strategic Plan and NCCCS Distance Learning Expansion Budget Request for '05-'06 & '06-'07 budget planning cycle.

Distance learning administration and organization varies among NCCCS institutions. Rapid growth of online delivery has often resulted in the creation of distance learning departments. Among the 58 institutions, there is one AVP Distance Learning position, several Deans with multiple responsibilities, and many Distance Learning Directors or Coordinators.

Distance learning modes: Asynchronous delivery systems include: *Blackboard*, *Ucompass/Educator*, *Campus Cruiser*, *Ed2go*, *Moodle* (open source; one college).

Nearly all online course and telecourse enrollments across the NCCCS are “Pure Distance Learning” requiring no on-campus/in-person instruction for the student. If mandatory meetings are required with face-to-face options, those courses are designated as hybrid or “other” as a distance learning format.

Content Sources

On Campus Faculty or Resources: To date, faculty development teams have centrally developed 203 curriculum and 12 continuing education courses for use by colleges throughout the state. However, this is only about 15% of courses that have been developed or procured. Of the other 85% of courses, NCCCS estimates 5% to 10% were "course cartridges," or commercially produced content procured from various sources, and the balance were developed by faculty.

NC-NET: NC-NET offers Community College faculty in North Carolina a collaborative, statewide professional development system that is committed to sharing best practices, leveraging resources, and avoiding duplication. There are no positions dedicated solely to the production of course content. Many Colleges produce their own courses, but production is completed by local faculty members. One College outsources hosting for its *Blackboard* installation, two Colleges share support for *CMS* installations, and five Colleges are negotiating *Blackboard ASP hosting services*. The System Office is negotiating ITS hosting of *Blackboard Learning System Enterprise version*, *Campus cruiser* is used in some colleges, and *Ed2Go* provides Occupational and Continuing Education for all colleges.

Purchased From 3rd Party: NCCCS currently purchases online content from two vendors, while some Colleges use online content from book publishers.

Support

No system-wide distance learning support is available due to funding limitations, and local support varies according to available resources. Most Colleges have telephone and email support, while two provide *Presidium Learning* online help desk services.

Software Platforms

Learning Management: Currently, *Blackboard*, *Ucompass/Educator*, *Campus Cruiser*, *Ed2Go*, *Moodle* (open source; one college).

Course delivery: CMS software (*Blackboard*, *WebCT*, *Educator*) is used to support hybrid courses and provide course enhancements. The *Blackboard* CMS platform has been established as a standard. Outsourcing and/or hosting services are utilized in isolated instances.

Evaluation

No hard data are available regarding distance learning effectiveness. However, there is anecdotal evidence stating that distance learning retention rates have been rising for the past five years and approximate those of traditional courses. Each College assesses the effectiveness of each course. A superset of distance learning course assessments does not exist.

It is the intention of NCCCS per Objective 5.1 in the *Strategic Plan for Distance Learning* to recruit a team of distance delivery experts to audit the process for creating Web-based courses.

4.E.2. INFRASTRUCTURE: UNC AND NCCCS

Distance learning plays a prominent and increasing role at both UNC and NCCCS. It represents a cost effective and potentially high quality method for providing instruction to the existing student base, as well as dramatically extending the reach of the UNC and NCCCS student base. If growth at UNC and NCCCS continues at the current pace, the need for adequate technical infrastructure (bandwidth, related communications technologies, and support) is critical.

A baseline review was undertaken of the University of North Carolina (UNC) and Community College (NCCCS) distance learning infrastructure in relation to their capacity, future utilization, and preparedness for anticipated growth.

Bandwidth Capacity

UNC

UNC's bandwidth comes from the North Carolina Research and Education Network (NCREN). NCREN is a charter member of Quilt, the national association of GigaPoPs. This membership enables NCREN to procure, on behalf of all connected institutions, the very lowest possible Internet and Internet2 rates. NCREN's charter allows the connection of all of Higher Education: UNC Universities; Community Colleges; K-12 Public and private schools; state, local, and county government offices; research organizations; other non-profit organizations; and a small number of related commercial organizations.

- While UNC has considerable bandwidth, the demands are likely to continue to grow because of the anticipated increase in older students (partly as a result of demographics), the increase in part-time students, and the increase in courses with greater bandwidth requirements (such as health related courses and graduate programs).

NCCCS

T-1 data connectivity is provided to all Community Colleges, and is directly funded by the System Office through its ITS department. Colleges can elect to augment ITS bandwidth with local funding, or Colleges can contract with local Internet Service Providers. Some Community Colleges (for example, Guilford Technical Community College, Fayetteville Technical Community College, Pitt Community College) are buying more affordable bandwidth, which is a short-term solution.

There is clearly a constraint on bandwidth, and informal reports state that NCCCS is at 95% of capacity during peak usage periods. NCCCS (Ref. *NCCCS Requests For Distance Learning IT Funding Proposal Project Justification*) reports that ITS data service has not been uniformly increased in 4 years, but that typical data utilization of an organization increases 20 to 25% annually—even without introducing new bandwidth-intensive applications.

As student enrollment levels increase, peak periods will become even more of a concern, and cause more systems to drop under stress. Efforts such as the CCLINC Consortium requests for server upgrade and data base maintenance funding (Ref. *NCCCS Requests For Distance Learning IT Funding Proposal Project Justification*) are steps in the right direction.

For several years, the NCCCS and the UNC have pursued an emerging wireless broadband technology called Educational Broadband Service or ITFS. About half the community colleges and some of the universities hold licenses for bandwidths regulated by the Federal Communications Commission. This is still an emerging technology, but it has significant potential for the institutions serving rural North Carolina.

The future will put even greater demands on bandwidth. These include, for example:

- Implementing programs like the BioNetwork initiative will overstretch the 3MB service now in place in many of the Community Colleges (Ref. *2005-7 Expansion Budget Request Justification*, page 1, para 4).
- Adding bandwidth intensive applications, such as *Campus Cruiser*, Video Streaming, e-procurement, H.323 video services, voice over IP, Allied health applications and other similar technology (Ref. *2005-7 Expansion Budget Request Justification*, page 1, para 2.)
- Contemplating other technology initiatives such as:
 - ✓ The Virtual High School that will provide a progression path from high school to Community College to university.
 - ✓ A learning content management system for system-wide management of all course materials. This initiative, when funded, could also help with consolidating programs and achieving system-wide cost efficiencies.

The following issues could also impact the need for increased bandwidth by UNC and NCCCS:

- Increasing the scope, depth and “media richness” of courses.
- Developing WiMax (wide area wireless).

Reliability and Flexibility of Present Systems (UNC/NCCCS)

- Both systems are currently using Video Streaming, H.323 video services and voice over IP. These are accepted current technical standards that are designed to ensure both reliability and flexibility of systems. For example, H.323 allows video over IP, the Internet standard protocol.
- UNC utilizes video networking that includes automatic conversion gateways, 6 ISDN-B channels and various downlinks. All of these systems add reliability and flexibility of both capacity movement and course content.
- For NCCCS, the Data and NCIH Consolidation Project will upgrade the videoconferencing network to the current H.323 industry standard, allow expansion of video services to all main campuses, facilitate the expansion of data infrastructure at each College, and move all budget management to the System Office.

PRELIMINARY FINDINGS

1. The number of programs and courses offered through distance learning is growing rapidly for the UNC and NCCCS.
2. Student enrollments in distance learning programs and courses are growing rapidly for both the UNC and NCCCS.
3. Both UNC and NCCCS appear to offer a greater percentage of courses through distance learning than national averages.
4. The level of involvement in distance learning activities varies widely with each university or Community College.
5. The scope of support, and the facilities and personnel provided for content development, vary considerably with each institution.
6. The demands on the UNC and NCCCS networking infrastructure continue to grow, due to increased numbers of course offerings and student enrollments, as well as the offering of more technologically demanding content presentations.

7. The present NCCCS network is near capacity for the distance learning offerings currently supported, creating a growing hurdle regarding expanding the scope or quantity of distance learning courses as well as planning for future joint initiatives with the UNC.

4F. STUDENT MOBILITY

Comprehensive Articulation Agreement (CAA)

In 1995 legislative action led UNC and the NCCCS to develop the Comprehensive Articulation Agreement (CAA) in 1997. The (CAA) was designed to benefit students by improving the transfer of Community College students to UNC institutions, especially for those enrolled in the Associate in Arts or the Associate in Science degree programs. The CAA does not guarantee admission to a particular campus; however, some campuses have worked with specific Community Colleges to establish independent agreements to ensure that students who meet specific requirements will be accepted into a specific UNC institution.

Intensive work was done in 1996 by University and Community College faculty to identify courses appropriate for the general education core. Working with the Transfer Advisory Committee, a list of courses that constitutes the general education core was selected. If completed successfully by a Community College student, the core is portable and transferable as a block across all 58 Community Colleges and to all UNC institutions. Furthermore, the CAA enables North Carolina Community College graduates of Associate in Arts and Associate in Science degree programs who are admitted to constituent UNC institutions to transfer with junior status. The UNC Office of the President web site has an excellent online resource for those interested in more detail on the CAA, including information on private colleges and universities that honor the CAA (www.ga.unc.edu/student_info/caa). Referenced in Attachment 5 of this report, Appendix 4.F.1 gives the Comprehensive Articulation Agreement.

Due to the reduced number of general education hours in the Associate in Fine Arts degree program (28 SHC), the CAA treats these students differently. The receiving institution determines whether the courses with a “C” or better grade count as general education, major, or elective credit. AFA students who transfer must meet the general education requirements of the receiving institution.

The UNC Board of Governors and the State Board of Community Colleges are currently considering modifications to the CAA, referred to as the Transfer Assured Admissions Policy, which will ensure Community College transfers of admission to a UNC institution in most circumstances, though not necessarily to a specific campus or to a specific program or major.

Articulation Agreements for the Associate in Applied Science Degree

A majority of Community College programs lead to an Associate in Applied Science degree (AAS). A number of students who take the AAS degree, which is designed primarily for movement directly into the workplace, decide they would like to pursue a bachelors degree. For many years, some of the UNC institutions have worked with individual Community Colleges on bilateral articulation agreements for specific AAS programs.

The Comprehensive Articulation Agreement includes a section on the Associate in Applied Science degree. It states that upon admission to another public two-year institution or to a public university, a Community College student who was enrolled in an AAS degree program and who satisfactorily completed with a grade of "C" or better all courses that are designated for College transfer (general education, elective, or pre-major) will receive credit for those particular courses.

Articulation of AAS degree programs is handled on a bilateral articulation agreement basis rather than on a statewide basis. Under bilateral agreements, individual Universities and one or more Community Colleges may join in a collaborative effort to facilitate the transfer of students from AAS degree programs to baccalaureate degree programs. The Transfer Advisory Committee maintains a current inventory of bilateral articulation agreements for AAS degree programs.

Articulation of Selected Programs Using Distance Learning

The UNC and the NCCCS are developing articulated NCCCS online degree programs with selected UNC online baccalaureate programs with the objective of creating programs that can be completed in their entirety through distance learning. Faculty from the two systems have met and approved the curriculum for four programs—communication, liberal studies, criminal justice, and business administration. Information and computer technology is also being considered. In some cases, these programs will involve Associate in Applied Science degrees at the Community Colleges. For these, new tracks have to be developed so they will fall under the guidelines of the Comprehensive Articulation Agreement.

In March 2004, the North Carolina Joint Legislative Education Oversight Committee of the General Assembly contracted with MGT of America, Inc., to conduct a study of the Comprehensive Articulation Agreement (CAA) between the University of North Carolina (UNC) and the North Carolina Community College System (NCCCS). Completed in late 2004, this study's findings and recommendations were presented to the legislative committee and to the two governing boards.

By most accounts, the CAA, though not perfect, has been successful. The 2004 study by MGT of America confirmed that seven years after its implementation, the CAA has improved the transfer of students from Community Colleges to UNC institutions. The transfer process has been standardized, and students are better able to plan their

movement to the public universities. This study revealed that most students expressed satisfaction with their transfer experiences and the advisement they received. However, advisors, administrators, and faculty described problems with the process and provided numerous suggestions for improving the process and the CAA. As a result, the study made 20 recommendations to the General Assembly and the two governing boards. These are in various stages of being implemented by the two systems, either independently or in collaboration.

The MGT study analyzed transfer information over a six-year period from 1997-98 through 2002-03. The analysis noted the following:

- Most measures of student performance showed an increase over the six-year time period. In many instances, significant shifts occurred after the 1998-99 year, suggesting that the changes were a result of the Comprehensive Articulation Agreement.
- Retention, graduation, and persistence rates for students entering UNC institutions with an associate degree compared to those without the associate degree demonstrated the advantage of completing the associate degree at a Community College prior to transferring to a UNC institution.

Table 1 below shows total Community College transfers to UNC institutions for Fall 2001-Fall 2003. These data include all Community College transfers, including those who transferred without an associate degree. Over these three years, total Community College transfers increased 17.5%.

Table 1: New Undergraduate Transfer Students from NCCCS

<u>INSTITUTION</u>	Fall 2001 Transfers	Fall 2002 Transfers	Fall 2003 Transfers
ASU	404	389	394
ECU	590	661	770
ECSU	72	95	76
FSU	160	175	207
NCA&T	151	198	194
NCCU	119	145	153
NCSA	8	10	11
NCSU	403	439	463
UNC-A	145	169	113
UNC-CH	146	124	180
UNC-C	751	812	871
UNC-G	469	471	467
UNC-P	234	284	286
UNC-W	527	579	711
WCU	265	259	307
WSSU	121	192	162
UNC Total	4,565	5,002	5,365

Table 2 below shows Community College transfers with associate degrees to UNC institutions for the same time period, Fall 2001-Fall 2003. This information shows a decrease in the number of transferring students with associate degrees over the three-year period by -2.9% and a decrease of -14.2% from Fall 2002 to Fall 2003.

Table 2: Transfer Students from NCCCS with Associate Degrees

<u>INSTITUTION</u>	Fall 2001 Transfers	Fall 2002 Transfers	Fall 2003 Transfers
ASU	167	178	137
ECU	232	219	237
ECSU	29	38	29
FSU	62	83	67
NCA&T	55	38	20
NCCU	46	47	33
NCSA	1	2	3
NCSU	202	223	207
UNC-A	56	85	56
UNC-CH	77	88	72
UNC-C	255	300	239
UNC-G	158	205	122
UNC-P	85	116	90
UNC-W	257	306	323
WCU	111	131	124
WSSU	29	25	29
UNC Total	1,842	2,084	1,788

The guidelines for CAA apply to transfers from Community Colleges to UNC institutions and to transfers within the Community College system. The general education core that is portable and transferable as a block from Community Colleges to UNC institutions is also portable and transferable among the Community Colleges. From Fall 1999 to Fall 2003, the number of students transferring from Community College to Community College increased from 915 to 1,405, a 53.6% increase. This sizeable increase is much larger than the increase in Community College curriculum enrollment over the same time period of 17.6%. Though other variables may be involved, it appears that the CAA has facilitated the transfer of students among North Carolina Community Colleges. However, the CAA does not apply to transfer among the UNC institutions.

Information on transfers from UNC institutions to Community Colleges is available from the Statistical Abstract of Higher Education, which is produced on an annual basis by the UNC. (It is available online and includes data for all higher education institutions in North Carolina.) In Fall 2003, a total of 886 students previously enrolled at UNC institutions transferred to Community Colleges. This was a 12.6% increase from Fall 2002 and a 20.7% increase from Fall 1999.

The Statistical Abstract of Higher Education, published annually by UNC, notes that in Fall 2003 a total of 1,917 students transferred from one UNC institution to another UNC institution. North Carolina State University received the most transfers, 280. UNC Charlotte had the highest number of students to transfer to another UNC institution, 290.

PRELIMINARY FINDINGS

1. The Comprehensive Articulation Agreement (CAA), developed by the two systems and approved in 1997 by the UNC Board of Governors and the State Board of Community Colleges, has significantly improved the transfer process for Community College students to UNC institutions; in addition, the number of students transferring from a Community College to another Community College has dramatically increased.
2. A study was recently done by MGT of America of the CAA and its impact on the transfer process. The study stated that the CAA is “widely perceived as indeed having improved the transfer of associate in arts and associate in science degrees. It is perceived that the primary strengths of the CAA include standardizing the transfer process and providing students with a path and plan for transferring. Quantitative data support that a greater number of students are transferring between North Carolina Community Colleges and UNC institutions.”
3. Numerous changes and enhancements were recommended in the MGT of America study and are being addressed by the UNC Board of Governors and the State Board of Community Colleges. These changes will strengthen the CAA and improve the transfer process for Community College students.
4. Information available at the time this Interim Report was prepared show a significant decrease from Fall 2002 to Fall 2003 in the transfer of Community College students with the associate degree to UNC institutions (-14.2%). Further research will be done to determine how much of this decrease may be a reporting anomaly attributable to a new information system implemented by NCCCS over the past several years. Forthcoming results on Fall 2004 transfer information will help determine whether or not this is a trend.
5. The CAA does not apply to transfer among the UNC institutions. That is the general education core of one UNC institution does not automatically transfer as meeting the general education core at another UNC campus. This may inhibit the mobility of students from one University to another (unless the institutions already do so informally).

4G. THE ROLE OF THE LIBERAL ARTS

The role of the liberal arts actually increases in importance as the knowledge economy grows. While at first glance the knowledge economy requires specialized skills, especially in science, math and technology, it actually most prizes employees who have strong critical thinking and problem solving skills; who have effective communication skills; who have the ability to work in collaborative teams; who have intellectual curiosity; and who can not just make a living but be productive citizens and contributing community members. As someone once said, “Education is what’s left after you have forgotten everything you have been taught.”

The knowledge and skills of the liberally educated graduate of higher education have also become more valuable because, unlike in previous eras, most graduates will have multiple careers and will work with technologies yet to be invented. Thus those entering the knowledge economy must have a high degree of flexibility and the ability to be lifelong learners. They must also have a sensitivity to the demands of operating within a global society and economy. For these and other reasons, it will be crucial that the preparation of the future workforce not just be considered a vocational enterprise, but rather a total education challenge. As the earlier analysis shows there is an increasing demand for employees who have the so called “soft skills.”

Fortunately, both the NCCCS and the UNC have made a strong commitment to the liberal arts in their academic programs. UNC institutions have a wide-range of liberal arts majors, most of which produce significant numbers of graduates. Of greatest importance, though, are the general education core requirements in both systems. Both systems have extensive general education/core requirements. Furthermore, a number of statutes have helped ensure the transferability of general education courses between the two systems. Statutes in the 1995 legislative session led to considerable activity in 1996, resulting in an agreed upon transferable general education core. This core is portable and transferable as a block across the Community College system and to all University of North Carolina institutions, as long as the student has at least a 2.0 GPA and a C or better grade in each core course. However, there is not a comparable block transfer of a general education core among University of North Carolina institutions.

The associate in arts and associate in science degree programs in the NCCCS require a total of 64-65 semester hours credit for graduation. Of these credit hours, 44 represent the general education transfer core. These include study in the areas of humanities and fine arts, social and behavioral sciences, natural sciences and mathematics, and English composition.

The course distribution for the general core for Community Colleges is as follows:

English Composition (6 Semester Hours Credit)

Humanities/Fine Arts (9-12 Semester Hours Credit)

Four courses from at least three of the following discipline areas: music, art, drama, dance, French, German, Italian, Russian, Spanish, interdisciplinary humanities, literature, philosophy, and religion. At least one course must be a literature course. (3 SHC in Speech/Communication may be substituted for 3 SHC in Humanities/Fine Arts. Speech/Communication may not substitute for the literature requirement).

Social/Behavioral Sciences (9-12 Semester Hours Credit)

Four courses from at least three of the following discipline areas: anthropology, economics, geography, history, political science, psychology, and sociology. At least one course must be a history course.

Natural Sciences/Mathematics (14-20 Semester Hours Credit)

Natural Sciences (8 SHC): Two courses, including accompanying laboratory work from among the biological and physical science disciplines.

Mathematics (6 SHC): At least one introductory mathematics course (college algebra, trigonometry, calculus, etc.) must be selected; the other unit may be selected from among other quantitative subjects, such as computer science and statistics.

The specific courses used to fulfill the requirement in each of these areas are identified by each Community College as meeting its own general education requirements. The courses are drawn from those courses designated in the North Carolina Community College Common Course Library as being appropriate as part of a general education core transfer curriculum.

The UNC institutions do not have as much uniformity in their general education requirements as do the Community Colleges. Total credits required range from 36 at the School of the Arts to 45 at Chapel Hill. These include courses in the following categories: English; Speech; Foreign Language; Humanities, Literature, Philosophy/Religion; Fine Arts; Social Science, History, Western Civilization, World Cultures; Science; Math; P.E.; and Other. Within these categories, the institutions vary considerably in their requirements. While all institutions have requirements in English (mostly 6 credits), Math (from 2-8 credits), Humanities (from 3-18), Social Science (from 3-21), Science (from 2-14), only six institutions have requirements in Speech, eight in Foreign Language, twelve in Fine Arts, and thirteen in P.E. These variations may help explain why the general education core does not automatically transfer from one UNC institution to another.

Both the Community College and University general education core are very traditional in nature, with a menu of course possibilities distributed over a number of general academic discipline categories. While it is noteworthy that the Community College general education core transfers to UNC, that core was largely developed in 1996 so it has been almost a decade since it was reviewed. Furthermore, proponents of a contemporary general education program suggest it ought to be built on defined skills and knowledge with a clearly articulated set of expectations for the student rather than just a large number of course options. They also suggest that certain skills (such as the ability to work in teams) and knowledge (such as the role of technology in modern society) be incorporated into the general education core.

PRELIMINARY FINDINGS

1. Both NCCCS and UNC institutions have significant requirements in the Liberal Arts.
2. The general education core from the Community Colleges transfers as a block to other NCCCS institutions and to all UNC institutions.
3. The general education core varies considerably from one UNC institution to another.
4. The general education core does not transfer automatically from one UNC institution to another.
5. The NCCCS general education core was largely developed nearly a decade ago and has not undergone a comprehensive review and revision since then. The increased demand for “soft skills” at all levels may also suggest the need to reexamine the role of general education in applied associates degrees, especially as they serve more students who will later seek other degrees.
6. Neither the NCCCS nor the UNC institutions’ general education core has a clear articulation of its aims or of the skills and knowledge required. Furthermore, it is not clear that there is sufficient emphasis on developing the “soft skills” in either the general education curriculum or other areas of the curriculum. This has important implications for the preparation of the workforce in a global knowledge economy.

The centrality of the liberal arts in preparing the workforce for a knowledge economy must be reaffirmed. There is every indication that cross-discipline knowledge and skills will be vital preparation for the jobs of tomorrow at every level. From students earning a Ph.D. in science, there will be a significant need for employees with both technical knowledge and “soft skills.” This is equally as true for those with Associate of Arts degrees. As the management guru Tom Peters said, “Victory in the brain-based, global economy will go to the perpetually curious.” The liberal arts, at its best, creates such lifelong curiosity and inventiveness.

4H. THE ROLE OF HISTORICALLY MINORITY INSTITUTIONS (HMI's)

The UNC has six of its 16 campuses identified as “Historically Minority Institutions” (HMIs); five of these (Elizabeth City State University, Fayetteville State University, North Carolina A&T State University, North Carolina Central University, and Winston-Salem State University) are Historically Black Colleges and Universities (HBCUs). This is an unusually large proportion of the total number of public institutions in the state. These six institutions enrolled a total of 33,682 students (18.9% of the UNC enrollment up from 16.1% in 1999) and awarded 4,636 degrees in 2004 (3,773 bachelors, 835 masters, 28 doctorates). This represents 12.98% of the degrees awarded in the UNC. Of the minority students attending the UNC institutions, 52.6% attend the six HMIs.

These institutions have a long history, with the oldest (Fayetteville State University) being founded in 1867 and the “youngest” (North Carolina Central University) opening its doors in 1909. They tend primarily to serve full-time (ranging from 91% at North Carolina A&T to 77% at UNC Pembroke), majority female (ranging from 68% at WSSU to 52% at North Carolina A&T), and predominantly non-white (ranging from 95% at North Carolina A&T to 49% at UNC Pembroke) students. They have relatively high freshman to sophomore retention rates (ranging from 78.2% at North Carolina Central University to 67.2% at UNC Pembroke). None of them has a six year graduation rate above 50% (ranging from 46.5% at North Carolina Central University to 34.9% at Fayetteville State University).

The changing demographics of the state, with minority population growth projected to be above the national average, further increases the centrality of the HMIs to the growth of the state’s economy as does the growth of their programs for all students. North Carolina and its University system have recognized this and have implemented such programs as the “focused growth initiative.” This program was established in 1999. One of its primary goals was to continue the historic access for students in North Carolina by disproportionately growing enrollment at those campuses with excess capacity. Seven of the 16 UNC institutions were included (the six HMIs and Western Carolina University, which serves a rural area of the state). Referenced in Attachment 5 of this report as Appendix 4.H.1. is a report on the focused growth program.

The “focused growth” program has received several recurring funding allocations from the legislature (\$10M in 1999; \$2.3M in 2000; \$11M in 2002-03) as well as one-time funding from the legislature, including special funding managed from the Office of the President. In addition, these institutions benefited, disproportionately, from the millennium bond program, receiving \$580M for new facilities. The resulting increases in enrollment earned \$69M in enrollment growth funding.

These unprecedented investments have allowed the focused growth institutions to, among other initiatives, add 66 new academic degree programs including 29 masters, and 3 doctorates. More academic programs are in the planning stage. Special emphasis has been placed on adding academic programs that respond to regional and state needs. In this time period over half the new bachelors degrees approved in the UNC were at these institutions, as well as over a third of the masters degrees.

Enrollment has increased substantially at these institutions. Between 1999 and 2004, their enrollment increased 36.3% (ranging from 72.4% at Winston Salem-State University to 11.5% at Fayetteville State University). During that same period, the total UNC enrollment increase was 17.8%. In the same period (the first five years of a two-phase ten year plan), research and sponsored program grants among the HMIs more than doubled from \$45.3M to \$119M.

The academic program array for the HMIs is extensive.

- North Carolina A&T, as one of the state's two land grant institutions, has programs through the doctoral level. Its programs include engineering, arts and sciences, agricultural and environmental sciences, business and economics, education, nursing, technology, and graduate studies. It has over 10,000 students and a graduate enrollment of approximately 1,300. It awarded 1,240 degrees in 2004.
- North Carolina Central University has a total enrollment of over 7,000 and a graduate enrollment of approximately 1,700, and its programs include arts and sciences, business, education, library and information sciences, and a law school. It awarded 956 degrees in 2004.
- Elizabeth City State University has recently been approved for a joint program in pharmacy (with UNC Chapel Hill); it has predominantly undergraduate programs with over 2,400 students. It awarded 363 degrees in 2004.
- Fayetteville State University has over 5,400 students, including approximately 1,000 graduate students, mainly in masters programs, although it also has a doctorate in educational leadership. It has undergraduate programs in business and economics, education, humanities and social sciences, and basic and applied sciences. It awarded 778 degrees in 2004.
- UNC Pembroke, with a total enrollment of just over 5,000 students, offers degrees up through the masters level in arts and sciences, business, and education. It awarded 742 degrees in 2004.
- Winston-Salem State University, with a total enrollment of over 4,800 students, also offers degrees up through the masters; it has a relatively young graduate school. It has undergraduate programs in arts and sciences, business, education, and health sciences. It awarded 557 degrees in 2004.

As the matrix below indicates, the HMIs offer a substantial number of programs, at both the bachelors and masters level, that produce graduates in the projected high growth areas.

	ECSU	FSU	NCAT	NCCU	UNC-P	WSSU
Acct	B	B	B	B	B	B
Bus.	B	BM	BM	BM	BM	BM
CPS	B	B	BM	B	B	BM
Education	BM	BMD	BM	BM	BM	BM
Electr. Eng	-	-	BMD	-	-	-
Nursing	-	B	B	B	B	BM
Clinical Psych	-	-	-	-	-	-
Social Work	B	M	BM	B	B	B
SP/Lang Path	-	-	-	-	-	-
Chem	B	B	BM	BM	B	B

PRELIMINARY FINDINGS

1. The HMIs have benefited enormously from the focused growth initiative, taking considerable advantage of the opportunities presented them. They have been transformed in size, in range of academic programs, and in facilities in a remarkably short period. While the investment has been substantial, the returns already appear to justify both the dollars and commitment to these institutions. Other states have attempted to strengthen their HMIs, but it is hard to imagine any program that has been more successful than this one.
2. The HMIs have not all managed to take equal advantage of the focused growth program (some have more challenging environments than others). For example, the rate of enrollment growth has a very wide range, not all of them have added academic programs that will be in high demand, and the increase in funded research has not been uniform.
3. The HMIs have experienced an unprecedented growth in academic programs, both at the bachelors and masters level. Most of these programs have been in high demand fields. For example, nursing, biotechnology, MBA, and computer science all received focused growth planning funds at Winston-Salem State University; all four of these programs have been identified as high state need programs by this study.
4. The HMIs have put special emphasis on academic programs in the sciences, where there are likely to be overall shortages and where minorities are traditionally seriously underrepresented, yet where increasingly the best employment opportunities are to be found in the knowledge economy.

5. The HMIs are critical to the economic future of the state. Not only are minority (and immigrant populations) increasing at a rate above that of whites (this growth is above the national average in North Carolina, although much of the projected increase is Hispanic), but also these institutions are assuming an increasingly important role in addressing the overall enrollment and economic development needs of the state.
6. The HMIs have considerable ambitions to continue to add new academic programs. This is understandable given their success to date. They are, however, experiencing some challenges as a result of the rapid growth, including managing the faculty recruitment and orientation process and managing infrastructure growth at the same time. Budget and tuition limitations may also impact their ability to secure additional programs, especially those that are high cost programs. Thus the selection of additional programs will need to be paced appropriately and selected strategically, especially as it relates to responding to demonstrated high occupational needs.

5. PRELIMINARY GAP ANALYSIS: STATE NEEDS/ACADEMIC PROGRAMS

This gap analysis section focuses primarily on the identified occupational areas with the greatest projected growth (See Section 3.A) and those emerging areas that may see increased demand (See Section 3.B). In the case of the former, the projections are largely based on data from the Labor Market Information (LMI) Division of the Employment Security Commission of North Carolina, except in teacher education and nursing, where statewide supply/demand reports supplemented the data and in engineering where a NCHEMS supply and demand report was prepared for the system. In the instance of the latter, regional economic development plans and specific industry group plans are examined in conjunction with the ECS data.

For most of the information presented in this section, the UNC and the NCCCS are treated separately. In a few areas where it seems logical to do so, the two systems are treated together.

5.A. PROJECTED HIGH DEMAND TRADITIONAL OCCUPATIONS REQUIRING BACHELORS, MASTERS, OR DOCTORATES

This section examines those occupational growth areas that are currently predicted to require bachelors, masters, doctorate, or professional degrees.

Bachelor Degree Requirements

In the **bachelor degree category** those occupational areas include high predicted needs for degrees in: computer science (and related fields); business (management, accounting, finance construction management); teacher education; child, family, and social work; pharmacy; chemistry; and electrical engineering. Nursing is also clearly a high current, and probably future, need. In meeting these needs for bachelor degrees, UNC has produced the following results. (Note: future references to “all UNC institutions” will exclude the North Carolina School of the Arts, unless otherwise indicated.)

- UNC institutions produced 653 bachelors degrees in **computer science** in 2004; the highest number of degrees awarded in the five-year period (1999-2003) was 720 in 2003. The projected annual need is for 4,830 bachelors degrees. However, recent national data confirm that this projected need is probably substantially overstated.

All UNC institutions offer bachelors degrees in computer science.

- UNC institutions produced 2,246 bachelors degrees in **business administration and management** (general) in 2004; this was the highest number of degrees awarded in the five-year period (2000-2004). There were also 577 bachelors degrees awarded in **accounting** in the same period, with a five-year high of 596 in 2000. If the projected high demand fields that may require general business degrees (business operations specialists, financial analysts, and loan officers) are totaled, 1,420 degrees are

required annually. The need for accountants and auditors is projected to be 690 annually. All UNC institutions offer bachelors in general business and accounting undergraduate degrees.

- UNC institutions produced 361 bachelors degrees in **social work** in 2004; the highest number of degrees awarded in the five-year period was 390 in 2003. The projected annual need for social work bachelors degrees is 390. All UNC institutions offer bachelors degrees in social work.
- UNC Chapel Hill produced 135 **Pharm.D.** graduates in 2004, a five-year low (the highest was 146 in 2002; before the introduction of the Pharm.D. the graduates numbered over 160). UNC Chapel Hill is now working with Elizabeth City State University to offer pharmacy degrees through a collaborative program. The need for **pharmacists** is projected to be 350 annually. A significant proportion of current pharmacists in North Carolina in-migrated.
- UNC institutions produced 328 **general chemistry** degrees in 2004; the highest number of degrees awarded in the five-year period was 334 in 2003. The projected annual need for chemistry bachelors degrees is 240. All UNC institutions offer bachelors degrees in chemistry.
- UNC institutions produced 339 **electrical, electronics, and computer engineering** bachelors degrees in 2004, a five-year high and up approximately 100 degrees from the previous four-year average. The projected annual need for electrical engineering bachelors degrees is 140. North Carolina A&T, North Carolina State University, UNC Charlotte, and a joint program between UNC Charlotte and Western Carolina University offer bachelors degrees in electrical, electronics, and computer engineering.
- UNC institutions produced 2,313 **teacher education** graduates in 2003. In addition, there were over 5,000 alternative entry students who had a bachelors degree in some field and were taking teacher education courses to qualify for teacher certification. Approximately 25% of these earn the certification each year. The projected annual need utilizing the Employment Security Commission Methodology is 4,830. A more detailed analysis, however, is available from the December 2004 report, "A Plan to Address the Shortage of Teachers in North Carolina," produced by the UNC Office of the President.

That analysis paints a very different picture, with an annual average need of 11,483 over the eleven-year period 2004-05-2014-15, with the highest need in 2014-15 (12,165) and the lowest in 2007-08 (10,984). The methodology uses a projection model based on student-teacher ratios (including assumptions about state plans to reduce class size in K-3 through 2004-05) that is adjusted for turnover replacements (with turnover from one North Carolina school district to another deducted) and new additional teachers needed.

In addition to examining the general need for teachers in North Carolina, the report also examines such special need areas identified by the North Carolina Department of Public Instruction as math, science, middle grades, and exceptional children. The first two have particular importance in a knowledge economy. UNC institutions produced 84 math teacher education graduates in 2004 (up from 76 in 2003); 59 in science (down from 61); 174 in middle school (up from 126); and 212 in exceptional children (up from 183). UNC projects increasing the number of traditional graduates in these programs to 192 in math a year by 2009-10, to 157 in science, to 353 in middle school, and to 329 in exceptional children.

All UNC institutions offer undergraduate teacher education programs, except the North Carolina School for the Arts.

- UNC institutions produced 1,076 **nursing** bachelors graduates in 2004; the highest number of degrees awarded in the five-year period was 1,019 in 2004. (In addition, see the NCCCS section that follows.) Although the Employment Security Commission data did not separately identify nursing as a high demand bachelors degree area, it listed a need for 3,460 registered nurses a year. A more detailed analysis is available, however, from the May 2004 “Task Force on the North Carolina Nursing Workforce Report,” produced by the North Carolina Institute of Medicine. This report concludes that:

“The state needs to add a total of 34,812 more RNs to the workforce over 2000 levels (21,975 new jobs plus 12,837 replacement openings) by 2010 in order to meet the demands of both new job growth and replacement openings. Given that approximately 65,000 RNs were in the workforce in 2000, these figures suggest that North Carolina will need to increase its RN workforce by 50% by the end of the decade in order to avoid a shortage.” (p.13).

The report also concludes a similar percentage increase will be needed for LPNs over the same period (7,874 additional positions over the 2000 workforce of approximately 14,500). Of particular note is the fact that approximately 60% of new RNs entering the North Carolina workforce currently come from out of state (and about 55% of the LPNs). (Also see the NCCCS section that follows.)

Eleven UNC institutions offer bachelors degrees in nursing.

Master Degree Requirements

In the **masters degree category**, the high demand occupations include: management analysts; educational and vocational counselors; clinical psychologists; rehabilitation counselors; speech language pathologists; medical and public health social workers; librarians; medical and substance abuse social workers; and postsecondary nursing instructors.

- UNC institutions produced 991 MBAs in 2004 which would prepare graduates to be **management analysts**, the highest number in the five-year period. The reported annual demand is for 430 masters prepared graduates annually for this sector of business. Twelve UNC institutions offer an MBA (Appalachian State University, East Carolina University, Fayetteville State University, North Carolina Central University, North Carolina State University, UNC Chapel Hill, UNC Charlotte, UNC Greensboro, UNC Pembroke, UNC Wilmington, Western Carolina University, Winston-Salem State University).
- UNC institutions produced 170 masters graduates in **counselor education** in 2004; the highest number of masters awarded in this discipline in the five-year period was 181 in 2003. The need for such masters graduates is 320 annually, according to the Employment Security Commission data. Ten UNC institutions offer the masters in counselor education, counseling, and guidance services.
- UNC institutions produced 23 masters in **clinical psychology** in 2004; the highest number of such masters produced in the five-year period was 26 in 2001. The reported annual demand is for 270 masters, prepared graduates. Only five UNC institutions (Appalachian State University, East Carolina University, UNC Chapel Hill, UNC Charlotte, and Western Carolina University) offer this masters degree.
- UNC institutions produced 28 **rehabilitation counselors** with masters degrees in 2004; the highest number produced was 38 in 2003. The projected annual demand is for 260 masters prepared graduates. The following UNC institutions offer this masters degree: East Carolina University, UNC Chapel Hill, and Winston-Salem State University.
- UNC institutions produced 88 masters in **audiology and speech-language pathology** in 2004; the highest number produced was 108 in 2000. The projected annual demand is for 180 such graduates. UNC Chapel Hill, East Carolina University, and UNC Greensboro have programs in this academic area. (Several other UNC institutions have masters programs in general communication disorders.)
- UNC institutions produced 275 masters in **social work** in 2004, the highest number produced in the five-year period. The annual demand for social workers specializing in medical and public health social work is 140 and 120 for medical and substance abuse social work. In 2004, UNC institutions produced 8 masters in substance abuse/addiction counseling. Six UNC institutions offer a masters in social work (East Carolina University, Fayetteville State University, North Carolina A&T, UNC Chapel Hill, UNC Charlotte, and UNC Greensboro). Three new MSWs have been added at North Carolina State University, UNC Wilmington, and Western Carolina University.
- UNC institutions produced 269 **library science/librarianship** masters in 2004, the highest number produced in the five-year period. The annual demand for masters prepared librarians is projected to be 180. Five UNC institutions offer this masters degree (Appalachian State University, East Carolina University, North Carolina Central University, UNC Chapel Hill, and UNC Greensboro).

- UNC institutions produced 252 **Masters of Science in nursing** degrees and eight Ph.D.s in 2004, by far the highest in the five-year period. These are the graduate degree nurses who are most likely to enter postsecondary teaching, although they also enter other professions as well. The demand for such graduates is 110 annually. East Carolina University and UNC Chapel Hill both offer doctorates and UNC Greensboro offers a masters in nursing science and has been authorized to offer a doctorate starting fall 2005.

Doctorate Degree Requirements

The projected high demand occupations requiring a doctorate are all post-secondary faculty positions, although all fields or institutions will necessarily need graduates with doctorates for post-secondary institutions. Since many higher education institutions recruit nationally, state production of doctorates is not directly relevant (although indirectly each state contributes to the national marketplace). The areas with the greatest need are health specialties (330 annually), art, drama, and music (140 annually), math (120 annually), computer science (110 annually), medical science (120 annually), and biology (100 annually).

Unless some states produce doctorates at much higher rates than North Carolina there are likely to be gaps in all of these fields (gaps that may be exacerbated by the predicted decline of international students in many of these fields and/or the increase in the number of foreign-born Ph.D.s who will return to their native countries). The size of the gaps could be considerable. For example, UNC institutions produced 19 Ph.D.s in computer science in 2004 and 37 in mathematics. Most of the areas which need new faculty also have to compete with the private sector for graduates.

Professional Degree Requirements

The projected high demand occupations requiring professional degrees include Clergy (210 positions annually), Family and General Practitioners (560 positions annually), and Veterinarians (500 positions annually). There are many pathways to positions in the clergy and public higher education does not play a prominent part in these pathways. UNC institutions produced a total of 234 medical degrees in 2004 (154 at UNC Chapel Hill and 80 at East Carolina University); this was a five-year high for medicine graduates. UNC institutions produced a total of 76 graduates in veterinary medicine in 2004, again a five-year high; North Carolina State University offers veterinary medicine.

5B. PROJECTED HIGH DEMAND TRADITIONAL OCCUPATIONS REQUIRING ASSOCIATE DEGREES/DIPLOMAS/CERTIFICATES

This section examines those occupational growth areas that are currently predicted to require postsecondary education at less than the baccalaureate level, including associate degree, diploma, and certificate offered by the 58 Community Colleges.

In addition, it is assumed that the continuing education programs offered by NCCCS, particularly those that directly support the education and training needs of business and industry, will continue to be vital to the future economic growth and development of North Carolina.

Using ESC data, high growth occupations were identified that require an associate degree. Referenced in Attachment 5 of this report as Appendix 5.B.1. All Occupational Projections gives North Carolina occupational employment projections sorted by level of education. Average annual openings (growth plus replacements) for the 2000-2010 interval are given for each occupation. Occupations pertinent to Community College programs are given in the Associate degree and the Post-secondary Vocational Training categories, with some falling into the Long-term on-the-Job Training category. It is obvious from an analysis of the categories that jobs for which Community College students obtain education and training do not neatly fall into the framework of this classification structure. However, it does give a general overview of occupations for which workers need education and training provided by Community Colleges. Also, many of the occupations are ones for which Community Colleges provide numerous short-term training through non-credit continuing education programs.

The following occupations are ones that show sizeable average annual openings (given in the first set of parentheses) for the 2000-2010 time period using ESC's projections. Completions or graduations in 2003-2004 in the Community College curriculum program that most closely fit each occupation are given in the second set of parentheses (A = associate degree, D = diploma, and C = certificate).

- Registered nurses (3,460) (1,679 A)
- Executive secretaries/administrative assistants (1,540) (404 A)
- Secretaries – excluding legal, medical, and executive (820) (107 D, 322 C)
- Practical and vocational nurses (790) (730 D)
- Cosmetologists (540) (287 D, 245 C)
- Medical secretaries (430) (433 A, 41 D, 360 C)
- Computer programmers (370) (220 A, 6 D, 137 C)
- Emergency medical technicians and paramedics (360) (123 A)
- Medical records/health information technicians (310) (433 A, 41 D, 360 C)
- Dental Assistants (290) (276 D)
- Legal secretaries (230) (22 A, 1 D, 9C)
- Paralegal and legal assistants (220) (223 A, 30 D, 34 C)
- Electrical and electronic engineering technicians (220) (180 A, 1 D, 29 C)

- Dental hygienists (200) (201 A)
- Medical and clinical laboratory technicians (200) (76 A)
- Aircraft mechanics and service technicians (190) (4 A, 10 C)
- Respiratory therapists (170) (163 A)
- Surveying and mapping technicians (170) (30 A)
- Medical transcriptionists (150) (98 D)
- Surgical technologists (140) (22 A, 173 D)

5C. PROJECTED DEMAND FOR HIGHER EDUCATION (BOTH UNC AND NCCCS) IN EMERGING FIELDS

In addition to examining the Employment Security Commission projections, the regional economic development partnership strategic plans were examined to identify occupations that may have faster growth rates as a result of specific initiatives or because they are emerging fields that would not be captured by trend data. The targeted industries that emerge from this approach include:

- ✓ Biotechnology and pharmaceuticals
 - ✓ Computing, software and the Internet
 - ✓ Logistics and distribution
 - ✓ Advanced manufacturing
 - ✓ Advanced materials: chemicals and plastics
 - ✓ Advanced materials: nanotechnology
 - ✓ Arts and design
- The **biotechnology and pharmaceutical industry** has an unusually high need for the proportion of its workforce with a bachelors degree or higher (60%). In particular, it requires life scientists, physical scientists, and specialized engineers (biomedical, chemical, industrial). From the ESC data, it appears that this sector will employ over 16,500 bachelors and above professionals in 2010, compared to 14,410 in 2000.

Using data from trend projections makes little sense in this emerging area. While traditional fields such as chemical engineering, chemistry, the life sciences, microbiology, medical sciences, and biomedical engineering may be producing sufficient graduates currently, the emerging interdisciplinary nature of this industry means that both the current production and projections may not be sufficient. Not only are these sciences becoming more interdisciplinary, but there are also other non-science disciplines (for example, specialized areas of business and law) that will see increased demands as this field emerges and matures.

Currently, UNC Chapel Hill and North Carolina State University offer biomedical engineering bachelors, masters, and doctoral degrees. North Carolina State University and North Carolina A&T offer chemical engineering (the former at all three levels, the latter at the bachelors and masters level). East Carolina University and UNC Chapel Hill offer primarily doctorates in the medical sciences. North Carolina State University offers microbiology at all three levels. North Carolina Central University's BRITE initiative is part of the state's emphasis on biotechnology; the university will develop undergraduate and graduate programs in biomanufacturing and biotechnology. All UNC institutions offer chemistry and biology majors. Several institutions are either just starting or planning to start new programs specifically in biotechnology.

In the NCCCS, biotechnology and related programs are receiving special emphasis. Biomanufacturing is projected to be a major growth area for North Carolina. The NCCCS, with the aid of the Golden LEAF Foundation, has established the BioNetwork to provide education and training for the emerging biotechnology area. This special funding has allowed the establishment of the biotechnology office at the Community College System Office, the selection of six BioNetwork Competitiveness Centers on Community College campuses, and provided approximately 65 innovation, equipment/facility enhancement, and distance learning grants to the Colleges.

The NCCCS has curriculum programs in biotechnology (at five Colleges and at 24 others by way of collaborative arrangements) and industrial pharmaceutical technology (at two Colleges and collaboratively at three others). Another College is planning a plant biotechnology curriculum to be submitted for approval later this year. Completions or graduations for these programs are shown in Attachment 5 of this report as Appendix 4.A.3. Industrial pharmaceutical technology has shown the highest graduation rate, with 22 AAS graduates in 2003-04. As the BioNetwork initiative continues to develop system-wide, enrollments are expected to significantly increase.

Forsyth Technical Community College received a \$5 million grant in 2004 that partners it with four other Community Colleges from around the nation to develop curricula and training modules for biotechnology workers. This initiative is part of a national effort to address workforce challenges facing the biotechnology industry.

- **Computing, Software and Internet.** See previous analysis regarding UNC production in this area.

UNC institutions produced 653 bachelors degrees in **computer science** in 2004; the highest number of degrees awarded in the five-year period (1999-2003) was 720 in 2003. The projected annual need is for 4,830 bachelors degrees, although this is probably substantially overstated because the projection is based on trend data that include the computer "boom" years of the 1990s. Recent national data confirm that this projection is likely overstated.

The NCCCS offers 13 curriculum programs leading to the AAS degree that fall into the area of computing, software, and the Internet. In 2003-04, only five had significant graduations at the associate degree level: **computer programming** (220); **information systems** (555); **network administration and support** (400); **Internet technologies** (121); and **networking technology** (69). All five of these programs offer tracks that lead to a diploma or a certificate. Students that take one of these options usually chose the one-semester certificate program. In 2003-04, certificate completions in these five programs were: computer programming – 137, information systems – 403, network administration and support – 162, Internet technologies – 69, and networking technology – 30.

- **Logistics and Distribution**, while a growing industry, has a relatively low proportion of its positions in occupations that require a bachelors degree (approximately 5%) in such areas as business, marketing, accounting, industrial relations, or economics. Some universities offer certificates in logistics and a few offer masters degrees. No UNC institution offers a degree program in this area.

The NCCCS has one curriculum program in this area, logistics management. In 2003-04, there were two completions in this program. With the recent announcement by Dell to build a large production facility in Winston-Salem, logistics and distribution education and training needs will increase.

- **Advanced Manufacturing** as an industry also has a relatively low proportion of its employment in bachelors (or above) required occupations. Of those that do (commercial and industrial designer, mechanical engineer, electrical engineer, industrial engineer, and computer programmer) several have been covered in the previous analysis. In addition, a 2003 study for the UNC President's Office by the National Center for Higher Education Management Systems (NCHEMS) found an oversupply of engineering graduates by UNC institutions, with the exception of electrical engineering and some select masters degrees for practicing professionals.
- The **Chemical and Plastics** industry has been identified as an emerging and targeted area for growth. Fewer than half of the occupations in this field require a bachelors degree or above. Those that do generally require degrees in business or engineering, both discussed previously. In 2000-01 the NCHEMS report on engineering indicated that UNC institutions produced 166 bachelors degrees in chemical engineering for 30 average annual openings.

In the NCCCS, Manufacturing Technology/Plastics is offered by eight Colleges, including a consortium in the Raleigh region with seven member Colleges.

- **Nanotechnology** is a fast-emerging, highly interdisciplinary field that will probably influence a number of occupations in several industries rather than create specific industries of its own. Therefore, it is not possible at this time to anticipate the openings or even the degrees required (existing disciplines such as engineering have to be infused with the life sciences and different modes of thinking). A number of UNC institutions are planning degrees in this field.

Forsyth Technical Community College in Winston-Salem received approval in September 2004 from the State Board of Community Colleges to establish an AAS degree program in **nanotechnology**. This program is offered in collaboration with Wake Forest University's Center for Nanotechnology and Molecular Materials. It is the only nanotechnology program offered in the NCCCS.

- **Art & Design** “industries” are often forgotten when discussing workforce and economic development. However, not only is there demand for such professionals in and of themselves, but such professionals contribute to the quality of life and sense of place that can be major factors in economic development. The occupations include fine artists, multimedia artists and animators, and art directors; they also include design occupations, such as commercial and industrial designers of manufactured products, fashion designers, floral designers, graphic designers, and interior designers. Most of these fields, with the exception of floral design, either require a bachelors degree or the person's skills are enhanced by getting a degree.

Art degrees, both visual and performing, are available from multiple UNC institutions, and in 2003 1,263 bachelors degrees, 142 masters, and 14 doctorates were awarded in the fine and applied arts. Design and visual communications degrees are offered by North Carolina State University; graphic design is offered by Appalachian State University, North Carolina State University and North Carolina A&T; industrial design is offered by Appalachian State University and North Carolina State University; and interior design at Appalachian State University, East Carolina University, UNC Greensboro, and Western Carolina University.

The NCCCS has a cluster of curriculum programs called the Commercial and Artistic Production Technologies. Included are several professional crafts programs (e.g., clay, fiber, and jewelry), photographic technology, interior design, film and video production, and digital effects/animation.

5D. CAUTIONS

A number of cautions have to be outlined about this interim gap analysis:

- This analysis focuses on the UNC and the NCCCS institutions.

The UNC and NCCCS institutions are not, however, the sole providers of graduates in the state. Independent colleges and proprietary schools also produce graduates in a number of these areas. Most Community College students stay in the area where they attend college. Students from the independent colleges and universities, particularly the larger ones, may come from out-of-state and may be less likely to enter the North Carolina workforce than graduates from the UNC institutions. Nevertheless, the independent colleges clearly do contribute to the workforce. For example, they produced 3,315 graduates in business (compared to 4,789 by UNC), 478 in computer science (721), and 572 in education (2,026). In total, independent colleges produce about half as many graduates as UNC (12,218 bachelors to 25,263; 2,831 masters to 7,432; 1,111 first professional to 898; and 308 doctorates to 850).

- This analysis does not examine migration patterns. Many states experience a net in-migration of graduates, especially in the high demand fields. This is particularly true for certain southern states where in-migration has been extensive, especially from midwestern and northeastern states. Nursing, for example, has over 50% of its new and replacement workforce coming from out of state. Teacher education, computer science, and pharmacy have significant in-migration.
- This analysis focuses on new graduates, most of whom will be new to the workforce. However, the majority of the workforce for 2010 is already in the workforce.
- This analysis does not consider the intent of students in receiving degrees in certain areas. For example, some students who take degrees in areas like education, nursing, and social work do not necessarily intend to enter the workforce in those fields.
- This analysis looks at trend data for projected job growth. Trend data cannot anticipate either abrupt changes in the economy (such as the reversals faced in computer fields around 2000) or intentional changes in state policy to fuel new directions in the state's economy.
- This analysis does not, at this point, examine these trends by geographic region. While it is possible to see projected job growth by region, there is not a reliable way to predict where graduates will go for employment. Some academic areas (education, for example) tend to see their graduates employed in the region where they got their degree; other academic areas (such as engineering and computer science) tend to see their graduates gravitate to where the best jobs, salaries, and quality of life are offered.

PRELIMINARY FINDINGS

UNIVERSITY OF NORTH CAROLINA

1. UNC institutions are not currently producing a sufficient number of bachelors degrees for the projected needs in the following high demand areas, although the projected gaps need to be understood within the context of the issues cited in the paragraph that follows:
 - Computer Science (annual gap of 4,183)
 - Teacher Education (annual gap of 2,517 or 9,170, depending on study)
 - Nursing (annual gap of 2,384)
 - Accounting (annual gap of 113)
 - Social Work (annual gap of 29)

It should be noted that the NCCCS has 54 Associate Degree **nursing** programs and that 1,679 graduated from these programs in 2003-2004. Without taking into consideration the type of RN (i.e., BSN or ADN), this significantly reduces the gap, but still leaves an annual gap of several hundred registered nurses. Also, **computer science** may be overstated because the trend years used for the projections include the

years of the computer “boom.” Conversely, the need for the **accounting** degree may be understated because the trend years preceded Sarbanes/Oxley requirements for corporate accounting and auditing. Both **teacher education** and **nursing** have been the topic for major supply/demand reports in the last year; these reports both include specific recommendations for responding to the projected shortages.

2. UNC institutions are currently producing sufficient graduates for the projected needs in the following high demand areas:
 - Business (annual excess of 826)
 - Electrical Engineering (annual excess of 199)
 - Chemistry (annual excess of 88)

In the case of business, however, students have a number of other choices for careers beyond those identified as high demand. So there may or may not be a sufficient supply for those fields.

3. UNC institutions produced the largest number of graduates in 2004 in only two of the projected high demand areas: business and electrical engineering. (The latter increase was very substantial). None of the other areas show a trend towards increasing the number of graduates, although some show increased enrollments.
4. UNC institutions are not currently producing a sufficient number of masters degrees for the projected needs in the following high demand areas:
 - Counselor Education (annual gap of 150)
 - Clinical Psychology (annual gap of 247)
 - Rehabilitation Counseling (annual gap of 232)
 - Audiology and Speech Language Pathology (annual gap of 92)
 - Social Work (275 produced; 260 needed for just two areas of Social Work; medical and public health; medical and substance abuse)
5. UNC institutions are currently producing a sufficient number of masters degrees in the following high demand areas:
 - MBA (as long as MBA students choose management analyst positions in sufficient numbers)
 - Library Science
 - Nursing Science
6. While the number of masters graduates needed (the gap) are not as great as the number of undergraduates, in many instances the need is proportionately greater. The masters degree may be emerging as a key degree in some academic areas for employment. UNC has a major initiative to create more professional science masters degrees and has received Sloan Foundation funding for parts of this activity.

7. The demand for higher education faculty is likely to increase substantially, especially in fields like math, science, and technology. While not all fields nor all higher education institutions will require faculty with doctorates, the number of doctorates will likely need to increase. The faculty marketplace tends to be a national one, so the gaps in the high demand fields in North Carolina cannot be taken as absolute. For one thing, the national reputation of higher education in North Carolina and quality of life issues make North Carolina an attractive destination for prospective faculty members. On the other hand, the national marketplace may see a decline in doctorates if predicted trends in some key fields (such as math, science, engineering, and computer science) develop, such as a reduction in the number of international students coming to U.S. universities and an increase in the percentage of those students who return to their home countries. China and India, for example, intend to train many more of its own doctorates.
8. There are substantial gaps in the production of two professional degrees (medicine and veterinary science); however, these fields tend to have substantial in-migration.
- 9.a. In the emerging industries and/or the industries that are part of regional initiatives, UNC institutions will need to produce sufficient graduates especially in the life sciences and computer sciences particularly for the biotechnology and pharmaceutical industries. It appears that UNC institutions are responding to this need, particularly in biotechnology.
- b. In the emerging industries and/or the industries that are part of regional initiatives, UNC institutions will need to produce sufficient graduates with either specialized or interdisciplinary skills in such areas as business and engineering. While the institutions are producing sufficient graduates in those fields, they may need to reexamine the curriculum and/or the need for new concentrations, specialized certificates, or masters programs. This is true for the logistics and distribution industry; advanced manufacturing; and chemical and plastics.
- c. In nanotechnology, UNC institutions do not presently have as many programs available as do the leading states.
- d. In arts and design there are great possibilities for expanding both employment opportunities and quality of life issues that can be central to economic development. A number of UNC institutions have identified this as a growth area.
- e. In virtually all gap areas (from traditional fields like nursing and teaching to emerging fields like nanotechnology and logistics) there are great opportunities for expanded partnerships and “ladder” programs between NCCCS institutions and UNC institutions. There are a number of such existing programs and prototypes, including some that use e-learning exclusively. Thus the primary issue is one of scaling up such activities and program availability.

NORTH CAROLINA COMMUNITY COLLEGE SYSTEM

1. Community Colleges are not producing an adequate number of graduates to meet projected needs in the following high demand areas:
 - Registered nurses (see prior discussion in UNC section)
 - Office staff – including executive secretaries, administrative assistants, and so on. (annual gap of several hundred, depending on how projected needs are viewed)
 - Computer programmers (annual gap of 150 at associate degree level)
 - Emergency medical technicians (annual gap of 237)
 - Legal secretaries (annual gap of 208 at associate degree level)
 - Medical and clinical lab technicians (annual gap of 124)
 - Aircraft mechanics and service technicians (annual gap of 186 at associate degree level)
 - Surveying and mapping technicians (annual gap of 140)
 - Medical transcriptionists (annual gap of 52)

It should be noted that as technology becomes more embedded in the workplace, it will have impacts that are difficult to precisely measure at this time. For example, as the information needed and used by health care providers (for example, medical records) becomes digitized, it will have a dramatic impact on those work places, including the skills needed by workers.

2. According to the occupational projections developed in this study using ESC data, the NCCCS is not producing an over supply of graduates in any of the high growth areas.
3. The NCCCS is responding to the targeted industries that emerge from the trend data (e.g., biotechnology and pharmaceuticals), though its responses are in the early stages. The BioNetwork initiative is in its second year of operation and has offered significant opportunities for collaboration with UNC institutions, particularly North Carolina State University. This should serve as a model as other emerging industries (for example, nanotechnology) expand and present the need for increased numbers of trained workers.
4. As noted in the UNC section above, there are many opportunities for new and expanded partnerships between the two public higher education systems. Addressing the needs in some critical areas, such as increasing the supply of teachers and nurses, has more to do with building new and better collaborative programs than with building new bricks and mortar facilities.
5. Distance learning options should be a critical consideration in all plans to expand programs, to develop collaborative arrangements, or to provide new services. This should apply to both systems.

6. A NEW COMMUNITY OF LEARNERS

In developing the academic and training programs of the future, it is important to recognize the many different kinds of student learners to which higher education must now be responsive. The students entering universities and community colleges represent a broad range of ages and experiences, economic, family and ethnic backgrounds. They are also driven by a variety of motivations that bring them into the college classroom.

As in the past, many higher education students are there to obtain the necessary skills to prepare them for their *first job*. Whether in a degree program or a technical training/certification program, these students are generally preparing to enter the workforce for the first time. They may be recent high school graduates, or coming into the workforce well after high school after years spent in other life pursuits.

Increasingly, a growing number of students are returning to higher education in order to *maintain* the careers that they already have. In today's competitive economy, industries and professions are changing rapidly, driven by new technological innovations, new technical knowledge, new products and services, new regulations, or changing consumer demands. The skills and knowledge required to maintain one's current position, and certainly to advance to more senior levels, require a constant retraining and reeducation. This continuing need for learning may be fulfilled by a single training session, an additional certification, or the achievement of a more advanced degree. The demand comes from students who are typically older, further along in their work and personal life responsibilities, and less able to sit in a traditional classroom or follow a traditional program of study. Student/faculty interactions, and modes of course delivery, must be adapted to meet these differing needs. This group of students is one of the fastest growing groups making demands on higher education. They require a wholly different understanding of their needs and the support structures required by them, versus the educational programs, financial and academic support structures in place thirty years ago.

Similar to the students returning to maintain their careers, an additional growing number of learners are turning to higher education to assist them in *changing* their career path. This change may be forced upon them due to job layoffs or a change of personal circumstances. Or it may result from a change in personal career choices and/or lifestyle. Here we see the long-term worker suddenly without employment and without transportable skills; or the middle-aged or retired workers rethinking their career history and seeking a new direction in their lives. A key driver here is the speed with which the education and training can be accomplished, a greater urgency to arrive at an end point that places one into that next job. For these learners, the traditional higher education programmatic structures and timelines, and the locations and/or modes of delivery may be especially inadequate. This group is relatively newly recognized within the higher education environment. For North Carolina, in the midst of its economic transformation and its pressing needs for workers within certain professions, this group of learners requires special attention.

In planning for North Carolina's future in higher education, old patterns and structures and formulas may no longer be sufficient to serve this far more diverse student population. It is a population which no longer experiences higher education at only one point in their lives. And it is a population that has many different expectations for its higher education experience. This is one of the many challenges that state and higher education officials must address in its planning for educating North Carolinians into this future workforce.

7. ADDITIONAL TOPICSTechnology Transfer, Research, Campus Culture and State Support for Innovation

- **Technology Transfer.** Universities have a responsibility to add to the body of knowledge through their research. Where this research has direct and practical applications for industry and business, the “technology” needs to be “transferred” from the research lab in a university to the marketplace through business and industry. This can be done through a number of different mechanisms such as industry-sponsored research, inventions, licensing intellectual property, and helping create start-up companies.
- ✓ **Industry Sponsored Research.** In North Carolina and in every other state, funding from federal agencies provides a very high proportion of the total research dollars. In FY04 UNC institutions generated \$1.016 billion in total research awards, of that \$664.8 million was federal research and \$49.6 million was industry sponsored research. Industry sponsored research reveals, to some degree, the extent of engagement Universities have with their state and national businesses and industries. Exhibit 1 below arrays these data.

Exhibit 1: Selected Sponsored Research Award Data FY 2002 through FY 2004

Sponsor	# of Awards						Trend
	FY02		FY03		FY04		
	Number	% of Total	Number	% of Total	Number	% of Total	
N. C. Business and Industry	313	4.43%	368	4.99%	261	3.44%	-17%
All Other Business and Industry	904	12.80%	1,048	14.20%	1,154	15.21%	28%
Total Business and Industry Awards	1,217	17.23%	1,416	19.19%	1,415	18.65%	16%
UNC TOTAL AWARDS	7,065		7,380		7,586		7%

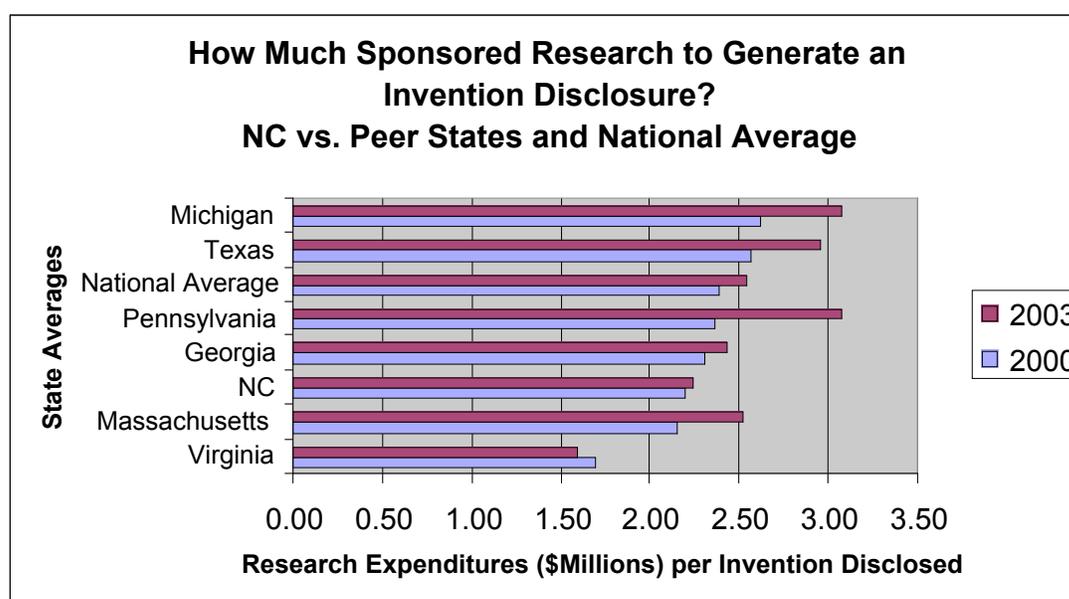
Sponsor	Dollars Received						Trend
	Fiscal 2002		Fiscal 2003		Fiscal 2004		
		% of Total		% of Total		% of Total	
N. C. Business and Industry	\$8,569,699	1.02%	\$8,171,060	0.87%	\$7,194,387	0.71%	-16%
All Other Business and Industry	\$29,922,886	3.56%	\$54,437,004	5.78%	\$42,416,451	4.17%	42%
Total Business and Industry Awards	\$38,492,585	4.58%	\$62,608,064	6.65%	\$49,610,838	4.88%	29%
UNC TOTAL AWARDS	\$840,556,027		\$941,278,688		\$1,016,473,232		21%

Note: The category 'Not-for-Profit Organizations' and its corresponding sub-categories are new in FY 2004 and may have impact on FY 2004 figures.

Data tracked by the UNC Office of the President

- ✓ **Invention Disclosure.** The number of invention disclosures per million dollars of research is a surrogate for measuring the amount of intellectual property generated by the research efforts. (An invention disclosure is made at the conception of an invention and is the first step in seeking a patent.) Select UNC institutions (plus Duke and Wake Forest Universities) expended an average of \$2.2M per disclosure in both FY 2000 and FY 2003. National and peer data were also examined for both years and are reported in Exhibit 2 below.

Exhibit 2: Sponsored research expenditures per invention disclosed, FY 2000 and FY 2003

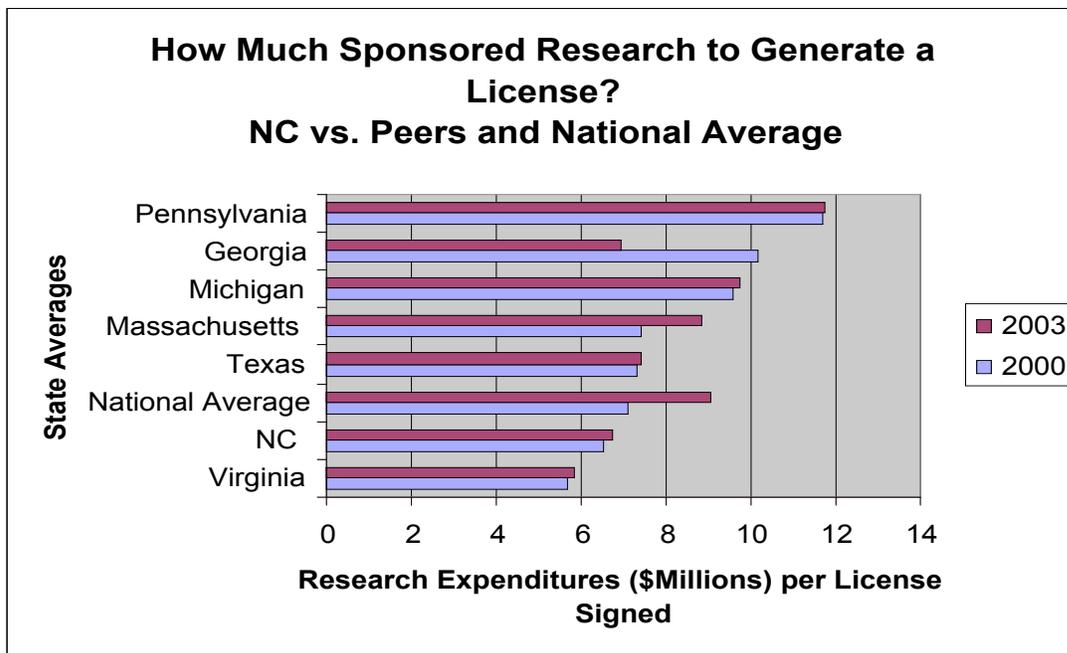


Sources: Association of University Technology Managers (AUTM)
FY 2000-2003 Annual Surveys

Peer States (Georgia, Michigan, Texas, Massachusetts, Pennsylvania, and Virginia) were selected from the 2003 Tracking Innovation Report of the North Carolina Board of Science and Technology.

- ✓ **Licensing Intellectual Property.** This measure examines how many research dollars, on average, were expended in relation to licenses or options signed. Select UNC institutions (plus Duke and Wake Forest Universities) expended \$6.5M per license in 2000 and \$6.7M in 2003. National average and peer data were also examined for both years and are reported in Exhibit 3 on the following page.

Exhibit 3: Sponsored research expenditures per license/option signed, FY 2000 and FY 2003

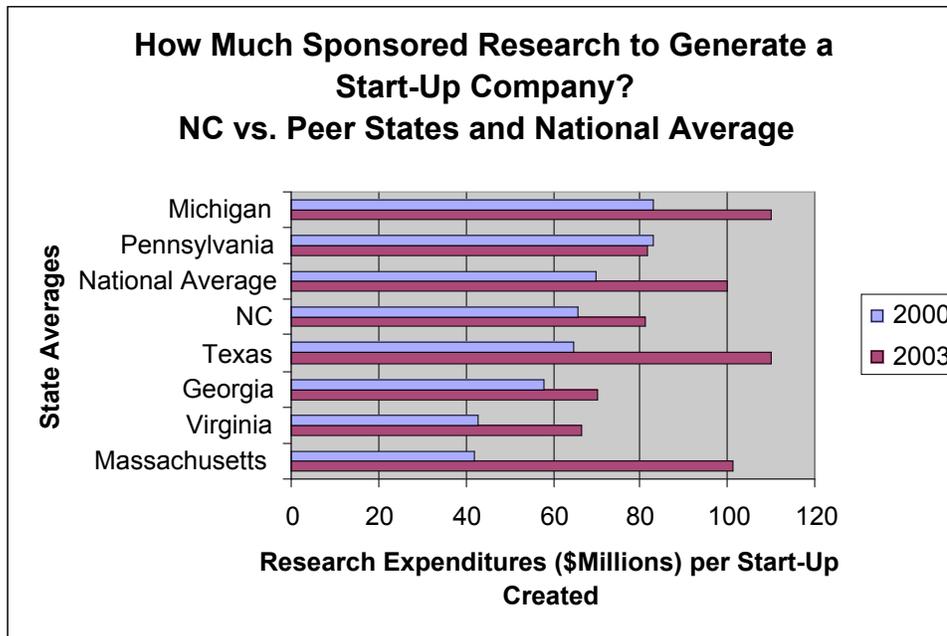


Sources: Association of University Technology Managers (AUTM)
FY 2000-2003 Annual Surveys

Peer States (Georgia, Michigan, Texas, Massachusetts, Pennsylvania, and Virginia) were selected from the 2003 Tracking Innovation Report of the North Carolina Board of Science and Technology.

- ✓ **University Start-Up Company Formation.** This measure examines, on average, the number of start-up companies formed as a result of University intellectual involvement in relation to total research dollars expended. Select UNC institutions (plus Duke and Wake Forest Universities) expended on average \$66M per University start-up company created. National average and peer data were also examined for both years and are displayed as Exhibit 4 on the next page.

Exhibit 4: Sponsored research expenditures per university start-up company created, FY 2000 and FY 2003



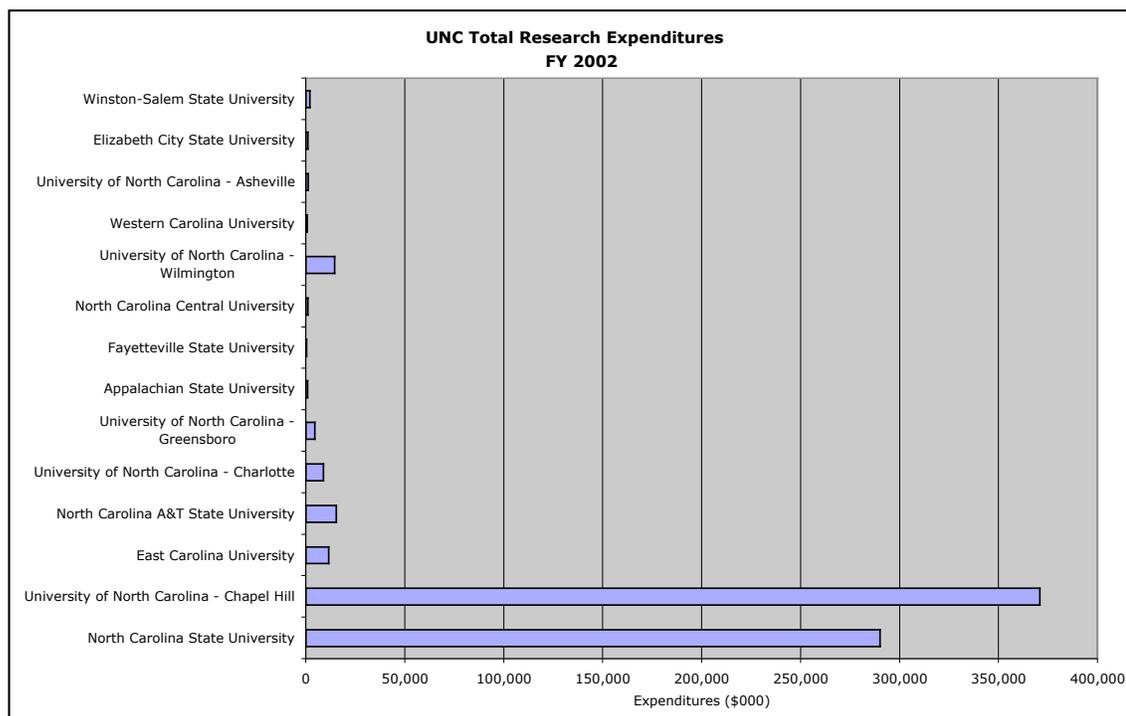
*Sources: Association of University Technology Managers (AUTM) FY 2000-2003 Annual Surveys
Peer States (Georgia, Michigan, Texas, Massachusetts, Pennsylvania, and Virginia) were selected from the 2003 Tracking Innovation Report of the North Carolina Board of Science and Technology.*

- Research.** Funded research is an indicator of the quality of the research faculty and, therefore, has a relationship to the universities' role in economic development, although it is important to note that not all funded research has a direct relationship to economic development. While all UNC institutions have some involvement in funded research, North Carolina, like most states, has its research concentrated in a relatively small number of institutions.

UNC total research expenditures in FY2002 were \$722.6 million. Of that total, UNC Chapel Hill expended \$370.8 million and North Carolina State University expended \$290 million, followed by North Carolina A&T at \$15.4 million, UNC Wilmington at \$14.6 million, and East Carolina University at \$11.5 million.

A similar pattern exists when just federal research expenditures are examined. Total federal expenditures in FY2002 were \$372.5 million with UNC Chapel Hill at \$254.6 million, North Carolina State University \$75.2 million, North Carolina A&T \$12.0 million, UNC Wilmington \$10.0 million, and East Carolina University \$6.0 million. Utilizing data from TheCenter at the University of Florida, national rankings were established for these universities and appear as Exhibits 5 and 6 on the following pages.

Exhibit 5

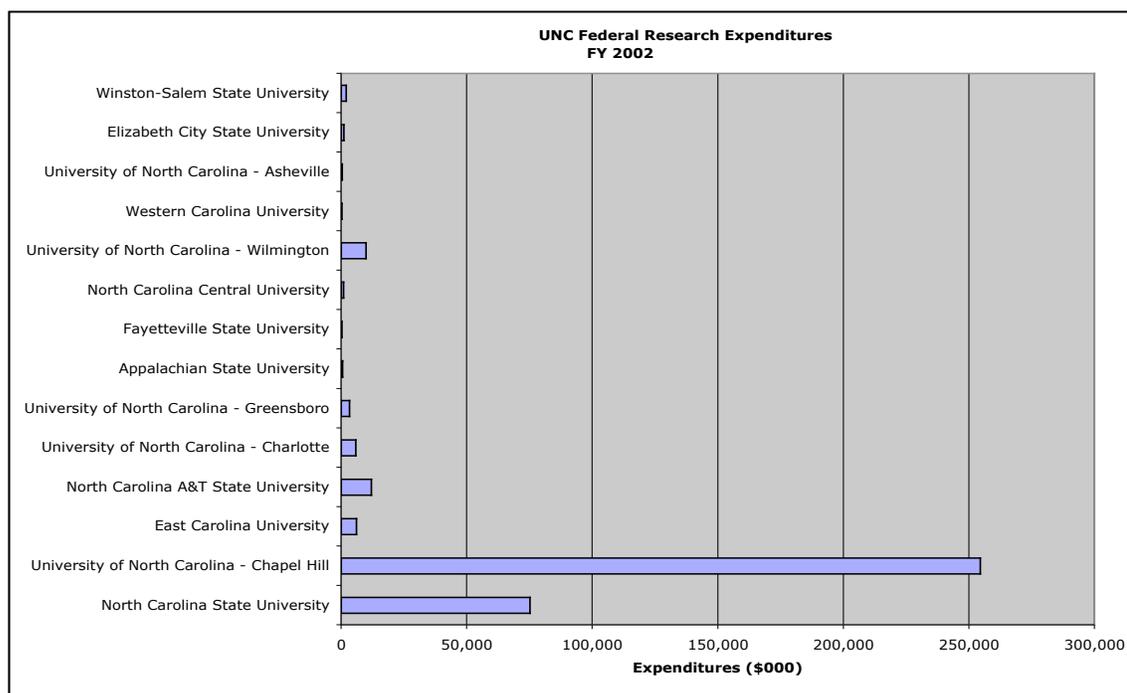


Source: <http://thecenter.ufl.edu>

UNC Universities with Research Dollars	2002 *** Total Research x \$1000	2002 *** National Rank All Universities	2002 *** Control Rank Public Universities
<u>Doctoral/Research-Extensive</u>			
North Carolina State University	290,018	33	21
University of North Carolina - Chapel Hill	370,806	28	17
<u>Doctoral/Research-Intensive</u>			
East Carolina University	11,513	258	189
North Carolina A&T State University	15,353	234	171
University of North Carolina - Charlotte	8,773	284	206
University of North Carolina - Greensboro	4,454	328	236
<u>Master's Comprehensive</u>			
Appalachian State University	781	510	334
Fayetteville State University	311	565	361
North Carolina Central University	1,035	479	316
University of North Carolina - Wilmington	14,568	238	175
Western Carolina University	653	525	344
<u>Baccalaureate-Liberal Arts</u>			
University of North Carolina - Asheville	1,232	452	304
<u>Baccalaureate-General</u>			
Elizabeth City State University	1,058	475	313
Winston-Salem State University	2,022	406	282

Source: <http://thecenter.ufl.edu>

Exhibit 6



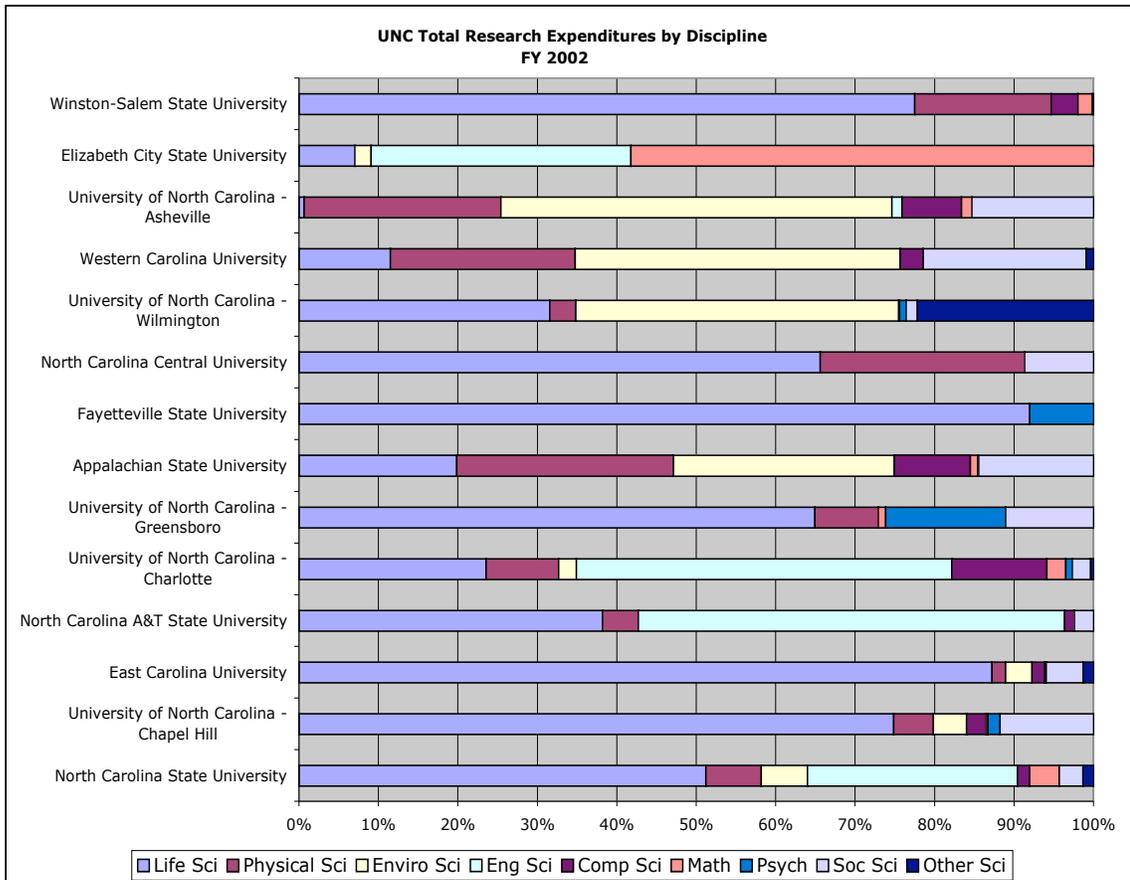
Source: <http://thecenter.ufl.edu>

UNC Universities with Federal Research Dollars	2002 *** Federal Research x \$1000	2002 *** National Rank All Universities	2002 *** Control Rank Public Universities
Doctoral/Research-Extensive			
North Carolina State University	75,204	92	60
University of North Carolina - Chapel Hill	254,571	22	10
Doctoral/Research-Intensive			
East Carolina University	6,030	262	189
North Carolina A&T State University	11,953	211	150
University of North Carolina - Charlotte	5,850	268	192
University of North Carolina - Greensboro	3,340	313	223
Master's Comprehensive			
Appalachian State University	543	472	315
Fayetteville State University	311	514	335
North Carolina Central University	971	414	289
University of North Carolina - Wilmington	9,950	226	163
Western Carolina University	280	521	338
Baccalaureate-Liberal Arts			
University of North Carolina - Asheville	412	490	324
Baccalaureate-General			
Elizabeth City State University	1,058	402	282
Winston-Salem State University	2,022	346	247

Source: <http://thecenter.ufl.edu>

These research expenditures, when examined by discipline (See Exhibit 7), show strong life sciences concentration on most UNC campuses. Seven of the universities (including UNC Chapel Hill and North Carolina State University) have over 50% of their funded research activity in the life sciences area; twelve of the Universities have research expenditures in the physical sciences, and five have research expenditures in the engineering sciences.

Exhibit 7



Source: <http://thecenter.ufl.edu>

This research activity is supported by graduate education, particularly at the Ph.D. level. As the gap analysis contained earlier in this report indicated, UNC institutions produced a total of 850 doctorates, a substantial number of which are in the high demand occupations (although, as was pointed out, most of these are for faculty careers where the marketplace is national not state). UNC Chapel Hill ranks 17 for public universities nationally in the number of doctorates produced (412), followed by North Carolina State University at 24 (322), and UNC Greensboro at 108 (67). Many of these doctorates are awarded in fields that do not produce funded research.

- **Campus Culture and State Support for Innovation.** In addition to the measurable items above, successful University involvement in research and technology transfer requires a supportive campus culture for and a state commitment to research, innovation, and entrepreneurship. The UNC Technology Development Initiative (TDI) examined campus issues and developed a number of recommendations, such as training for faculty and administrators in innovation and entrepreneurship; incorporating of these activities into promotion and tenure guidelines; explicit identification of economic development as a central mission; and recognition for success for the period 2000-2004. Other states, such as Georgia and California, have created models to invest state dollars to stimulate economic growth by leveraging University innovations and partnerships with the private sector. Georgia, for example, has created “Centers for Innovation” in targeted areas of research strength and state need. (See <http://www.georgiainnovation.org/> for more details). California, through its “California Institutes for Science and Innovation” and its “University of California Discovery (See <http://www.ucop.edu/california-institutes/about/about.htm> and <http://uc-industry.berkeley.edu/about/goals.htm> for more details.) is investing both in specific areas with the former program (for example, bioengineering, biotechnology, and quantitative biomedicine; telecommunications and information technology; and nanosystems) and in general collaborative research with the latter. The most competitive states in innovation and technology transfer will be those that have both supportive campus cultures and focused state support.

PRELIMINARY FINDINGS

I. TECHNOLOGY TRANSFER

1. UNC institutions are trending upward on total research awards (21%), federal research (65.4%), and industry sponsored research (29%). However, business and industry outside of North Carolina have fueled that growth; industry-sponsored awards from North Carolina business and industry have declined 16%. (Note: some data definition changes might have impacted to some degree these percentages.)
2. UNC institutions are, in relation to the overall research activity, only minimally involved in joint research with North Carolina business and industry. This equates at best to 1% of the total research amount awarded.
3. North Carolina selected institutions (Duke University, East Carolina University, North Carolina State University, UNC Chapel Hill, UNC Charlotte, and Wake Forest University) at \$2.2M per invention disclosure, were more efficient than the national average in both years examined (national averages \$2.4M in FY 2000 and \$2.5M in FY 2003.)

4. North Carolina selected institutions ranked second of seven states (behind only Virginia) examined in 2003 in efficiency of invention disclosures. In 2000, North Carolina was behind Virginia and Massachusetts and ahead of Georgia, Pennsylvania, Texas, and Michigan.)
5. North Carolina selected institutions, at \$6.7M in 2003 and \$6.5M in 2000 per license, were more efficient than the national average in both years examined.
6. North Carolina selected institutions ranked second of seven states in both years (behind Virginia) in their efficiency at converting research dollars into licenses.
7. North Carolina selected institutions are above the national averages in both 2003 and 2000 (more so in 2003), for research dollars expended per university start-up company created. North Carolina institutions expended \$88M in 2003 compared to a national average of \$100M. (In 2000, it expended \$66M compared to the national average of \$70M.)
8. North Carolina selected institutions ranked fourth (behind Massachusetts, Virginia, and Georgia) in their efficiency at converting research dollars into start-up companies created. They ranked fifth in 2000.

Overall, then, the technology transfer findings indicate select North Carolina institutions compare favorably to both national averages and to some other states, although they do not have a dominant competitive advantage in any of the areas. In addition, it appears that potential exists to grow significantly the North Carolina business and industry sponsored research.

II. RESEARCH

1. UNC Chapel Hill ranks 17 in total research expenditures by public universities (2002 data), followed by North Carolina State University (21), North Carolina A&T (171), UNC Wilmington (175), and East Carolina University (189).
2. UNC Chapel Hill also ranks very high (10) on federal research expenditures by public universities (2002 data), with a larger gap before the next institution; University of North Carolina State University (60). These two institutions were followed by North Carolina A&T (150), UNC Wilmington (163), and East Carolina University (189).
3. The two primary doctoral research universities (UNC Chapel Hill and North Carolina State University) have strong national rankings. They, and many of the other UNC institutions with smaller funded research programs, have developed areas of specialization in such fields as life sciences, which should have positive implications for supporting a number of the identified emerging industries in North Carolina.

III. CAMPUS CULTURE AND STATE SUPPORT FOR INNOVATION

1. UNC has begun initiatives to address insuring a campus culture at each of its institutions that supports innovation and entrepreneurship. While progress has been made, much work remains to be done.
2. North Carolina has traditionally provided very substantial support for its universities in general and has gained a national reputation as a result. However, a number of competitor states have made more substantial state investments in specific programs aimed at maximizing the partnerships among the state, its universities, and targeted businesses and industries.

8. OTHER PRELIMINARY FINDINGS

While the following do not necessarily fall within the scope of the current project, these findings surfaced during our work and are presented for consideration:

I. FUNDING

1. The funding formula for the NCCCS does not provide a financial incentive for developing or expanding academic programs in the areas of high state need. These programs are often high cost programs. While the UNC funding formula recognizes discipline cost differences, it does not recognize the high start up or expansion costs of such programs.
2. The funding formula for the NCCCS is based on a schools model, reflecting the origins of the System. For example, it provides no funding for curriculum programs in the summer even though that would be an ideal time for extensive developmental education programs and other academic programs. (The same is largely true of the UNC funding formula.)
3. While there are modest amounts in the state budget for collaborative programs between the two systems (and among institutions within each system), these are largely targeted and not extensive enough to provide adequate incentives.
4. With a high school drop-out rate in excess of 40%, North Carolina has a high need for basic skills programs. While the NCCCS has an extensive and successful program, it will not meet the future needs.
5. State budget priorities and shortfalls will require higher education to diversify its resource base.

II. POLICY

1. While UNC has well developed policies for program review and for taking programs off campus, it does not have a policy for the establishment or development of branch campuses or new campuses.
2. Both systems have program approval processes that appear thorough and timely, including notification of other institutions within each system of new program intents; however, there is no notification requirement between the two systems, although UNC posts its program proposal information on its website.
3. The NCCCS falls under the administrative rule making of the state which, in some instances, inappropriately slows response time (for example, approving and implementing new academic programs). Collaborative initiatives with UNC are often hindered because the Board of Governors can take quicker action than can the State Board of Community Colleges.

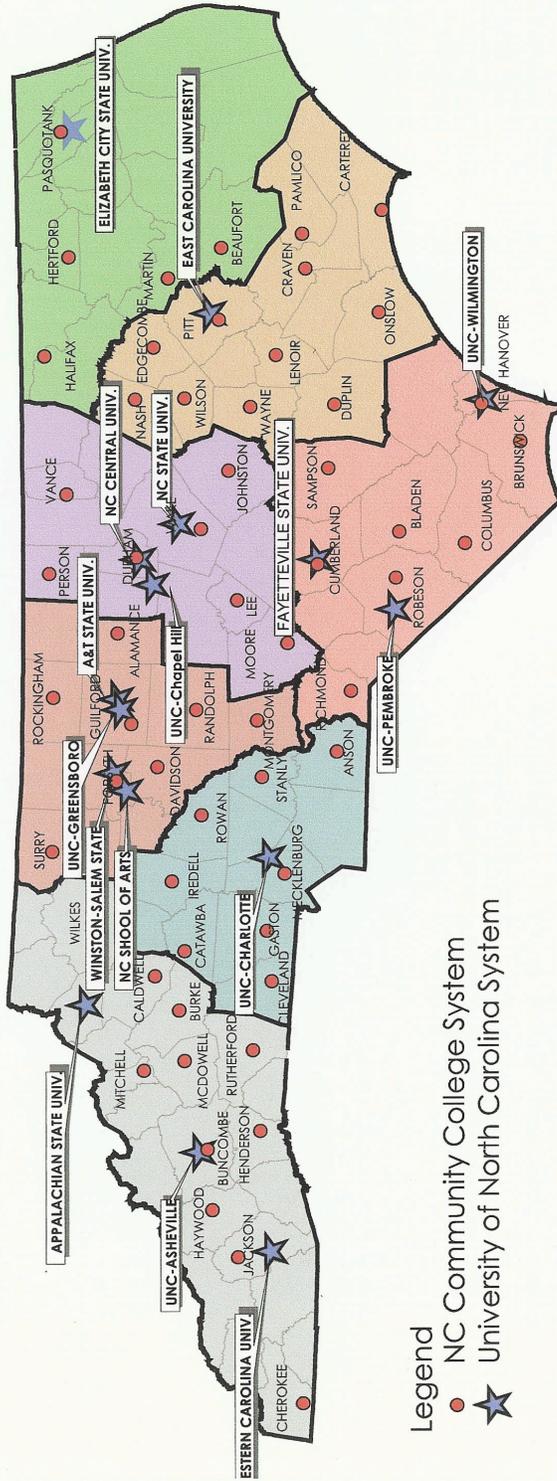
4. North Carolina does not appear to have as highly developed a P-16 approach to seamless education as do the leading states. With increased interest in innovations such as early and middle colleges in North Carolina and with a very high school dropout rate, it would seem an appropriate time to expand the P-16 initiative in the state to include all segments of the education system and the business community. The development of a K-16 data warehouse would be an example of a beneficial activity for such an expanded initiative.
5. Unlike many states, North Carolina does not have reciprocal in-state tuition with bordering counties in other states (it does have scholarships for students in border states who indicate their intention to become teachers in North Carolina's schools). Some economic development opportunities in border parts of the state may involve more than one state.
6. With the associate degree replacing the high school diploma as an entry level qualification for many occupations, the role of the bachelors degree and particularly the masters degree is changing. The need for the masters may even be proportionately higher than the need for students with bachelors. At the same time, many people with bachelors degrees may seek a specific diploma or certificate from a community college at some point in their careers.
7. North Carolina, like all states, has achievement gaps between its white and Asian students and African-American, Hispanic, and Native American students. Even though African-American and Native American participation rates in college are similar to whites, minority students do not have as high graduation rates for undergraduates nor the participation rates in graduate programs.
8. Current financial aid policies do not adequately address the financial needs of students taking multiple courses in joint programs at different campuses, as well as joint UNC and NCCCS programs.
9. Not all academic program expansions are initiated by UNC based solely on need and existing/projected data; external program initiations can undermine the integrity of the academic program review process.
10. Both internal and external communications about higher education's role in workforce and economic development are inadequate for building support for increased involvement.
11. There is a history of collaborative policies and agreements for joint academic programs and shared facilities between UNC and NCCCS; these could be expanded.
12. Many UNC, NCCCS, and other facilities exist that could be considered as sites to provide greater access to higher education in North Carolina (both for in-person and e-learning).

ATTACHMENTS

- ATTACHMENT 1: State of North Carolina Higher Education System and Economic Development Regions
- ATTACHMENT 2: North Carolina Community College System – Summary
- ATTACHMENT 3: University of North Carolina - Summary
- ATTACHMENT 4: Issues Regarding Employment Data and Projections
- ATTACHMENT 5: Listing of Appendices/URLs
- ATTACHMENT 6: Original Language of HB 1264

ATTACHMENT 1

State of North Carolina
Higher Education System and Economic Development Regions



- Legend**
- NC Community College System
 - ★ University of North Carolina System

- Economic Development Regions**
- Advantage West
 - Charlotte Regional Partnership
 - North Carolina's Eastern Region
 - North Carolina's Northeast Partnership
 - Piedmont Triad Regional Partnership
 - Research Triangle Regional Partnership
 - North Carolina's Southeast



ATTACHMENT 2:**NORTH CAROLINA COMMUNITY COLLEGE SYSTEM - SUMMARY**

North Carolina has 58 comprehensive community colleges and one specialized technology center, listed alphabetically below. The system serves all 100 counties. Individual colleges have service areas that may include one or several counties.

COLLEGE	COUNTY	REGION
Alamance CC, Graham	Alamance	Triad
Asheville-Buncombe TCC, Asheville	Buncombe	West
Beaufort County CC, Washington	Beaufort	Northeast
Bladen CC, Dublin	Bladen	Southeast
Blue Ridge CC, Flat Rock	Henderson	West
Brunswick CC, Supply	Brunswick	Southeast
Caldwell CC/TI, Hudson	Caldwell	West
Cape Fear CC, Wilmington	New Hanover	Southeast
Carteret CC, Morehead City	Carteret	East
Catawba Valley CC, Hickory	Catawba	Charlotte
Central Carolina CC, Sanford	Lee	Triangle
Central Piedmont CC, Charlotte	Mecklenburg	Charlotte
Cleveland CC, Shelby	Cleveland	Charlotte
Coastal Carolina CC, Jacksonville	Onslow	East
College of The Albemarle, Elizabeth City	Pasquotank	Northeast
Craven CC, New Bern	Craven	East
Davidson County CC, Lexington	Davidson	Triad
Durham TCC, Durham	Durham	Triangle
Edgecombe CC, Tarboro	Edgecombe	East
Fayetteville TCC, Fayetteville	Cumberland	Southeast
Forsyth TCC, Winston-Salem	Forsyth	Triad
Gaston College, Dallas	Gaston	Charlotte
Guilford TCC, Jamestown	Guilford	Triad
Halifax CC, Weldon	Halifax	Northeast
Haywood CC, Clyde	Haywood	West
Isothermal CC, Spindale	Rutherford	West
James Sprunt CC, Kenansville	Duplin	East
Johnston CC, Smithfield	Johnston	Triangle
Lenoir CC, Kinston	Lenoir	East
Martin CC, Williamston	Martin	Northeast
Mayland CC, Spruce Pine	Mitchell	West
McDowell TCC, Marion	McDowell	West
Mitchell CC, Statesville	Iredell	Charlotte
Montgomery CC, Troy	Montgomery	Triad
Nash CC, Rocky Mount	Nash	East

COLLEGE	COUNTY	REGION
Pamlico CC, Grantsboro	Pamlico	East
Piedmont CC, Roxboro	Person	Triangle
Pitt CC, Greenville	Pitt	East
Randolph CC, Asheboro	Randolph	Triad
Richmond CC, Hamlet	Richmond	Southeast
Roanoke-Chowan CC, Ahoskie	Hertford	Northeast
Robeson CC, Lumberton	Robeson	Southeast
Rockingham CC, Wentworth	Rockingham	Triad
Rowan-Cabarrus CC, Salisbury	Rowan	Charlotte
Sampson CC, Clinton	Sampson	Southeast
Sandhills CC, Pinehurst	Moore	Triangle
South Piedmont CC, Polkton	Anson	Charlotte
Southeastern CC, Whiteville	Columbus	Southeast
Southwestern CC, Sylva	Jackson	West
Stanly CC, Albemarle	Stanly	Charlotte
Surry CC, Dobson	Surry	Triad
Tri-County CC, Murphy	Cherokee	West
Vance-Granville CC, Henderson	Vance	Triangle
Wake TCC, Raleigh	Wake	Triangle
Wayne CC, Goldsboro	Wayne	East
Western Piedmont CC, Morganton	Burke	West
Wilkes CC, Wilkesboro	Wilkes	West
Wilson TCC, Wilson	Wilson	East
NC Center for Applied Textile Technology, Belmont	Gaston	Charlotte

ATTACHMENT 3:**UNIVERSITY OF NORTH CAROLINA - SUMMARY**

UNIVERSITY	FOUNDED	STATUS	COUNTY / REGION
Appalachian State University, Boone	1899	Master's I (Comprehensive)	Watauga West
East Carolina University, Greenville	1907	Doctoral/Research-Intensive	Pitt Eastern
Elizabeth City State University, Elizabeth City	1891 HBCU	Baccalaureate	Pasquotank Northeast
Fayetteville State University, Fayetteville	1867 HBCU	Master's I (Comprehensive)	Cumberland Southeast
NC Agricultural & Technical State University, Greensboro	1891 HBCU	Doctoral/Research-Intensive	Guilford Triangle
NC Central University, Durham	1909 HBCU	Master's I (Comprehensive)	Durham Triangle
NC School of the Arts, Winston-Salem	1963	Specialized	Forsyth Triad
North Carolina State University, Raleigh	1887	Doctoral/Research-Extensive	Wake Triangle
UNC Asheville, Asheville	1927	Liberal Arts	Buncombe West
UNC Chapel Hill, Chapel Hill	1789	Doctoral/Research-Extensive	Orange Triangle
UNC Charlotte, Charlotte	1946	Doctoral/Research-Intensive	Mecklenburg Charlotte
UNC Greensboro, Greensboro	1891	Doctoral/Research-Intensive	Guilford Triad
UNC Pembroke, Pembroke	1887 Native American	Master's I (Comprehensive)	Robeson Southeast
UNC Wilmington, Wilmington	1947	Master's I (Comprehensive)	New Hanover Southeast
Western Carolina University, Cullowhee	1889	Master's I (Comprehensive)	Jackson Western
Winston-Salem State University, Winston-Salem	1892 HBCU	Baccalaureate	Forsyth Triad

ATTACHMENT 4:**ISSUES REGARDING EMPLOYMENT DATA AND PROJECTIONS**

Many countries and regions, for example, Shanghai, Malaysia, and Germany, develop comprehensive country-wide economic and workforce development plans focusing on the growth of strategic clusters. In North Carolina, there appears to be no comprehensive, statewide, strategic plan or overview of the economic and workforce development needs of the State. Different regions gather data differently, the classification systems differ, and there appears to be no central data depository for the various parts of the system to feed into. The quality and consistency of secondary data available in North Carolina makes it difficult to pinpoint precise areas of skill shortages as they are perceived by employers, who are the customers of the state's workforce development and post-secondary system. In the process of the research supporting this study, significant discrepancies were uncovered between the kind of data gathered by the State, by its regions, and the US DOL's Bureau of Labor Statistics. These discrepancies are a cause for concern and an opportunity.

Specifically, the following issues hinder North Carolina's ability to see clearly economic development and employment opportunities:

1. *The way in which data are cut.* The US Bureau of Labor Statistics (BLS) maps specific occupations into industries, but not necessarily in sectors or clusters. For example, biotechnology workers are spread over a number of occupational categories found in the BLS data.
2. *Challenges with regional data.* The data and economic development strategies for the regions are highly variable in quality, depth, and accuracy, and not sharply enough defined in terms of occupational forecasts. Also, the studies were highly dissimilar in scope and content. Several of the regions had not completed the current visioning process. This led to gaps in the data, especially for the Northeast region. The regional forecasts do not tie back to the occupational categories, either in the NCEC or in the BLS because the classifications are different. For example, North Carolina's biopharmaceutical report divides occupations into three broad categories: entrepreneur/leader, R&D, and manufacturing. No such categories (colored by the needs of the biopharmaceutical sector) exist in the NCEC or USDOL data. What specific occupations fit under those three headings in North Carolina's Biopharmaceutical cluster(s) can only be gathered with primary research. There is a similar problem with the IT industry, as the heading "computing and mathematical occupations" may not include enough occupations found in that industry in North Carolina.

3. *Problems with the NCEC data.* The biggest challenge is that the NCEC is in the middle of completing its 2012 forecast. Therefore, this study had to rely upon the 2010 projections. These projections were based on 1976-2000 occupational and employment data. Since major changes have occurred in the economy since 2000, these forecasts have limits as to their use. Additionally, the NCEC occupational forecasts did not always add up. For example, manufacturing workers for the state were forecast to decline by 10,000; however, looking at the seven different regions showed an increase for each region of a total of 50,000.

**ATTACHMENT 5:
LISTING OF APPENDICES/URLS**

APPENDICES

3. NORTH CAROLINA EMPLOYMENT ENVIRONMENT

3.A. North Carolina Economic Development Forecast

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- 3.A.11. Top 25 North Carolina Occupations Forecast for 2000-2010 sorted by Absolute Change
- 3.A.12. North Carolina Counties by Workforce Development Board Regions and Economic Development Regions.
- 3.A.13. North Carolina Occupational Forecasts 2000-2010 by Major Occupational Groups
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**ATTACHMENT 5:
LISTING OF APPENDICES/URLS**

APPENDICES continued

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- 4.A.3. Student Completions by Program-2003-04 (North Carolina Community College System Fact Book: Section IV-Page 65-68)
- 4.A.4. Curriculum Student Information II; Student Enrollment by College 2003-04 (North Carolina Community College System Fact Book: Section IV-Page 69-70)
- 4.A.5. Continuing Education Student Information, Student Enrollment by College, 2003-04 (North Carolina Community College System Fact Book: Section IV-Page 71-72)
- 4.A.6. New and Expanding Industry Training Annual Statistical Data 1986-1987 through 2003-2004

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5.B. North Carolina Community College

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URL WEBSITES/FOOTNOTE/SOURCE DATA LISTING**Chapter 3 Tables/Figures/Charts*****Source: RTI calculations based on aggregation of NCESC data***

- Figure 3.A.6 Percent Job Changes by Major Occupational Grouping by Economic Development Regions
- Figure 3.A.7 Absolute Job Changes 2000-2010: by Major Occupational Grouping by Urban/Rural

Source: NC Employment Security Commission

- Table 3.B.3 North Carolina Occupation Trends 2000-2010: Employment in Production Occupations
- Table 3.B.4. North Carolina Occupation Trends 2000-2010: Employment in Vehicle Parts Manufacturing Related Occupations
- Table 3.B.5. North Carolina Occupation Trends 2000-2010: Employment in Selected Advanced Materials-Related Occupations
- Table 3.B.7. North Carolina Occupation Trends 2000-2010: Employment in Life, Physical and Social Science Occupations Plus Architectural and other Engineers
- Table 3.B.8. North Carolina Occupation Trends 2000-2010: Employment in Biotechnology and Pharmaceutical-Related Occupations
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- Table 3.B.13. North Carolina Occupation Trends 2000-2010: Employment in Transportation and Material Moving Occupations
- Table 3.B.15. North Carolina Occupation Trends 2000-2010: Employment in Selected Transportation and Material Moving Occupations
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Source: Figure 5.1 Nanotechnology's Probable Business Impact in 2007, Larta, 2003

- Figure 3.B.6. Nanotechnology's Impact on Traditional Industries:

Source:1. Creating a Bio-science Workforce: National Skills Standards for Entry into the Bioscience industry. EDC 1995. Monika Aring and Judith Leff. Funded by the US Department of Labor and US Department of Education. Source 2. Windows on the Workplace 2003: A Training Needs Assessment for the Biomanufacturing Workforce. March 2003. NC Biotech Center Education and Training Program. <http://www.ncbiotech.org/pdf/files/goldenleafrpt.pdf>

- Table 3.B.9. Analysis of Skills Requirements for Biopharmaceutical Workforce

Source: <http://demog.state.nc.us>

- Table 3.C.1 Population Forecasts for 2010 by Age
- Figure 3.C.2 Growth 2000-2010 by County

Source: www.ncruralcenter.org

- Figure 3.C.3 Manufacturing Decline: *Source:*
www.ncruralcenter.org/databank/trendpage_employment.asp
- Figure 3.C.7. Educational Attainment Levels: *Source:*
www.ncruralcenter.org/databank/trendpage_education.asp
- Figure 3.C.8 Population with a College Degree by County: *Source:*
www.ncruralcenter.org/databank/trendpage_education.asp

Source: www.census.gov

- Table 3.C.4 North Carolina Educational Attainment, 2004, Percent of Population 25 and Older
Source: www.census.gov/population/www/socdemo/education/cps2004.html. Tables A, 12 and 14, accessed 4/12/05.
- Table 3.C.5 North Carolina Educational Attainment, 2004, Percent of Population 18 and Older
Source: www.census.gov/population/www/socdemo/education/cps2004.html. Table 14, accessed 4/12/05.
- Table 3.C.6. North Carolina Educational Attainment, 2004, Percent of Population 25 and Older
Source: www.census.gov/population/www/socdemo/education/cps2004.html. Table 14, accessed 4/12/05.
- <http://www.bls.gov/oco/cg/home.htm>
- The Teaching Firm: where productive work and learning intersect. A 7-firm empirical study of learning and skill needs in high performing work organizations competing globally in the manufacturing sector, including Boeing, Motorola, Siemens, and a number of SME firms throughout the U.S. Published by EDC Inc. Monika Aring and Betsy Brand, Co-Directors, 1998 (Funded by the USDOL, Pew Charitable Trust, states of NC, MA, WA, CT, FL, IL.)
- National Skill Standards for Entry into the Biotech industry. EDC, Inc. 1995. (Funded by the USDOL and USDOE). Monika Aring, Principal Investigator. Judy Leff Project Director.
- National Skill Standards for the Chemical Process Industry. National Chemical Society. Monika Aring, Advisor.
- <http://www.nccommerce.com/categories/aboutus.htm>, accessed March 28, 2005.

National Coalition for Advanced Manufacturing (NACFAM). 2003

- National Coalition for Advanced Manufacturing (NACFAM). 2003. "Industrial Transformation: Key to Sustaining the Productivity Boom." Washington, D.C.
- National Coalition for Advanced Manufacturing (NACFAM).2003. "The Case for Enhancing American Workforce Skills." Washington, DC.
- Reported in NACFAM, 2003. "The Case for Enhancing American Workforce Skills." pages 12-13.

- Feser, Edward and Renski, Henry. 2000. High-Tech Clusters in North Carolina. North Carolina Board of Science and Technology.

- MIT Sloan School of Business. 2002. "Industry Cluster Analysis for Forward Greensboro Economic Development Partnership."

- Salek, Jeffrey. "How to Prepare for a Career in Industry." Chemical and Engineering News. <http://pubs.acs.org/cen/125th/pdf/7913salek.txt.pdf>. Accessed March 18, 2005.

- Wesemann, Jodi. 2004. "The Role of Chemical Technicians in the Chemical Industry and ACS: Celebrating Contributions and Identifying Opportunities." www.chemistry.org, accessed March 18, 2005.

- California Council on Science and Technology. 2004. "Nanoscience and Nanotechnology: Opportunities and Challenges in California: A briefing prepared for California Legislative Joint Committee on Preparing California for the 21st Century.

- Zucker, Lynne and Darby, Michael. 2005. "Socio-economic Impact of Nanoscale Science: Initial Results and Nanobank. Waltham, MA: National Bureau of Economic Research. Working Paper No. 11180. www.nber.org.

- Roco, M.C. and Bainbridge, W. (eds.) 2001. "Societal Implications of Nanoscience and Nanotechnology." Arlington, VA: National Science Foundation.

- Roco, M.C. 2003. "Converging Science and Technology at the Nanoscale: Opportunities for Education and Training." *Nature Biotechnology*, 21 (10).

- Fonash, Stephen. 2001. "Education and Training of Nanotechnology Workforce." *Journal of Nanoparticle Research*. 3:79-82.

- California Council on Science and Technology.

- Milken Institute, 2004. *Biopharmaceutical Industry Contributions to State and US Economies*.

- Institute for Emerging Issues. 2004. *Program Report: Biotechnology and Humanity at the Crossroads of a New Era*.
http://www.ncsu.edu/iei/pastforums2002/2002_iei_forum_report.pdf. Accessed March 21, 2005.

North Carolina Biotechnology Center (March 2003)

- North Carolina Biotechnology Center (March 2003). *Window on the Workplace 2003. A Training Needs Assessment for the Biomanufacturing Workforce*. Accessed on March 1, 2005 from <http://www.ncbiotech.org/ouractivities/spproj/workplace03.cfm>
- North Carolina Biotechnology Center (March 2003). *Window on the Workplace 2003. A Training Needs Assessment for the Biomanufacturing Workforce*, page 13. Accessed on March 1, 2005 from <http://www.ncbiotech.org/ouractivities/spproj/workplace03.cfm>
- <http://www.bls.gov/oco/cg/cgs009.htm>, accessed March 21, 2005.
- Regional Technology Strategies, 2003. “Meeting the Long-term Skills Needs of North Carolina’s Biomanufacturing Industries and Biotechnology Cluster.”
- http://www.soc.duke.edu/NC_GlobalEconomy/biotech/, accessed March 28, 2005.
- Perrins, Gerald. 2004. Employment in the Information Sector in March 2004. Monthly Labor Review. <http://www.bls.gov/opub/mlr/2004/09/ressum1.pdf>, accessed March 22, 2005.
- Information Technology Association of America, 2004. “Adding Value...Growing Careers: The Employment Outlook in Today’s Increasingly Competitive IT Job Market.” <http://www.ita.org>, accessed March 22, 2005.
- National Workforce Center for Emerging Technologies, 2004. “Applications of Information Technology: Trends Assessment for 2004.” www.nwcet.org/products/trends2005.asp, accessed March 22, 2005
- U.S. Department of Commerce, Office of Technology Policy. 2003. “Education and Training for the Information Technology Workforce.” www.technology.gov/reports/IT_Workforce/ITWF2003.pdf, accessed March 22, 2005.
- Salzman, Harold 2000. “The Information Technology Industries and Workforces: Work Organization and Human Resource Issues. Washington, DC: National Academy of Science Committee on Workforce Needs in Information Technology.
- NC Electronics & Information Technologies Association (2000). *North Carolina Information Technologies Industry. Competitiveness Study*.

- ITAA (2000). *Bridging the Gap: Information and Technology Skills for a New Millennium*. Accessed March 1, 2005 from <http://www.ita.org/workforce/studies/hw00execsumm.htm>

Ibid

- Ibid. Executive Summary.
- Ibid, page 328.
- Florida, Richard. 2002. *The Rise of the Creative Class*. Basic Books, page 356.
- Coursey, Don L. “The Arts and Culture Workforce Project: Documents Prepared for Advancing Chicago’s Civic Agenda through the Arts: 2003-2004.” <http://culturalpolicy.uchicago.edu/pdfs/artsworkforceproject.pdf>, accessed March 14, 2005.
- Bureau of Labor Statistics, www.bls.gov.
- Feser, Edward, and Renski, Henry. 2000. *High-tech Clusters in North Carolina*. North Carolina Board of Science and Technology.
- <http://www.aifl.org/>, accessed March 24, 2005.
- <http://www.fs5.info/logisticsJobHunts/jannews2.html>, accessed March 24, 2005.
- Gammelgaard, Britta and Larson, Paul D., 2001. “Logistics Skills and Competencies for Supply Chain Management.” *Journal of Business Logistics*. 22 (2):27-53.
- Aring, Monika and Brand, Betsy. 1998. *The Teaching Firm: Where Productive Work and Learning Intersect*. Washington, D.C.: EDC, Inc.
- Business-Higher Education Forum, 2005. “A commitment to America’s Future: Responding to the Crisis in Mathematics and Science Education.” www.bhef.com, accessed March 23, 2005.
- American Electronics Association, 2005. “Losing the Competitive Advantage: The Challenge for Science and Technology in the United States.” www.aeanet.org/publications/IDJJ_AeA_Competitiveness.asp, accessed March 23, 2005.
- Taskforce on the Future of American Innovation, 2005. “The Knowledge Economy: Is the U.S. Losing its Competitive Edge?” www.futureofinnovation.org/PDF/Benchmarks.pdf, accessed March 23, 2005.
- Fullerton, Howard N and Toossi, Mitra. 2001. “Labor Force Projections to 2010: Steady Growth and Changing Composition.” *Monthly Labor Review*. <http://www.bls.gov>. Accessed March 30, 2005.

- NC Rural Center, *www.ncruralcenter.org*, accessed 1/31/05.
- www.ncatlasrevisited.org, accessed 1/31/05
- Bureau of Economic Analysis, *www.bea.gov*, accessed 1/31/05.
- *www.ncesc.gov*, accessed 1/31/05.
- Watt, Graham, North Carolina Displaced Workers Study, Department of Commerce, May 2002.
- Center for Regional Economic Competitiveness, “Situation Analysis of the Future Forward Study Region: 10th and 11th Congressional Districts of North Carolina,” February 2003, page 46.
- Milken Institute, “Biopharmaceutical Industry Contributions to State and US Economics,” October 2004.
- <http://demog.state.nc.us/demog/hisp9000.html>, accessed 1/31/05.
- *www.factfinder.census.gov*, accessed 1/31/05.
- Digest of Educational Statistics, 2003. *www.nces.ed.gov*.
- <http://www.elon.edu/nccc>
- *Evolving Campus Support Models for E-Learning Courses*, Paul Arabasz and Mary Beth Baker, Educause 2003.
- *Ref. NCCCS Requests For Distance Learning IT Funding Proposal Project Justification*
- *Ref. 2005-7 Expansion Budget Request Justification*, page 1, para 4).
- *Ref. 2005-7 Expansion Budget Request Justification*, page 1, para 2.)
- www.ga.unc.edu/student_info/caa
- Statistical Abstract of Higher Education, which is produced on an annual basis by the UNC. (It is available online and includes data for all higher education institutions in North Carolina.)
- Data from TheCenter at the University of Florida

- Georgia, for example, has created “Centers for Innovation” in targeted areas of research strength and state need. (See <http://www.georgiainnovation.org/> for more details

- California, through its “California Institutes for Science and Innovation” and its “University of California Discovery (See <http://www.ucop.edu/california-institutes/about/about.htm> and <http://uc-industry.berkeley.edu/about/goals.htm> for more details.) is investing both in specific areas with the former program.

**ATTACHMENT 6:
ORIGINAL LANGUAGE OF HB 1264**

Original Language as approved in House Bill 1264:

PART 6. UNIVERSITY SYSTEM AND COMMUNITY COLLEGE SYSTEM
JOINT STUDY OF HIGHER EDUCATION STRATEGY

SECTION 6.1. To ensure that the State's citizens are academically prepared and equipped for current job opportunities and jobs of the future in North Carolina's growing knowledge economy, the Board of Governors of The University of North Carolina, in collaboration with the State Board of Community Colleges, shall, within 60 days after this act becomes law, contract with a private consulting firm that has experience in higher education to conduct a comprehensive study of the mission and educational program needs for the University System and the Community College System. The Board of Governors may enter into contracts with consultants for the purposes authorized in this section without complying with the provisions of Article 3C of Chapter 143 of the General Statutes. The study shall include all of the following:

- (1) An analysis of demographic, economic, and educational data regarding the needs for higher education programming in the State as a whole, as well as in all geographic and economic regions of the State.
- (2) An updated enrollment projection for each System and each institution that includes adult, noncredit, career, and degree program enrollments.
- (3) An analysis of current program offerings and majors in undergraduate, graduate, nondegree, and workforce training programs, offered by each institution.
- (4) Recommendations as to how the institutions might better serve current and emerging needs related to existing and new programs; opportunities for regional program delivery; enhanced effectiveness and quality that can be achieved via sharing of resources, and program partnerships and collaborations both within and between higher education systems; and opportunities for online program delivery and other distance technology delivery systems.
- (5) An analysis of and suggested updates to existing long-range capital plans of both the University and Community College Systems that will address land acquisition and facility needs to support the program recommendations identified in this study, taking into account opportunities for modernization of and new uses for existing facilities.

- (6) With regard to the University System, there shall be special emphasis on the development of signature programs for Historically Black Colleges and Universities and the University of North Carolina at Pembroke. In conducting the study, the consulting firm shall take into account that the General Assembly finds the Historically Black Colleges and Universities and the University of North Carolina at Pembroke to be institutions with important historical traditions and equally important contemporary purposes and, as such, are valuable and indispensable assets of The University of North Carolina and the State. The General Assembly intends to encourage the continued growth and development of those constituent institutions and would resist any suggestion to eliminate the historical function and purpose of those institutions.
- (7) With regard to both the University System and the Community College System, there shall be an acknowledgement of the existence and importance of a strong liberal arts education foundation and, at the same time, an emphasis on existing and new programs specifically aimed at meeting business, industry, workforce, and career needs of North Carolina in the State's changing and growing knowledge-based economy, taking into account, as appropriate, State and regional economic strategies.

SECTION 6.2. These studies shall be designed to provide information and recommendations that will assist the General Assembly in setting priorities for funding to address the strategic higher education needs of the State. The Board of Governors, the State Board, and their consultant shall periodically report their findings to a higher education programming of the Joint Legislative Education Oversight Committee. The two boards and their consultant shall report the preliminary results of the study to the General Assembly and to the Joint Legislative Education Oversight Committee by April 15, 2005, and shall file a final report and recommendations with the General Assembly and the Joint Legislative Education Oversight Committee no later than December 31, 2005.

SECTION 6.3. The Joint Legislative Education Oversight Committee may create a higher education programming subcommittee to monitor the study authorized in this part.

Technical Correction – the following change was made in Senate Bill 1225, 2004 Technical Corrections Act:

SECTION 51. If House Bill 1264, 2003 Regular Session, becomes law, then the first paragraph of Section 6.1 of House Bill 1264, 2003 Regular Session, reads as rewritten:

"SECTION 6.1. To ensure that the State's citizens are academically prepared and equipped for current job opportunities and jobs of the future in North Carolina's growing knowledge economy, the Board of Governors of The University of North Carolina, ~~in collaboration with the State Board of Community Colleges, Carolina and the State Board of Community Colleges~~ shall, within 60 days after this act becomes law, contract with a private consulting firm that has experience in higher education to conduct a comprehensive study of the mission and educational program needs for the University System and the Community College System. The Board of Governors and the State Board may enter into contracts with consultants for the purposes authorized in this section without complying with the provisions of Article 3C of Chapter 143 of the General Statutes. The study shall include all of the following:".