

Staying a Step Ahead: Higher Education
Transforming North Carolina's Economy
(HB 1264)

P A P P A S
CONSULTING
GROUP

Final Report
July 21, 2006

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Erskine Bowles
President
The University of North Carolina General Administration

Box 2688
910 Raleigh Road
Chapel Hill, NC 27515-2688

H. Martin Lancaster

President
North Carolina Community College System
Caswell Building
200 West Jones Street

Raleigh, NC 27603-1379

Dear President Bowles and President Lancaster:

The Pappas Consulting Group Inc. is pleased to present you its final report in fulfillment of HB1264, *Staying a Step Ahead: Higher Education Transforming North Carolina's Economy*.

Appendices to this report contain: HB1264; the Final Interim Report dated January 17, 2006; Preliminary Recommendations dated February 1, 2006; the NCCCS Mission Statement; the UNC Mission Statement; and enrollment projections for UNC and NCCCS.

During this study, there have been a number of significant leadership changes at the University of North Carolina. In January, Erskine Bowles assumed the Presidency. Since that time, a new Board Chair has been elected and new appointments in three key areas of the General Administration have occurred in Academic Affairs, Finance, and Economic Development.

From the Community College System perspective, the senior leadership of the System has remained the same. A remarkable collaboration between the President of the University of North Carolina and the President of the North Carolina Community College System emerged in January of this year. A joint UNC-NCCCS Cabinet has been formulated and has started meeting on a quarterly basis to enable both systems to work more seamlessly for the benefit of students in both sectors and to formulate higher education policy that will address the educational, workforce and economic development needs of the state.

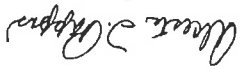
Erskine Bowles, President
President

H. Martin Lancaster
President
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Our report provides much for UNC and NCCCS, as well as the legislature and others to consider. In the case of the University of North Carolina, the impending, mandated Board of Governors Mission Review will enable the 16 constituent members and UNC to undertake a meaningful self-assessment in order to serve better the people of the state of North Carolina, especially when taken in concert with the many recommendations contained in this report.

When we started this study, we indicated that to our knowledge HB1264 was the "first of its kind" in the nation as it engaged both the University of North Carolina and the North Carolina Community College System in a transformative effort. Doing the right things right are essential in this increasingly, global, competitive and instant gratification culture in which we reside. There are a number of bold initiatives, indeed some "first-of-a-kind" recommendations in this report that will require will and fortitude. We are hopeful that the leadership in place at the University of North Carolina and the North Carolina Community College System will enable higher education in North Carolina to help transform North Carolina's economy and that this report will add value to that effort.

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**

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

FINAL RECOMMENDATIONS

INTRODUCTION

The State of North Carolina enjoys an outstanding reputation for connecting higher education and the economy. Long before it became fashionable, North Carolina recognized the link between research and the economy, between universities and businesses by creating the nation's first research park: the legendary Research Triangle Park. North Carolina and its communities also over the years built an enviable network of community colleges, making workforce training readily accessible to the people of the state. One of the primary reasons for the innovations in creating synergies between higher education and the economy has been the partnership with, and leadership from, state government. The proactiveness of the legislature surfaced again with the passage of HB 1264 in 2004. This legislation sought to insure that higher education was sufficiently anticipating the future economic needs of the state.

HB 1264 correctly assumed that North Carolina could not just rely on the traditional modes of economic development; the state needed economic transformation. While all states faced economic challenges early in the new millennium, few – if any – experienced the pressures hitting North Carolina. It came up on the short end of an economic triple play, as the traditional powerhouses of tobacco, textiles, and furniture all declined. The shift in employment sectors has been away from manufacturing (from 27% of employment in 1990 to 15% in 2005) and towards the service sector that now comprises over 70% of the employment in the State.

- Total employment is projected to increase to 4.8 million by 2012 (increase of 700,000)
- Manufacturing will continue to lose jobs in the future
- Service sector jobs will continue to replace goods-producing jobs

- 2000-2010 North Carolina population increased 16%; U.S. average 10%.
- In-migration of Hispanics grew 394% (300,000 residents) during the 1990's.
- Blacks make up 22% of state's population, by far the largest minority group in the state.
- Net migration accounted for 70% of population increase (1,000,000 people)

At the same time that major shifts are occurring in the economy, there are fundamental demographic changes taking place. This growing and already diverse state will become increasingly diverse. For instance, from 1999-2004 the population of North Carolina increased 7.4% overall, yet the White population only grew 4%. The Black population grew by 7.4%; the Hispanic population grew by 59.2%. The diversity, however, has regional variation. Along the Coastal Plain, Blacks account for 30% of the population, and in six counties in the east and northeast, over half the population.

Without positive intervention, this diversity will pose substantial economic, educational, and regional challenges for the state. For example, the poverty rate in North Carolina is approximately the same as the national average (12.4%), yet 23 rural counties have poverty rates above 18%. The median household income is below the national average (\$39,184 vs. \$41,994) with significant disparities by race (White \$42,530; Black \$27,845; and Hispanic \$32,353).

- North Carolina population 48% urban, 52% rural.
- In 2005, overall unemployment rate of 5.9%
- In 2005, 13 rural counties had unemployment rates above 8%.

The state is not monolithic. It is a collection of very different regions, of many communities of varying sizes and wealth. As John Silvia, the Chief Economist of Wachovia Corporation, pointed out, the state cannot even be divided into urban and rural areas any more because of the "increasing 'suburbanization'" in the metropolitan areas. And there are significant differences between one city and another, between one rural area and another.

- Almost one million people live in poverty.
- 25% Hispanic, 23% Black, 21% American Indian
- Displaced workers are more than 1.7 times as likely to be Black.

Thus, a one-size-fits-all solution to economic growth is unrealistic. A couple of common themes, however, apply to every region and to every community. First, the better educated the population, the better the prospects for economic transformation. Second, the better the quality of life, the better the prospects for economic transformation. On the latter point, authors like Richard Florida have pointed out the importance of "place," especially for young professionals. Thus recommendations that impact the quality of the schools (teachers), of health care (nursing and other health fields), and cultural opportunities (the performing and fine arts) are indeed responsive to economic development.

While sensitivity to regional differences is important on one level, on another level it must not constrain educational responses. With the advent of technology in education, past limits of space and time can be significantly diminished. The same is somewhat true of economic opportunities. Technology allows, for example, call centers to be located anywhere as long as there is a willing and sufficiently skilled workforce and an adequate technology infrastructure.

The real economic competition today is not between different parts of the state or even between southern states or within the U.S. Global competition is palpable and as Tom Friedman so convincingly portrays the world has become flat. And as Silvia points out, "This global labor market represents a challenge to labor market participants and policy makers alike as both struggle to grasp the implications of domestic oriented decisions in a global labor market". He concludes that the solution is not to try to attract companies to fit the current workforce skills but to retrain the workforce to fit the emerging industries. Public policy will need to be intentional in accomplishing this.

- 19.5% growth in college age cohort by 2010.
- 47% growth in 55-64
- 19.4% growth in 65+

The college population will likely increase significantly, with the population of college-age North Carolinians in 2010 reaching almost 1 million. In addition, more and more older students will seek life-long learning as people change careers multiple times, changes that often require new skill sets. As with the general population, the higher education population will be more diverse.

With high drop out rates from high school, North Carolina is facing an unprepared workforce for a knowledge economy. A recent (June 20, 2006) report by the Education Research Center utilizes a Cumulative Promotion Index to estimate the probability that a student in the 9th grade will complete high school on time with a regular diploma. North Carolina was at 66%, which is below the national average. The high was 84.5% in New Jersey; the low was 52.5% in South Carolina. The increasing diversity will further challenge preparation as there are substantial educational achievement gaps among different socio-economic groups. For example, in UNC, the overall first year retention rate (those freshman students returning for the sophomore year at the same institution) was 81.2% in Fall 2004. The rate for Whites was 82.5%, for Hispanics 80.2%, and for Blacks 77.8%. The six year graduation rate was 59.1%. The rates for Whites was 62.6%, for Hispanics 50.9%, and for Blacks 49.8%. NCCCS reports its data differently, although achievement gaps are apparent (for example, 12.76% of White enrollment were graduates in 2004-05, compared to 9.68% Black and 9.03% of Hispanic enrollment).

North Carolina's workforce, however, is not and will not all be homegrown. Indeed, North Carolina had the third highest net domestic immigration between 1995-2000 at 338,000 (after Florida and Georgia). In key areas, like teachers and health fields, North Carolina is likely to continue to import professionals.

So change is, and will be, the norm in North Carolina. Changes in its demographics and changes in its economy will be ever-present. To respond to both of these changes, there will need to be accelerated changes in education. This study has concluded that, in general, both UNC and NCCCS have been responsive and, to some degree, anticipatory about the needs of North Carolina's economy. Indeed, while HB 1264 might have expected large gaps between the production of graduates in many fields and employment opportunities that has not proven to be the case. However, the trends all point to the imperative of higher education and the state accelerating its partnership in a number of areas and of discovering new processes and opportunities for anticipating and responding to future needs. For example, the long-standing collaboration between UNC and NCCCS has already accelerated in recent months, and this study points out ways that this vital collaboration can continue to grow.

Business and industry nationally and in North Carolina have also called for changes in the skills and knowledge that students gain from higher education. They want students who can solve more problems; who can work in teams; who can see the big picture; who can communicate effectively; who can utilize technology effectively; and who can bring a strong work ethic. They don't want students who cannot think across disciplines. They do want more students with strong math and science skills. Again, there are already best practices in North Carolina (for example, the UNC focused growth initiative emphasized the science and technology disciplines, especially for minority students), but not yet systemically and pervasively in the higher education institutions and the pipeline from K-12 appears to have many leaks. This report includes recommendations to address these and other issues of importance to the state.

This final report, when viewed with the Final Interim Report (Appendix 2) and Preliminary Recommendations (Appendix 3), responds to each of the seven items in HB 1264 (Appendix 1):

1. Analysis of state and regional demographic, economic, and educational data. (See *Final Interim Report, Section 3. A, B, C and Section 5. A, B, C, D.*)
2. Enrollment projections for UNC and NCCCS. (See *Appendix 6 and Final Interim Report, Section 4.D and referenced in Attachment 5 of that report as Appendices 4.D.1 and 4.D.2.*)
3. Analysis of current academic program offerings. (See *Final Interim Report, Sections 4.A and 4.B and referenced in Attachment 5 of that report as Appendix 4.B.1.*)
4. Recommendations on increased effectiveness through collaborations and distance learning. (See *pages 29-32 in this Final Report.*)
5. Analysis of long-range capital plans. (See *pages 32-36 in this Final Report.*)
6. Special emphasis on the Historically Black Universities and UNC Pembroke. (See *pages 17-29 in this Final Report and page 5 in Findings and Preliminary Recommendations. See also Final 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 *pages 6-16 in this Final Report and page 20 in Findings and Preliminary Recommendations. See also Final Interim Report, Section 4.G.*)

As noted previously, most of the analysis and data requested in HB 1264 are included in the two previous documents produced by this study. The Final Report focuses on recommendations. These recommendations are organized as follows:

- I. Mission
- II. Academic Programs (Processes; Revolving Funds for Collaboratives and Start-ups; Soft Skills; General Education, Liberal Arts, and Majors; Program Gaps)
- III. K-16 Approach
- IV. HMI Signature Programs
- V. Distance Learning and Facilities
- VI. Research, Technology Transfer, Economic Transformation Structures, Regional Partnerships, and Rural Economic Transformation
- VII. Legislative Actions

In those instances where analysis and data are not included in the previous reports, the recommendations include background, challenges, and a summary. This applies to the Program Gaps Section of Academic Programs, to the HMI Signature Programs, to the Distance Learning and Facilities, to the Regional Partnerships, and Rural Economic Transformation sections of this report.

The recommendations, among other things, call on both UNC and NCCCS to take a more intentional leadership role in higher education and economic transformation. They call on even greater collaboration between the two systems (and K-12) and among institutions within each system. They challenge the systems and institutions to be even more focused on innovative ways to respond to both key traditional programs and to emerging industries. They ask the legislature to be a partner by investing in new programs and in changing some laws and practices that inhibit optimal responsiveness of higher education. Collectively, the recommendations expect more focus on economic transformation by higher education and a series of follow-up activities. One finding reported earlier was that higher education in North Carolina had been more proactive and responsive to economic development needs than most states. However, attention to these specific recommendations ought to insure that North Carolina can indeed stay a step ahead and be the leading asset to the state as it transforms its economy.

I. MISSION

Recommendations

1. While reaffirming its current mission (Appendix 4), the NCCCS Board should consider adding an item to its mission to reflect its partnership with UNC for advancing higher education in North Carolina, especially as it relates to economic development.

2. The UNC Board should consider adding an item to its mission (Appendix 5), to reflect its partnership with the NCCCS for advancing higher education in North Carolina, especially as it relates to economic development.

3. Within the Board of Governors mandated UNC mission review of each of its institutions, the Board needs to insure that:

- (i) Each institution's mission includes a specific statement of the University's role in economic transformation.
- (ii) Each institution's mission is sufficiently distinctive in keeping with North Carolina's tradition of mission differentiation.
- (iii) Each institution's mission permits it, either individually or collaboratively, to meet the demonstrated economic development needs of its region and that the collective missions meet the demonstrated economic development needs of the state as a whole.

II. ACADEMIC PROGRAMS

A. Processes

Recommendations

1. Both NCCCS and UNC should conduct reviews of their academic program approval processes to insure that they are sufficiently nimble to respond to, or to anticipate, emerging needs. This review should include input from business and industry.

2. UNC should ask a group of Chief Academic Officers (who should select their own chairperson) to identify modifications to the academic program review process specifically for programs that respond to economic development needs.

They should also design:

- (i) "Incubator" degrees with fast track initial approval and assessment of outcomes after one and five years. An "incubator" degree would be one that responds to an emerging industry need and would be experimental in nature; therefore, it would not need to be as highly developed or as significantly documented as a normal program approval.

- (iii) Accelerated degree programs at the Bachelors, Masters, and Ph.D. level. These programs should be developed based on need, should be able to be completed in at least 25% less time than the norm for that level of degree, and should utilize hybrid (in person/e-learning) modes of delivery. UNC should request a permanent revolving fund in the amount of \$2.5 – \$3.0M to fund the start-up of these programs; industries that directly benefit should also help fund start-up costs.
- (iii) Elimination of Graduate Council review of new graduate programs. Few state systems include such a step that inevitably slows the approval process and vests considerable authority in those with existing graduate programs.
3. Both UNC and NCCCS should establish enrollment projection models that can measure the impact of changes in participation, retention, and graduation rates (as well as demographic changes).

B. Revolving Program Funds for Collaboratives and Start-Ups

Recommendations

1. UNC and NCCCS should significantly increase the number of "ladder" degree programs and collaborative degree programs that have statewide approval (rather than individual articulation agreements). These should be focused in high demand economic development areas; should, whenever possible, utilize (in whole or in part) e-learning; and should create pathways from certificate programs to Associate degrees to Bachelors and, in some instances, to Masters and Doctoral programs. Allied health programs should be the initial target. A standing committee of chief academic officers with representatives from institutions in both systems, and chaired by the CAO of each system, should be charged with this responsibility. UNC and NCCCS should jointly request legislative funding for a permanent, revolving fund of \$10M to support UNC/NCCCS collaborative programs with priority given to those in high demand areas.
2. NCCCS should examine its basic skills programs, its skills certification programs, and its statewide standards to insure that they are anticipating future state job needs. NCCCS Board should request legislative funding for expansion of these programs where there is a demonstrated need. It should also request a permanent revolving fund of \$2.5 – \$3.0M to fund the start-up of academic degree programs; industries that directly benefit should also help fund start-up costs.

C. Soft Skills: General Education/Liberal Arts and Majors

Recommendations

1. UNC and NCCCS should jointly convene a business and industry group (with additional input from non-profit and governmental sectors) to identify the skills and knowledge needed to succeed in the 21st century economy.

2. UNC and NCCCS should hold a joint summit to examine the future of their general education programs, utilizing the information from the group above. This summit should also explore where the information could be incorporated into the requirements of majors.

3. UNC should require each of its institutions to review and revise its general education requirements to incorporate both the skills and knowledge expectations of the 21st century and the need for greater interdisciplinary thinking. Best practices should be sought from North Carolina A&T State University's "University Studies" for recommendations C.2 and C.3.

4. UNC should reaffirm the individual nature of each of its institution's general education requirements, while also requiring each of its institutions to accept the completed general education requirements from another UNC institution as meeting its own general education requirements.

5. NCCCS should review and revise its general education requirements for transfer programs to incorporate both the skills and knowledge expectations of the 21st century and the need for greater interdisciplinary thinking. This activity should be conducted in consultation with UNC to insure the continued transferability of the core to all UNC institutions through the Comprehensive Articulation Agreement (CAA).

6. NCCCS should review and revise its general education component of the Associate in Applied Science degrees, since an increasing number of these degrees are likely to transfer to UNC primarily through articulation agreements at the UNC level (preferably) or individual UNC institutions. For this reason, the activity should be conducted in consultation with UNC.

D. Major Program Gaps

Background

HB 1264 called for an analysis of current program offerings in both UNC and NCCCS so as to identify major gaps with the workforce needs of the state. This analysis (See Final Interim Report, January 17, 2006, pages 67-82) indicated that, in general, both systems have been attentive and responsive to the needs of the state. The track record suggests that the systems will be able to respond to most of the existing gaps with some minor adjustments to their program development and review processes (see recommendations

II.A.1-3) and some significant increase in collaborative (ladder) programs (see recommendation II.B.1).

It is also likely that UNC and NCCCS will both work with the emerging industries (identified in this report as Advanced Manufacturing; Advanced Materials; Biotechnology and Pharmaceuticals; Computing, Software, Internet, Design and Film; and Logistics and Distribution) to respond to their needs, although an additional recommendation is made in that regard (See recommendation D17). Indeed, there is already evidence of innovative and creative responses to emerging areas, such as in the Kannapolis project, the BioNetwork initiative and several others where both systems are collaborating and where research and instruction are adding substantial value.

Challenges

There are a number of challenges in meeting state shortages in three key areas: **teaching, nursing, and computing**. These challenges are not unique to North Carolina; they exist in virtually every state. The issues surrounding these areas tend to be complex. All three have career attractiveness challenges and gender (and, to some extent, race) disparities. Teaching and nursing have relatively low salaries, difficult working conditions, and are female dominated professions. Computing is a male dominated profession that generally pays well but is not as attractive a career as it once was.

Teaching as a profession does not attract sufficient interest from students to meet state needs nor does it retain an adequate percentage of those students who do decide to enter the profession. Nursing attracts a significant amount of interest from students but there are limits on program size particularly because of nursing faculty shortages and because of a lack of clinical sites. Computing has seen a decline in student interest (declared majors declined 32% from 2000-2004) for a number of reasons (including concerns about job availability, offshore outsourcing, and lifestyle) and has never been able to attract a substantial percentage of female students (who now constitute a significant majority of students in higher education; only 0.3% female students nationally expressed interest in majoring in computer science).

North Carolina higher education has responded aggressively to these gaps, especially in teaching and nursing, employing many best practices and receiving some support from the legislature for initiatives. However, significant gaps remain.

Recommendations

1. The normal program development and review processes of UNC and NCCCS, as modified per recommendations II.A.1-3, should be utilized to respond to the following gaps:

- At the Associate degree/diploma/certificate level: office staff of various types; emergency medical technicians; computer programmers; medical and clinical lab technicians; aircraft mechanics and service technicians; and surveying and mapping technicians.
- At the Bachelors level: accounting; business; recreation; and social work.
- At the Masters level: rehabilitation counseling; physical therapy; and market research.
- At the Doctorate level: medical sciences; clinical, counseling, and school psychologists.
- At the professional level: law; pharmacy; medicine; dentistry; veterinary.

While the normal processes may be sufficient for most of these programs, several observations need to be made. The gaps in the Masters in rehabilitation counseling (273 projected annually) and Doctorate in clinical, counseling, and school psychologist (76 projected annually) need special attention. There are currently only four institutions that offer the Masters in rehabilitation counseling (Appalachian State University, East Carolina State University, UNC Chapel Hill, and Winston-Salem State University). UNC will need to either significantly expand these programs and/or create additional programs and/or seek an online collaborative degree solution. There are currently only three institutions that offer the Ph.D. in clinical counseling, and school psychologist (UNC Chapel Hill, North Carolina State University and UNC Greensboro). UNC will need to either significantly expand these programs and/or create additional programs (although that would have mission implications). The gap in the physical therapy Masters (66 projected annually) is complicated by the field moving towards an entry-level Doctorate. The gap in pharmacy (154 projected annually) may be partially addressed by the new collaborative program between UNC Chapel Hill and Elizabeth City State University (which is off to a promising start in its first full year), plus the possibility of a similar program at Winston-Salem State University. In both instances, these programs respond to the HB1264 interest in signature programs at HMT's. The gap in dentistry (67 projected annually) has recently been addressed by UNC with a proposed program strengthening at UNC Chapel Hill and the addition of a program, aimed at rural dentistry care, at East Carolina University. This again reaffirms that the normal processes can be responsive.

As with the UNC program gaps, the NCCCS's normal program development processes will address most of the identified needs in the foreseeable future. Outside of nursing, the largest gap is in what can be collectively called office or administrative support jobs of all types, such as executive secretaries, administrative assistants, secretaries, legal secretaries, and so on (over 2,000 projected annually). All 58 colleges offer the Office Systems Technology program and a smaller number offer more specialized programs such as in the legal office area, including Paralegal Technology. Where there is demonstrated local need, colleges will need to ramp up capacities in the office support programs. Computer programming jobs show a projected annual gap of 267. Thirty-six of the 58 colleges offer the AAS degree in

this area. The NCCCS should closely examine the gap in this area to determine if additional programs are needed or if existing programs should focus on expanding their production of graduates. Special attention will need to be focused on responding to gaps in aircraft mechanics/technicians (192 projected annually), emergency medical technicians (84 projected annually), surveying/mapping technicians (156 projected annually), and medical/clinical lab technicians (146 projected annually).

2. A statewide Task Force should be established to examine the multiple issues that involve health related fields. There should be special emphasis on collaborative programs between UNC and NCCCS; on accelerated programs; and on the use of distance learning, particularly online learning. The legislature should consider funding the priority recommendations of the Task Force.

With an aging population and general demographic and educational trends, North Carolina faces many projected shortages in health related fields. Indeed, an examination of the gap areas listed in recommendation II.D.1 indicates that a disproportionate number of them, at all educational levels, are in health related fields. Many of these programs are particularly expensive to offer and require the cooperation of the health care sector (for clinical sites, for example), thus the need for the legislature and the health care sector to be partners in the solutions.

3. UNC and NCCCS should create a special program to produce faculty for the North Carolina community colleges and the legislature should fund this program. Allied health fields, particularly nursing, should be the first priority for this program and distance learning should be a key component.

Many of the gaps in the NCCCS are created by the chronic shortage of faculty. Since community colleges tend to hire a significant portion of faculty from in-state, a special program specifically to prepare those faculty in-state could reap significant benefits. A tuition forgiveness program for teaching within NCCCS would be a particularly attractive feature.

4. The UNC President should reaffirm the targets for teacher graduate production and retention as outlined in "A Plan to Address Shortage of Teachers in North Carolina" by making results part of his annual evaluation of Chancellors. The President should also inventory all real and perceived UNC policy and practice barriers to innovation and to accelerated programs and work toward the removal of all such barriers (for example, no formula funding for summer enrollment, a prime period for continuing teacher education programs; registration and financial aid challenges in joint programs.)

Leadership matters. Frequently education programs have been low on the priority among schools and colleges within the University. Furthermore, those schools and colleges often lack innovation and are viewed as risk averse. In fairness, the demands on them have increased substantially in recent years and the student pool has decreased since World War II as female students have seen other professional fields (such as medicine, law, veterinary medicine) open up to them. Accountability has

also increased more than in most fields, with national tests such as PRAxis and the requirements of the "No Child Left Behind" act. Nevertheless, schools and colleges of education must step up to the challenge, and the Chancellors must be made fully accountable for the performance of their education programs.

5. Higher education leaders should consolidate, simplify, and adjust the scholarship and grants programs for students seeking to become teachers.

There is an impressive list of available scholarships (38 pages of them) from federal, state, and private sources. These have undoubtedly proved to be extremely helpful in increasing interest in education. However, many of them were designed at a time when the traditional student was full-time, 18-24 years of age, and enrolled in a traditional educational major. The reality today is that the highest potential group for growth is the non-traditional student, seeking certification in other than a traditional bachelor degree program. North Carolina has recognized this reality with its multiple programs, such as NCTeach, authorizing NCCCS to develop lateral entry programs, and funding a 2 + 2 online degree program. Wherever it is feasible, donors should be encouraged to be more flexible in the requirements of their scholarships and the state should have relatively few, but easily marketed, scholarship programs.

6. UNC should assume both the responsibility for a three-year induction program for all the teachers it trains and should be given the responsibility to train and utilize mentors for new teachers (for example, by retired teachers) as part of the induction process.

The loss of new teachers to the profession in the first three years is substantial (greater than 1 in 5). There are many reasons for this, including personal ones, and a substantial proportion of those who leave may one day return to the profession. Nevertheless, far too many new teachers abandon the profession because of the challenges they face early on and the sense that they have no real support system. Student teaching experiences alone cannot prepare a student fully for all the challenges of the profession. In addition to traditional induction programs, a mentoring program can be a fine complementary support system. However, it needs to be integrated with the induction program, hence, the recommendation that UNC assume that responsibility and any resources available for training and mobilizing mentors.

7. The state's K-16 group (see recommendation III) should undertake, with legislative support and funding, a major student achievement tracking data project and a teacher-need projection data project.

The student achievement data model would be designed, within appropriate privacy guidelines, to track individual student performance PreK – 16. This can be accomplished through data-sharing agreements, or through data warehouses, or through a unit-record system (which is the most reliable but most controversial methodology). This student performance system would then enable research to determine if there is a correlation between student achievement and teacher

preparation. North Carolina also needs a more reliable methodology for projecting the number of teachers that will have to be employed. One current project methodology predicts a shortage of 5,000 annually (ECS); a more sophisticated analysis projects 11,000 (UNC "A Plan to Address the Shortage of Teachers in North Carolina"). Neither makes a distinction between "need" and ability (that is resources) to actually hire. Nor do they examine in detail regional variations or discipline differences. If the state is to invest additional dollars in meeting projected needs, it must have the most reliable methodology for doing so.

8. UNC should, in collaboration with NCCCS, place general emphasis on the preparation of teachers of the STEM (Science, Technology, Engineering and Math) disciplines. Support should be provided for recruitment efforts (including out-of-state students), for summer enrichment programs, and focused scholarships. In particular, the lessons learned from introducing STEM degree programs in the HMT's should be implemented in attracting minorities to be teachers of the STEM disciplines.

9. UNC and NCCCS should take a stronger leadership position in increasing both the number of nursing graduates and nursing faculty.

While there are a number of collaborative programs (especially between a UNC institution and one or more NCCCS institutions), there does not appear to be great intentionality about using the power of being systems to increase collaboration, especially among institutions within the same system. As with the production of teachers, for example, UNC General Administration has basically set institutional targets. This does provide metrics and accountability, yet it does not necessarily enable the whole to be greater than the sum of the parts.

The University System of Georgia, for example, has a centrally led, institutionally implemented Intellectual Capital Partnership Program (ICAPP). This has produced over 1,000 additional nursing graduates. It also led the introduction of two collaborative programs to increase the number of available nursing faculty: The Medical College of Georgia will offer its existing Doctor of Nursing Practice program at eight other colleges and universities in the state; Georgia State University will partner with five other institutions to establish a statewide Doctoral (Ph.D. program) in nursing.

In the NCCCS, some nursing programs, particularly the Associate degree in nursing, have been offered in consortial arrangements. Currently, 11 of the 58 colleges offer the ADN program in collaboration with other colleges (through four consortia). All four collaborative programs are in rural parts of the state. The State Board of Community Colleges is encouraged to continue and to increase its emphasis on sharing resources, especially for high cost programs.

10. The state of North Carolina should invest in a specific program aimed at increasing the number of nursing faculty in the community colleges.

As noted in recommendation D.3 above, this needs to be a special program designed jointly by UNC and NCCCS. It should be an intensive and accelerated program offered collaboratively by a number of UNC institutions under UNC General Administration leadership, utilizing distance learning. The program design should be innovative and the students in the program should be supported with forgivable loans in an amount sufficient to allow them to earn their degree in the shortest possible timeframe (that is to be able to go "more than full-time").

11. UNC and NCCCS should require all their nursing programs to become nationally accredited (but only if the legislature fully funds both initial and on-going costs); should establish minimum sizes for programs; and should increase minimum graduation and licensure pass rates for continuation of programs.

This is a complex issue. On the one hand, because there are more students who want to become nurses than there are available slots for them (the Task Force on the North Carolina Nursing Workforce Report in 2004 indicated that there were 7,000 students who could not get admitted), one could argue that the state should focus its resources on the most qualified students in those programs that have the highest graduation and licensure pass rates. On the other hand, regional access to nursing graduates and increased diversity are probably enhanced by having a large number of programs, widely disbursed, and of varying sizes.

These need not be mutually exclusive points of view however. The state would be best served by multiple programs throughout the regions of the state as long as they had high quality and strong results. UNC and NCCCS should be provided additional resources to accomplish these goals and should be held accountable, within a reasonable deadline, of either getting all programs to meet acceptable standards or of eliminating programs that cannot do so. These standards should probably be higher than the State Board of Nursing's minimum passage rate on NCLEX, which is 75% so as to maximize output. (Or the State Board of Nursing might consider raising that standard.) While UNC has a higher standard (85%), it has not enforced that standard.

12. The legislature should target resources for increasing the production of nursing graduates at the Associate and Bachelors level for that purpose.

Nursing education is one of the most expensive areas because of limits on certain class sizes (although these need to be carefully scrutinized to optimize enrollment). A legitimate case can, therefore, be made to increase the funding for nursing education in both the NCCCS and UNC funding formulas. Yet to do that alone would not guarantee that these resources will find their way to nursing programs because allocations to the institutions are not done on a line item basis. The legislature, then, would be well advised to make a special allocation for the specific purpose of increasing nursing graduates. This should be recurring funding with, perhaps, an accountability review of results after five years.

13. The Presidents of both UNC and NCCCS should meet together with healthcare CEO's on a regional basis to expand the availability of clinical sites. These meetings should be facilitated by the area AHECs.

An expansion of faculty, funding, and facilities will not necessarily lead to an increase in nursing graduates without an increase in clinical sites and clinical supervision. This has been a long-standing challenge and requires intervention at the highest level to bring about long-term solutions. It will be important to do this on a regional basis because nursing graduates tend to remain in the regions where they receive their clinical training.

14. UNC and NCCCS should target pre-college year round and summer programs at minority and female K-12 students to attract and prepare them to major in computing fields. The computer industries in North Carolina should help fund these programs, provide internships, and offer mentors.

As is true nationally, North Carolina has a dearth of female and minority students majoring in computer science. In UNC, for example, there were 790 Bachelors degrees awarded in 2004-2005. Of those, only 169 were awarded to women. Of the 790 Bachelors degrees in computer areas, 215 were awarded to Blacks (201), Hispanics (10), and American Indians (4). The projected gap between degrees awarded and positions available is 980 currently; that gap would drop to 528 if women earned the degree at the same rate as males. The National Science Foundation (NSF) has started a program called "Broadening Participation in Computing" and provides grants to institutions seeking to close the gap. The greatest gap in North Carolina is gender rather than race.

15. UNC and NCCCS should collaborate to design new academic programs (or concentrations) in computer related areas that have the potential to attract additional students to the field.

For example, a small number of institutions in both the U.S. and elsewhere have introduced "gaming" programs. Carnegie Mellon, for example, has a Center for Entertainment Technology and has developed a Masters in Gaming that links with the arts and entertainment fields (one of the emerging industries in North Carolina). In addition, UNC and NCCCS should insure that adequate options exist for students to major in management information systems (MIS) and in emerging specialty areas, such as computer security and the uses of computers in homeland security. Some of these degrees may attract a greater number of women and minorities into the field.

16. UNC should design a statewide, accelerated, Bachelors degree in computer science/information technology marketed to underemployed workers who already have a Bachelors degree in another field. This degree should be a consortial degree offered by a group of UNC institutions; should use e-learning to the extent possible; and the state should provide forgivable loans to the students sufficient to enable them to take the program "more than full-time". The degree should be awardable in twelve months. Whenever possible, major computer using companies should help in the design of the curriculum and in providing resources (for example, equipment).

A similar program was provided in Columbus, Georgia in collaboration with the state and with the Total System Company. Several hundred graduates were produced a year and Columbus now produces a very high percentage of its own computer graduates. The state provided \$10,000 forgivable loans.

17. The Presidents of UNC and NCCCS should form statewide (as widely representative of the regions as is possible) business advisory groups in each of the emerging areas:

- Advanced Manufacturing
- Advanced Materials
- Biotechnology and Pharmaceuticals
- Computing, Software, Internet
- Design and Film
- Logistics and Distribution

These advisory groups should include appropriate academic expertise from both UNC and NCCCS to insure a direct link to academic program development and collaborative UNC/NCCCS possibilities. Such groups will be essential to anticipate projected needs in these industries as traditional projection models are inadequate for this purpose (since they project based on ten years of previous employment; some of these industries, especially subsets of them such as nanotechnology, barely existed ten years ago). In addition, these groups can advise UNC and NCCCS on the design of the curriculum and the nature of the degrees, Associate degrees, and certificates (new interdisciplinary programs and degrees are likely to be required). Furthermore, they can provide a link between the industries and the research at the university level, seeking to increase the proportion of research produced that directly benefits North Carolina based companies. The groups will need to be nimble rather than bureaucratic and action as well as analytically oriented. For example, there is an emerging logistics opportunity around the potential development of a premier container terminal on a 600 acre undeveloped parcel on the West Bank of the Cape Fear River; a specific subgroup of the Logistics and Distribution Advisory Group should be tasked with examining this opportunity and the higher education needs it might require.

III. K-16 APPROACH

North Carolina does not have as comprehensive a K-16 approach to education as many other states.

Recommendations

1. North Carolina should form a statewide K-16 Council with membership from stakeholders of education at all levels, including business and industry. Pre-K, K-12, community colleges, public and independent universities should all be involved. The Council should meet quarterly and address issues that cut across educational systems (see, for example, items 2(i), (ii) below). Also, consideration should be given to establishing regional K-16 Councils. North Carolina should examine the models in

states like Georgia and Maryland (both of which have existed for over a decade and have been widely recognized for their leadership in this area), and in Ohio (which has just reconstituted and energized its K-16 approach).

2. The State K-16 Council should address the following issues as priorities:

- (i) Reducing the need for remedial education in both NCCCS and UNC. The percentage of students needing remediation in both systems exceeds the levels that allow North Carolina to be globally competitive in the economic marketplace. The K-16 Council should adopt common definitions and common (or translatable) placement tools in both systems so that the real level of remediation needed can be measured (and so that students do not need to retake placement tests if they change systems). It should then examine best practices in other states, recommend appropriate programs, and establish measurable targets for reducing remediation. Special emphasis should be placed on reducing the need for remediation in Math because of the impact on technology-based employment.
- (ii) Closing the achievement gap between majority and minority students, especially as it relates to graduation rates and the participation of minority students in math, science, and technology degrees. It is recommended that the K-16 Council seek legislative funding to secure external assistance in reviewing this issue and in developing programs based on best practices nationally.

IV. SIGNATURE PROGRAMS AT HISTORICALLY MINORITY INSTITUTIONS (HMP'S)

Background

HB 1264, item 6 states:

"With regard to the University System there shall be special emphasis on the development of signature programs for Historically Black Colleges and Universities (Elizabeth City State University, Fayetteville State University, North Carolina A&T State University, North Carolina Central University, Winston-Salem State University) 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 suggestions to eliminate the historical function and purpose of those institutions."

The six HMI institutions serve over 50% of the minority students attending UNC and have experienced extraordinary growth in programs, enrollment, and facilities since 1999, significantly assisted by the state's investments in the "Focused Growth Institutions" initiative. As the findings indicated in the Preliminary Recommendations document, "while the investment has been substantial the returns already appear to justify both the dollars and the commitment to these institutions". Furthermore, the Preliminary Recommendations suggest that "Other states have attempted to strengthen their HMI's, but it is hard to imagine any program that has been more successful than this one."

Nearly half of the new academic programs added to the HMI's since 1999 have been at the graduate level, and many of the programs have been in fields where there is a high state need. The emphasis on math, science, and technology has been particularly impressive and demonstrated the foresight of emphasis since these have emerged as areas of national priority.

Challenges

The findings contained in the Preliminary Recommendations document indicate that:

"The HMI's 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."

These are among the fundamental challenges for the HMI's. They have momentum and must maintain that. Yet they will suffer setbacks if newly introduced programs falter. Overall, the quality of new faculty hires seems encouraging and several HMIs are actively seeking national accreditations (AASCB in business, for example) where they don't already exist. These activities will continue to need attention and resources. So, too, will the programmatic responses to President Bowles' challenge for improvements in retention and graduation rates.

Even with these cautions, however, the HMIs do appear to have the capacity to add a limited number of "signature programs" that will benefit both the institutions and economic transformation in the state if sufficient additional investments are made. The recommendations that follow result from extensive material review and two sets of intensive meetings with each institution's leadership, one in Chapel Hill and one during visits to each campus. "Signature programs" have been defined as those that are distinctive, that build on existing strengths, that advance the institution's profile, and that serve regional and/or state economic transformation needs.

Recommendations

1. Elizabeth City State University should have as its "signature programs" the partnership Pharm. D. program and an expansion of its Aviation program.

• **The Pharm.D. program** admitted its first class of 14 students in fall of 2005 as part of a single class of pharmacy students with UNC Chapel Hill. The program makes extensive use of sophisticated distance learning and appears to be off to a strong start because of the commitment to success by both institutions, a focus on quality, and significant dedication from the small core group of people responsible for the program. Much of the planning has been "just in time" planning because approvals came late in the cycle. In addition, the program has been launched in temporary facilities adjacent to the science building. Once again, Elizabeth City State University has paid attention to quality by making the temporary facility not only functional, but also relatively attractive. In addition, it has dedicated an information technology person to the program to insure sufficient support for distance learning and other technology activities.

The implementation of this program, then, has been a major undertaking, especially as the institution has an undergraduate emphasis and no previous experience with professional programs. The initial faculty hires seem to have contributed to the success of the program initiation, as has the experience and commitment of UNC Chapel Hill. Since this program is considered part of UNC Chapel Hill's program and is thus accredited as a single program, there are real incentives for UNC Chapel Hill to insure its success. A planned and funded new building will be timely as additional cohorts of classes will begin to strain physical capacity.

While the program is off to a good start, significant issues remain to be addressed before it can truly help transform health care and, consequently, economic vitality in the region. The core rationales for introducing a Pharm.D. at Elizabeth City State University was to prepare pharmacists to work in northeast North Carolina and to increase the number of minority pharmacy graduates. Yet the initial class of 14 students includes only two minority students and only four students from the region (several students are from out-of-state). There are multiple, and understandable, reasons for this including the late approval; the admissions process; and the need to launch the program with a class that has high probabilities of being academically successful. Long-term, however, Elizabeth City State University has to establish a watertight pipeline of students. Thus even though there has been support for this program already, it is identified in this report as a "signature program" in need of deeper support. And this support will also need to be broader so that it can provide for pre-college and summer programs (maybe in collaboration with AHEC), marketing (many in the area do not have a full understanding of the richness of the pharmacy profession), intensive recruiting, and a further strengthening of the Bachelors degrees in math and science at Elizabeth City State University (most students entering pharmacy

already have a Bachelors degree). In addition, the state should consider a forgivable loan for students in the program who remain in northeast North Carolina to practice.

Another area that will need to be addressed for this program to realize its full potential is the availability of clinical sites. Students who not only come from the area, but also do their clinical work in the region are most likely to stay in the area. Yet as classes of additional cohorts of students are added, there are unlikely to be sufficient staff at clinical sites to provide the appropriate supervision. This requires additional planning, a clarification of roles and responsibilities (UNC, AHFC, ECSU, UNCCH, private sector), and resources to increase the availability of community based supervision.

Without these interventions of support, the program may still succeed on one level. However, it is unlikely to succeed at the most fundamental of levels: increasing economic opportunities for a region with significant needs.

- **Aviation Science** has existed in the Technology program at Elizabeth City State University since 1996 and has approximately 30 majors currently. There is considerable interest in the economic development community in the region for expanding the program. One aviation related company (Tamsco) already operates in the region; the Eastern Seaboard Coastguard operates from the region; the state Department of Transportation has interest in assisting the program; and there are several regional airports plus Norfolk airport within an hour of the campus. Employment opportunities exist in flying, maintenance, control operations, business services, and navigational systems, as well as in manufacturing.

Since there are relatively few such programs in the nation, and since it would take a significant increase in the size of the program plus additions to its majors and/or concentrations, Elizabeth City State University has wisely begun with a feasibility study, assisted by external expertise. This study should help guide the final program decision, design, and investment needs.

Elizabeth City State University, then, has the opportunity to build two very distinctive "signature programs." From a population and opportunity perspective, Elizabeth City State University is among the most challenged of the HMT's. Substantial success in these two programs, and the corollary build up of math, science, and technology capacity and aspirations in K-12 schools, would serve the institution and region well.

2. Fayetteville State University should have as its "signature programs" **Criminal Justice and Intelligence Studies**.

- **Criminal Justice** has a twenty-year history at the University. The Bachelor of Science Degree in Criminal Justice has a proven track record, with over 400 undergraduates in the department of Criminal Justice within the College of Basic and Applied Sciences. In February of 2006, the University of North Carolina Board of Governors approved the proposed Masters; the first cohort of Masters students will enroll in the fall of 2006.

Criminology has long been taught in academic departments, but in the last two decades interest in the subject has increased as the criminal justice system has expanded. Between 1982 and 1999, state, federal and local government expenditures on criminal justice increased by 300% and the number of persons employed by the criminal justice system nationally grew by 72%. Since 9/11, the rate of growth in the field has grown in exponential ways.

Given the quality of the program at Fayetteville State University and the growing demand for practitioners in the field, the University should consider the development of an online Masters of Criminal Justice for working law enforcement professionals who want to blend their practical experiences with the scholarship available to them through FSU faculty. Further, the University has interest in the development of the applied Doctorate in the field. This, however, would raise a question of mission and should only be considered after the Masters has been in place for five years.

- The Bachelor of Arts in **Intelligence Studies** would be a new signature program for the University. Fayetteville State University resides in close proximity to Fort Bragg and Pope Air Force Base. Fort Bragg, the home of the Airborne and Special Operations Forces, is an especially critical component of this country's army and defense strategy. Currently, the Army is undergoing a significant self-study concerning how it "will remain relevant to the challenges posed by the global security environment—across the range of military operations from regular conflict to high intensity conventional warfare-and ready to provide the focus and capabilities required by the Combatant commanders and the Joint Team." (Taken from Our Army at War--Relevant and Ready--Today and Tomorrow, November 2004). This translates into an opportunity for Fayetteville State University.

Fourteen years ago, Mercyhurst College established the first non-governmental multidisciplinary baccalaureate degree in Intelligence Studies. Lessons from Mercyhurst (and Embry-Riddle, which also has a program) should be helpful in the design of Fayetteville's proposed BA in Intelligence Studies, as both institutions offer both the Bachelors and the Masters program.

Fayetteville State University has the opportunity to develop a Bachelor's level program that combines a liberal arts core with foreign language requirements, internships, and intelligence-related courses as well as national and international studies. The program would be offered both in online and hybrid formats and would take advantage of the expertise resident at Fort Bragg and the library resources of the region. In the Fall of 2006, the University will offer Hindi, Pashto, and Chinese for the first time through partnerships with other universities outside the state and is currently looking for partners to provide Arabic.

Given the needs of the military and the needs of the intelligence community, FSU is well positioned to implement a "signature" program in this area. In addition to preparing students for employment in military intelligence and in entities such as the Central Intelligence Agency, the Department of Homeland Security, and the National Geospatial-Intelligence Agency, the program would prepare students for careers in business intelligence.

3. North Carolina A&T State University should have as its "signature programs" the innovative **University Studies** (general education) program and a **Public Health** program.

- **University Studies** is indeed a signature for North Carolina A&T State University in UNC and, perhaps, the nation. As noted in the Final Interim Report (see pages 54-57) North Carolina business and industry leaders, particularly those involved in emerging industries, have identified particular skills and knowledge that they need in 21st century professions. These include the ability to integrate different disciplines; the need to link theory with real world practice; the need for "soft skills" (for example, working in teams; effective communication; conflict resolution; resource management; cultural adaptability; and strong work ethic); and the need to think system and see the big picture. Interestingly, North Carolina A&T State University's revision of its general education program, called University Studies, that will be implemented in the Fall of 2006, anticipates these needs.

The purposes of the University Studies program are to develop in all students:

- ✓ broad-based critical thinking skills
- ✓ effective written and communication of ideas
- ✓ appreciation for diverse cultures
- ✓ commitment to ongoing civic engagement and social responsibility

The design of the program is extraordinarily impressive, placing the needs of students foremost and being intentional about student intellectual development. Most general education programs in the nation continue to be primarily a menu of traditional courses. Yet North Carolina A&T State University describes its developmental model this way:

“Conceptually, the University Studies curriculum represents all intentional developmental processes focused on introducing basic inquiry, discovery, and critical thinking skills in the freshman year, strengthening analytical and problem-solving skills in the sophomore year, deepening those skills through coursework in the major during the junior and senior years, and ending with an interdisciplinary, integrative capstone experience in the senior year. At each of these levels, coursework and experiences outside the classroom should build and reinforce critical thinking and communication skills, social responsibility and ethical decision-making, and appreciation and understanding of diverse cultures.”

This comprehensive approach, including theme based/interdisciplinary courses, culminating in a senior capstone experience (which can include such activities as internships, foreign study, and community projects), will impact every single student. This is an unusual feature for a signature program.

North Carolina A&T State University needs to be supported and rewarded for its innovation and courage. While the faculty have done an exceptional job in designing, approving, and establishing the program, they will need faculty development support as the program is implemented. This is a very different type of teaching than most have been prepared for and have experienced. Furthermore, the success of the program is likely to be enhanced through the ability to hire a core of new faculty who do have such experience and preparation. Not only will these new faculty hires strengthen the University Studies program, but they will also likely contribute to the improvement of retention and graduation rates. This is likely to occur because the new curriculum will engage students in active learning to a much higher degree than traditional curricula. Also, some additional faculty lines will reduce the student-faculty ratio, which should allow more faculty-student engagement (a major factor, according to research, for student retention).

Support for this “signature program” will be an investment, since there are lessons to be learned and best practices to be gleaned as other UNC institutions revisit their own general education programs and the general skills and knowledge required in their majors (as called for in recommendations II.C.2,3). And, if successful, University Studies may give A&T graduates a competitive edge in employment, based on what employers say they need in graduates to help them transform North Carolina’s economy.

- **Public Health** is a “signature program” desired by North Carolina A&T State University. The University sees opportunities to build on its traditional strengths in agriculture and its recent investments in faculty and lab staff in biology and chemistry. The primary focus to date has been on developing a research agenda, with special emphasis on health disparities. Opportunities also exist in emerging areas such as food safety, nutrition and environmental impacts.

Academic programs in public health do not currently exist at North Carolina A&T State University and would need UNC approval. (There are existing programs in the field.) The initial plan centers on certificate programs and, potentially, a Masters degree. While many existing courses could be utilized, a number of new courses (and, therefore, faculty) would be required.

Healthcare and public policy on health contribute to economic development; good schools and good healthcare are essential ingredients in attracting or retaining companies. North Carolina A&T State University has begun its investments in this area and believe they can sustain the program development even with the recent departure of the Chancellor and Provost.

- A few further comments are in order. North Carolina A&T State University is the most mature graduate and research institution of the HMI's. It has had three Ph.D. programs in the engineering area for some time and has recently introduced two interdisciplinary Ph.D.'s that have considerable appeal. Yet its undergraduate/graduate ratio remains predominantly undergraduate and its (approximately 90%/10%). To capitalize on its Carnegie classification and its graduate programs, North Carolina A&T State University needs to grow the size of its graduate population substantially. Because North Carolina A&T State University would benefit from a specific state investment in its graduate student funding to accelerate this growth.

North Carolina A&T State University is also well positioned to grow programs in some of the areas identified as emerging industries; however none yet appear to qualify as areas for "signature programs." Also, A&T has explored requesting a professional program in veterinary medicine. However, the projected gap (27 positions annually) is a modest one and would not justify the cost of such a program (the least expensive program in the nation is \$12M a year; start-up costs are substantial, in the \$40-\$95M range).

Many states do not even have a veterinary school (28 total in the nation); only Alabama has two. Yet the participation of minority students nationally in vet schools is unacceptable. After Tuskegee at 42.1% black, the next highest percentage is 3.9%. North Carolina State University has the seventh highest percentage but is only at 1.3% (2003 data), which represents four students. UNC General Administration should work with North Carolina State University and the other HMI's to identify ways to remedy this situation, short of creating a second vet school.

North Carolina A&T State University has great potential to develop a national signature as an institution that truly integrates interdisciplinary learning in both its general education and majors, with the potential to become a national model. Thus University Studies, along with consideration of Public Health, can continue the impressive momentum at the institution.

4. North Carolina Central University should have as its "signature programs" **The BRITE (biomanufacturing)** program and the emerging **Homeland Security** program.

- **The BRITE Program (Biomanufacturing Research Institute and Technology Enterprise) for Biomanufacturing** has great potential for NCCU and the state of North Carolina. Launched with a \$19.1M grant from the Golden Leaf Foundation and supported with operating funds from the legislature, BRITE aims to provide degree programs and research in biotechnology (particularly biomanufacturing). North Carolina has the third largest number of biomanufacturing jobs in the nation (after California and Massachusetts) and is adding several thousand such jobs a year. Through the Golden Leaf Foundation and the biotechnology industry, \$64.6M has been invested to train biotechnology workers. In addition to NCCU, North Carolina State University received \$36M to develop a pilot scale biomanufacturing plant, and the community colleges received \$9.4M for workforce training. BRITE at NCCU builds on the existing strength of the Biomedical/Biotechnology Research Institute (BBRI), a largely grant funded research operation.

BRITE will enroll its initial class of 40 students in the fall of 2006 and aims for an enrollment of 200 students by 2010. NCCU will provide 10 of the initial students with scholarships so as to attract a strong class. Initially the undergraduate program will provide concentrations (such as biopharmaceutical sciences) in Biology and Chemistry majors. Certificate programs are also planned. NCCU brings some unique interdisciplinary assets to the new programmatic thrust, especially as it has a longstanding Law School (for example, intellectual property law has implications for biomanufacturing) and a business school (although it needs to complete its AACSB accreditation).

NCCU has also clearly made BRITE faculty hiring a priority. The initial seven faculty have excellent backgrounds, all with Ph.D's from major institutions and several with extremely relevant industry experience (for example, with Eli Lilly Company), as well as prior research activity. The Director has worked extensively in the industry and also as Director of Lead Discovery, Laboratory for Discovery in Neurodegeneration at Harvard.

It would be wise for UNC and the state to invest further in the success of BRITE and to be sure it is able to add quality faculty. There will likely be a demand for a Masters level program, which should be developed once the Bachelors program is in place and has graduated a class.

NCCU has considerable ambition to add Doctoral programs. This ambition is best explored through the upcoming mission review process as Doctoral programs at other than major research universities rarely have a direct impact on economic development. However, should the mission review process support this mission change, a Ph.D. in Biomanufacturing would be a natural choice.

Much has already been invested in NCCU's biomanufacturing direction. UNC would be well advised to continue that investment rather than to support duplication in biomanufacturing (as distinct from biotechnology), at least until the BRITF program is fully established.

- The emergence of **Homeland Security** as an academic area for both teaching and research provides NCCU with a unique opportunity for a "signature program." With an established and large criminal justice program, an investment of focused growth funds in developing an Institute for Homeland Security and Workforce Development, and an ability to bring interdisciplinary links (such as bio and computer forensics), NCCU has the potential to develop not only undergraduate concentrations and degrees, but also a Masters degree. Furthermore, there are likely to be extensive opportunities to provide training (perhaps some of it on a contract basis) and to conduct externally funded research. While faculty hiring has begun, and has yielded some excellent results, more hires will be necessary for the program to reach full potential.

5. The University of North Carolina Pembroke should have as its "signature programs" **Teacher Education** and an **Allied Health Professional Degree Program in Physical Therapy**.

- **Teacher Education** has historically been at the core of Pembroke's mission. Founded in 1887 as a normal school to train American Indian public school teachers, Pembroke has emerged from an institution of 15 students and one teacher to 5,632 students and 237 faculty. Until 1953, Pembroke was the only state supported four-year college for Indians in the nation.

Today, of the 2,400 American Indians who attend a UNC institution, 1,100 are enrolled at Pembroke. As 23% of Pembroke's current student population is African American, Pembroke is among the most racially diverse campuses in the University of North Carolina. Pembroke generates considerable teaching graduates, most of whom remain in Robeson County and serve the community.

The current curriculum for teacher education majors is comprised of four components: General Education; Specialty Area (Major); Professional Studies and Content Pedagogy. The culminating professional development experience for prospective teachers is the senior internship (student teaching) under the direct supervision of a master teacher in a clinical setting.

Given the predominantly rural nature of the Southeast Economic Development region in which it resides, Pembroke's historic strength in producing teachers, and the low graduation rates of high school students in the region, there is an opportunity to collaborate more assertively with the nearby community colleges and K-12 schools to develop a pilot program for a K-16 approach to education with particular emphasis on the STEM disciplines. (See earlier recommendations in K-16 Approach section of the Final Report.)

- The demand for professionals in the **Allied Health Professions** is palpable, most especially for physical therapists. Subject to the deliberations of the proposed recommendation creating a joint UNCC/NCCCS Task Force on Allied Health programs delineated in Section II.B. of this report and once the nursing program is further developed, consideration should be given to Pembroke for its second entry-level of the degree to Doctoral, a mission change would have to be approved first.

Currently Pembroke has a strong track record in the biological sciences and nursing. A new building is being constructed to house an expanded nursing program. In addition, the campus boasts an Athletic Training Education Program that is in the third year of candidacy with the Committee on Accrediting Allied Health Education Programs. State-of-the-art clinical settings exist for the Athletic Training Program and may be considered as part of the development of a broader allied health program at the University if the campus is approved for the Doctor of Physical Therapy Degree.

As this would be the first Doctoral granting degree program at the University, careful, focused planning would need to be undertaken at the institutional level to ensure that the investments required would not be a burden for the institution from a fiscal and human resource perspective. More specifically, the funding for the initial facilities investment would need to be budgeted at the state level and the current funding formula for professional degree programs analyzed to ensure that a start-up physical therapy program would be financially viable and not drain the financial resources of other critical, high demand degree programs currently offered.

6. Winston-Salem State University should have as its "signature programs" **Physical Therapy and Nursing.**

During the past six years, the Chancellor has intentionally focused the institution's program offerings in Nursing, Physical Therapy, Clinical Laboratory Sciences and Rehabilitation. At this juncture, the incumbent is leaving to assume a new role within the General Administration. There is a new Provost and a cadre of new Deans. Much of the momentum built on campus for academic program excellence will need to be shepherded by the Interim Chancellor, in consultation with this new academic leadership team while the search for a permanent Chancellor is underway.

- The School of Health Sciences is poised to offer the Doctor of **Physical Therapy** Degree in 2007. This change is in concert with the expanding role of physical therapy practice and with the national trend of offering the Doctorate in Physical Therapy (DPT); such a change may require a mission adjustment. At the conclusion of 2005, an estimated 135 of the 209 (67%) accredited physical therapy programs offered the DPT and all but 7 programs indicated their intent to plan for the DPT. In order to remain competitive, Winston-Salem State University proposes two tracks: the entry level (e-DPT) and the transitional level (t-DPT) degree.

The e-DPT would prepare graduates to appraise scientific literature and conduct clinical research in support of physical therapy interventions. The program would be completed in 36 months rather than the current 30-month program for MPT students. The t-DPT program would be designed for practicing Physical Therapists who wanted the DPT degree. This particular curriculum would combine distance learning and web-based instruction to accommodate the clinical practitioners.

- Winston-Salem State University stands to become one of the UNC's "signature programs" in **Nursing** if it is enabled both from a facilities perspective and a human resource perspective to introduce a significant research component into its nursing program. The Division of Nursing is accredited by the Commission of Collegiate Nursing Education and is approved by the North Carolina Board of Nursing. For a considerable period, WSSU's nursing graduates have had strong pass rates on the licensure exam. There are more than 3,000 graduates of the nursing program.

Nursing options at WSSU provide access to both traditional and non-traditional learners. Program options include the traditional option for generic, transfer and second-degree students, RN to BSN, LPN to BSN, Paramedic to BSN, Accelerated BSN, and the Master's degree with a concentration as a Family Nurse Practitioner. The Division of Nursing also provides distance learning at several off-campus sites including Murphy, North Carolina.

As faculty members in the Division of Nursing are already committed to partnerships in the community that bring health education and health care services to the citizens of Winston-Salem and the surrounding region, it would benefit the state to invest in a pilot program to develop collaborative programs with the community colleges (See Recommendation #9 on page 13) to increase the number of nursing graduates and to expand WSSU's research component to promote healthy communities.

7. UNC should create a single STEM (Science, Technology, Engineering, Math) summer pre-college program offered by the six HMI's working together collaboratively.

The focus growth initiative impressively targeted STEM disciplines for growth at the HMIs. For these programs to continue to grow, however, the pipeline of students must be expanded. The program should have two elements: one aimed at K-12 students and one aimed at STEM K-12 teachers. In both instances, state and private funding should be sought to offer scholarships. The program design should be facilitated by the General Administration Office of Academic Affairs, and there should be insistence that it be a single program, so as to increase collaboration among the HMIs. There are likely to be more and more general grant dollars available to assist with funding the programs as STEM areas have become a national priority; specific grants are also likely to be available for programs that target minority students in these areas.

Summary

The total number of "signature programs" recommended (12 at 6 institutions) is relatively small. They are also mostly an expansion or repackaging of existing programs or areas of strength. In addition, many have major interdisciplinary elements. All of this is appropriate given the goals of HB1264 to develop "signature programs" that will enable "the continued growth and development of those constituent institutions." Support for these programs should assure that the momentum continues. These programs all have direct ties to the economic transformation of either the state or a region of the state. The HMT's will also, through the normal processes of UNC, be able to explore additional program development and/or mission changes. They can also benefit from other initiatives to respond to projected gaps in teaching (particularly so given the historic origins of several of the HMT's), nursing (for example, an RN to BSN program at ECSU), and computer science. At the same time, they will all benefit from the renewed emphasis on strengthening retention and graduation rates.

These recommendations do not include dollar amounts. First, UNC must determine if it accepts these recommended "signature programs." Where it does so, it will need to work collaboratively with the institution on developing an acceptable budget proposal. In quite a few instances, the institutions are either awaiting the conclusion of a feasibility study or need further time to develop the specifics of a proposal (since a number of these proposals "firmed up" as a result of interactions around this study). However, more developed proposals could be finalized well before the next budget cycle begins.

V. DISTANCE LEARNING AND FACILITIES

Distance Learning

Background

HB 1264, item 5 calls for "recommendations on increased effectiveness through collaboration and distance learning." Distance learning has a long history in American higher education, including such delivery methods as itinerant faculty, correspondence courses, and off-campus delivery sites. Technology use has also been part of that history, from audio systems, to one-way then two-way compressed video systems, to video conferencing. The advent of e-learning via the Internet has been perhaps the most significant technology advance for distance learning as it permits any time any place learning. In addition to pure distance learning, there are also hybrid forms of higher education where part of the program is on-campus and the rest is provided via distance learning.

North Carolina higher education has made extensive use of all forms of distance education. As a state with a significant rural population and substantial numbers of displaced workers, North Carolina has much to gain from supporting a vigorous distance learning approach to higher education. For many years, the legislature has funded

distance education in general and has, in particular, supported specific collaborative ventures in distance learning between UNC and NCCCS, most notably the 2 + 2 online program in teacher education. Both UNC and NCCCS show substantial growth in the number of courses, academic programs, and students using distance education since 1999. Most of the UNC courses and programs are institution-specific, although they may be offered statewide; under a third of student credit hours in distance learning are generated in online distance education, and over half the online degrees offered are at the graduate level. Approximately 15% of the NCCCS online courses have been developed at the state level through faculty teams, 5-10% are commercial products, and the balance have been developed locally by faculty.

Challenges

Distance learning in North Carolina faces a number of challenges.

- Policy and funding decisions are currently hampered by the lack of common definitions and common data approaches, both within and between the two higher education systems. For example, what exactly constitutes “distance learning”? What is e-learning (or online learning)? Definition differences lead to data that are difficult to compare across the two systems.

- Distance learning, particularly online, in North Carolina is not currently operating in a highly planned environment, either in UNC or in NCCCS. This is not entirely unexpected as many states have begun their online efforts with more encouragement and incentives than with programmatic planning. This can, however, lead to significant unevenness in the availability and quality of both courses and programs. Furthermore, it can also lead to duplication and, therefore, to the loss of one potential advantage of online programs. In UNC, for example, while the overall number of programs appears impressive, a very substantial proportion of those programs are through the initiative of East Carolina University. There is also considerable unevenness among the community colleges. Both systems have duplicated online programs within their systems, and there are additional opportunities for online collaborative programs between the systems. The full effectiveness of distance learning is unlikely to be realized in North Carolina without more robust planning within and across the two systems (with connectivity to the recommendations of the E-Learning Commission, which are primarily focused on K-12.)

- Distance learning growth using technology-based instruction will likely be constrained by the infrastructure. UNC’s bandwidth comes from the North Carolina Research and Education Network (NCREN) and is adequate at the current time but may become an issue if the demand increases, which is likely. NCCCS utilizes T-1 data connectivity, funded by the System office; some community colleges augment bandwidth either with local funding or contracting with a local Internet service provider. At peak periods, NCCCS is already close to capacity. With already planned additional activities and initiatives, NCCCS faces major infrastructure challenges.

Recommendations

1. A joint committee from UNC and NCCCS should establish common terminology and definitions. It should also establish common data definitions and reporting requirements. Wherever possible, both the terminology and data definitions should allow for national and regional benchmarking.
2. Both systems should engage in comprehensive strategic planning for distance learning, with special emphasis on online degree programs. The planning in both systems should be integrated or connected to maximize collaborative efforts.
3. NCCCS should engage a consultant who specializes in technology infrastructure planning to prepare a plan to assure that the community colleges have the necessary bandwidth to expand online offerings. UNC should be consulted during this planning to see what possibilities exist for a shared solution. The legislature should make the funding of this plan a high priority, higher, for example, than any single facility funding item.
4. UNC General Administration should take a greater leadership role in online degree programming and marketing, with special emphasis on programs to meet the economic transformation needs of North Carolina.

While UNC General Administration has facilitated and incentivized some of the online academic program activity, it does not appear to have been particularly intentional in working with institutions to develop a program array and there have been only a modest number of collaborative online degrees (such as UNCW and UNCC online RN-BSN and NCCU and ECU Masters in Library Science). For example, rather than multiple institutions offering a particular online degree (such as nursing), it might be a better strategy to have a single online collaborative degree (which could also be linked to a NCCCS Associate degree). This would also simplify marketing of online degrees.

5. NCCCS should also take a greater leadership role in expanding online Associate degree offerings.

There are approximately 20 such degrees available currently. The plan enumerated in recommendation 2 above should include prioritizing future online degree offerings again perhaps through the collaborative efforts of several community colleges. The top priority should be given to programs that would respond to high state need, as identified in this study.

6. NCCCS should request from the legislature recurring funding to support a minimum of one instructional designer at each college and a core team of instructional designers in the system office.

Without instructional design support, it is unlikely that sufficient numbers of NCCCS faculty will be able to develop robust online courses at the rate required to expand statewide and local offerings.

7. UNC and NCCCS should make online degree programs as seamless as possible for users. They should pilot one joint degree program that has a single registration process (online) and a single e-rate tuition.

There are many complications administratively with collaborative programs (both within and between systems), including tuition rates, fee payments, and assignment of student credit hours. This pilot program would help assess whatever a totally student friendly approach is feasible, where a student pays a single tuition rate and has seamless registration (even if registering for courses taught by more than one institution).

8. Both UNC and NCCCS should establish system-wide distance learning portals; these should be linked to one another. The legislature should fund the development of both portals.

A key element in maximizing distance learning, including online learning, is marketing. If students have to search out opportunities through the 16 UNC and 58 NCCCS institutions, they may not persevere nor may they ultimately find the right match for their program needs. It would be ideal if students could register and perhaps even pay tuition online through the portals. The portals should include special links to information about high demand occupations and the educational path to follow to enter those occupations.

Summary

Distance learning will be a crucial tool in North Carolina higher education's response to a distributed population. Both UNC and NCCCS institutions have considerable experience in providing education at a distance and are increasingly utilizing online learning. However, while both UNC and NCCCS have helped with the facilitation of distance learning, both system offices should engage in comprehensive strategic planning for distance learning with links to each other's plans. These plans would include, among other topics, the identification of programs, the increase in collaborative degrees, the examination of infrastructure (both technology and off campus sites), and the use of electronic portals for marketing and services. Both system offices would, therefore, take a more prominent leadership role in the coordinated development of a statewide and regional distance learning strategy.

Facilities

Background

HB 1264 stipulates that "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" be undertaken. From the inception of the study, the decision was made by the UNC/NCCCS Study Team to defer the engagement of a facilities planning consultant until this final report was delivered. The decision was based on the costs and efficacy of conducting a "wish list" study of construction and renewal and replacement needs before the program gap analyses were conducted and to ensure that the facilities planning needs would be in sync with the emerging strategic plans of the two systems and the mission review of the University of North Carolina's 16 constituent institutions that is to take place in the academic year 2006-2007.

Challenges

In 2000, North Carolina voters approved \$3.1 billion in bonds for the backlog of repairs and new construction at the state's universities and community colleges. Despite this record-breaking infusion of resources, financial support for repairs and maintenance has not kept pace. Consequently, the deferred maintenance bill for the 16-campus University of North Carolina alone is currently reported to be \$1 billion and that of the 58-member Community College System is reported to be \$357 million. In addition to this renewal and replacement activity, there is need for new construction to keep these institutions competitive and to provide the adequate space to attract and retain a growing student population at both the university and community college level. It is unlikely in the current fiscal climate that another major bond can be proposed and, unfortunately, there is likely a public perception that the facilities problem was "fixed" by the 2000 bond. Without another major bond, North Carolina will clearly have to set priorities for annual capital funding. Included in those priorities has to be annual maintenance funding for the facilities. Too often this funding has had to be absorbed primarily by the operating budgets of the institutions, as the 1993 law that the state's General Assembly enacted to provide a minimum sum annually to all governmental agencies equal to 3 percent of the current replacement value of each state building has not been applied (although the most recent short session budget did include funding for higher education facility renovation).

Recommendations

1. North Carolina should review the existing inventories of current higher education facilities, analyze the utilization of these facilities, and maximize the utilization of existing facilities.

Given the funding constraints, higher education must be more efficient in its use of current facilities. In addition to the underutilization of campus facilities at many hours of the day, many other facilities are single purpose when they could have multiple uses. For example:

- **Extension Offices.** UNC has extension offices in every county in North Carolina. Many of these have conference rooms or other facilities and/or technology that could be adapted for additional educational uses, such as sites for distance learning instruction or testing or for seminars or workforce training.

- AHEC Facilities. These nine area education sites could also be adapted for additional educational uses, most logically in the expansion of nursing and allied health programs cited in this study.

- Public Libraries. The 379 public libraries (64 central libraries and 315 branches reported in 2002-03) have missions consistent with higher education and are usually very accessible to local community members. They often have areas or rooms that could be used for instruction. In addition, they have technology available for online learning.

- K-12 Schools, UNC Campuses, and NCCCS Campuses. In many instances, these sites are used exclusively for students in their own sectors with minimal consideration for more general educational uses. This provincialism leads to expensive underutilization.

2. UNC and NCCCS should work together to identify whether additional higher education sites are needed, and, if so, where those should be located.
There has been considerable interest in several locations about creating new higher education sites, often in conjunction with an existing facility that is available. Rather than respond to these interests, UNC and NCCCS should analyze the strategic needs of the state based on data and geographic access considerations. Where there is a demonstrated need, the establishment of a center should be developed on the following principles:

- Providing collaboration among two or more institutions with special emphasis on UNC and NCCCS collaborations.
- Offering academic programs in high state need fields.
- Serving a geographic area underserved by higher education and/or underserved socio-economic population.
- Identifying strategic partners, with special emphasis on those that contribute facilities or financial facilities.
- Offering high quality academic programs in flexible formats.
- Maximizing the use of technology for instruction and support services.
- Providing superior support services to students, including career counseling.

3. North Carolina should rank the adequate funding of a distance education infrastructure (see recommendation A.3 on page 31) as the highest priority new "facility need" for the state before any "bricks-and-mortar" request from either system.

4. UNC and NCCCS should both examine their current inventory of capital requests and prioritize those requests with the highest priority being given to facilities that expand capacity in those fields identified as needing expansion in this HB 1264 study, including the emerging fields*.

For example, space availability is a constraint on expanding nursing programs. The same is true of allied health and some other professional fields, and new areas, like nanotechnology, have very expensive facility and equipment requirements. This re prioritization will be controversial as some other existing needs may well be urgent (such as classroom facilities) and a case can be made from an economic development vantage point for facilities that enhance the attractiveness of a region (such as fine arts and performing arts facilities). Nevertheless, if the state has limited capital resources it must prioritize, and the economic transformation of the state has to be at the top of that priority list. Within those priorities, special attention should be given to the capital needs to support the high-demand fields at the HMTs.

5. North Carolina's business and industry that would directly benefit from the increased output of graduates cited in 3 above should be challenged to provide a portion of the funding (for example, the state would pay for the buildings; business and industry would pay to equip the facilities).

6. North Carolina should, as a matter of good public policy, make annual maintenance funding its highest capital funding priority.

One of the consequences of the 2000 public bond is that there has been an intense period of building, meaning that these buildings (and those renovated) will all "grow old" together. If the state is not intentional about a significant annual allocation for maintenance, the state will face a major crisis in the future. Indeed, the magnitude of need for the 2000 bond was caused by the state not having had a regular method of building maintenance. This annual funding, then, while not as visible as funding new facilities, must be the first call on available capital funding resources.

7. North Carolina should consider establishing an endowment fund over a period of time that, long-term, could provide regular annual capital funding without impacting the state's indebtedness.

In Texas a 1984 amendment to the Texas Constitution allowed the legislature to create a dedicated Higher Education Fund (HEF). The goal of HEF is to reach \$2 billion dollars, at which time 90% of the annual investment income will go to higher education facilities funding (the other 10% of investment income will be added to the endowment). To date, the state is about a quarter of the way to the \$2B goal. This is a

* teaching, nursing, computer science and the emerging fields (Advanced Manufacturing; Advanced Materials; Biotechnology and Pharmaceuticals; Computing, Software, Internet; Design and Film; and Logistics and Distribution)

proven methodology in Texas because the University of Texas and Texas A&M are currently the beneficiaries of annual, primarily facilities funding that are derived from an \$8.1B endowment (the distribution for FY 2005, for example, was \$341M) resulting from land grants in 1876 (some of which had oil on them!). The 1984 amendment aimed to create a similar funding source for all other higher education in the state. This approach probably diminishes the amount annually available for capital funding but long-term removes higher education facility funding from the constraints of the state's indebtedness.

Summary

While one of the original intents of HB1264 may have been to develop another major bond proposal, these recommendations reflect current fiscal realities. For that reason, the recommendations focus on maximizing current resources; emphasizing technology infrastructure as a capital need; establishing on-going maintenance as the highest priority for annual facility funding; urging that facilities related to high state need programs be placed at the top of the priority list; and suggesting the long-term establishment of a state higher education facilities endowment.

VI. RESEARCH, TECHNOLOGY TRANSFER, ECONOMIC TRANSFORMATION STRUCTURES, REGIONAL PARTNERSHIPS, AND RURAL ECONOMIC TRANSFORMATION

A. Research

Recommendations

1. North Carolina should create an "innovation model" and invest state dollars in one or more specific research areas.

This innovation model should be designed after studying the "best practices" in several other states (California, Arizona, Georgia, and New York). It should be built on areas of proven UNC research strength in such areas as nanotechnology and high performing computing. Furthermore, it should emphasize an interdisciplinary focus, involving multiple campuses and economic development regions. Consideration should be given to areas where a workforce development component can be established, thereby involving the community colleges (as happened in the biomanufacturing initiative). Any successful innovation model will require the active involvement by business and industry in its development.

2. North Carolina should establish a state matching research grant program to incentivize faculty collaboration with North Carolina business and industry.

This grants program should be modeled on those such as the University of California Discovery Grants Program. The emphasis needs to be on faculty interaction with North Carolina business and industry. While UNC is considered one of the national leaders in research, its impact on North Carolina business and industry is surprisingly low. A grants program would not only involve faculty, but it would also develop links with graduate students and post-docs; these links, in some instances, could develop into mutually beneficial employment opportunities. North Carolina business and industry would benefit from direct access to UNC intellectual assets, thereby increasing their company's R&D capacity and accelerating commercialization of intellectual property.

B. Technology Transfer and Economic Development

Recommendations

1. North Carolina should invest matching funds in a proactive, market-oriented, university-wide technology transfer program. The funding should be provided on a regional basis, preferably to a consortium of UNC and, where applicable, NCCCS institutions.

This program should provide resources to support UNC, and, where appropriate, NCCCS in the management of intellectual property, technology transfer, and economic development program activity. The funding should provide:

- Staffing and program support
- Facilities and equipment
- Infrastructure management systems

The state funding should be on a 2/1 state/local matching dollar basis (the local could come from multiple sources, including system or institutional funds; regional economic development funds; business and industry; other private sources; and/or grant dollars). Since the funding should be provided to regionally-based consortia, each economic development region should develop goals and objectives for this funding, with an accountability system of performance-based metrics that measures commercialization impact of intellectual property on economic development and the effectiveness/return-on-investment of other funded activities. Wherever possible, the higher education consortium and regional economic development organization should agree on the priority cluster economic areas for investment.

2. UNC and, where applicable, NCCCS should be authorized by the legislature to utilize state funds for investing in innovative technologies, in commercialization studies, in regional incubator centers, and in venture capital investments in higher education spawned North Carolina start-up companies.

These investments in emerging North Carolina companies and technologies that have links to North Carolina higher education could have significant returns for the state and its economic development regions. Early-stage technology could be supported through the build-out of "pre-beta test" models, thereby facilitating licensing and attracting outside equity capital. Commercialization studies (see Massachusetts Technology Transfer Center) allow for authoritative assessments of the market potential of university technologies and can be used as the basis for marketing licenses or attracting outside equity capital. Incubators have proven to be successful in North Carolina and other states. It is recommended that, in cooperation with NCCCS, UNC establish a minimum of one incubator center in each economic development region of the state. In urban areas, these could be in partnership with the private sector. In rural areas, they will likely require state subsidy. Venture capital funds provided by the state have proven to be valuable investments in some states, and North Carolina would benefit from having such a fund targeted at the emerging industry areas.

(For full report, "The Impact of Technology Transfer on Workforce Needs in North Carolina," see pages 40-47 of Preliminary Recommendations document dated February 1, 2006.)

C. Economic Transformation Structures

Recommendations

1. UNC and NCCCS should jointly establish a one-stop, higher education economic transformation office. This office should include an electronic portal of the two systems' intellectual assets targeted at economic development opportunities (with e-links also to the regular academic programs of both systems).

2. The joint higher education economic transformation office above should work with the institutions to identify, package, and market emerging academic fields. For example, North Carolina has significant assets in areas like nanotechnology, but states like New York have been more aggressive in funding, packaging, and marketing these assets.

3. In addition to the K-16 recommendations, UNC and NCCCS should build on the recent initiative to increase collaboration through a joint cabinet by forming a joint committee from the two boards. The joint committee should:

- (i) Facilitate and provide oversight to the multiple current collaborative activities and to these recommended in this study.
- (ii) Publish an Annual Report, in a consistent format, for the General Assembly and the people of North Carolina detailing collaborations.
- (iii) Prepare joint budget requests for collaborative activities to be presented to the respective boards and then to the General Assembly.

While economic transformation would be one focus of the joint committee, it would not be limited to that topic.

D. Economic Transformation and Regional Partnerships

Background

North Carolina and other states expend considerable resources to promote economic development. Like most states, North Carolina has an executive branch division, the North Carolina Department of Commerce (DOC), that is legislatively charged with operating programs to improve the economic well being and quality of life for all North Carolinians. This agency operates several programs to attract new businesses and jobs to the state and coordinates these initiatives with other state agencies and with the higher education systems in North Carolina. For about three decades, specialized job training programs operated by the North Carolina Community College System have been closely coordinated with business expansions that are promoted by DOC. The University of North Carolina also has programs that promote economic development, particularly through its two land grant universities.

Other public sector economic development programs are operated at the local and regional levels. Most of the larger counties and cities in North Carolina have economic development programs. In addition, a number of larger private sector businesses, such as utility/energy companies, have economic development units that work closely with the North Carolina Department of Commerce and other entities, including higher education institutions, as new businesses are sought.

Starting in the early 1990s, seven regional economic development organizations have been created in North Carolina. The first group of these developed in the three major urban areas of the state – the Research Triangle area (Raleigh and Durham), Charlotte, and the Piedmont Triad. These were and continue to be predominantly private-sector funded and governed. A few years later, legislators from rural parts of the state promoted and funded regional partnerships in the western, northeastern, and southeastern parts of North Carolina. The most recent regional economic partnership entity was created as a part of the Global TransPark initiative in Kinston and the surrounding region.

Each of the partnership programs is delivered on a regional basis. North Carolina's 100 counties are divided among the seven partnerships, with the number of counties in each ranging from 11 to 23. The primary goal of the regional partnerships is to market their regions, particularly to businesses seeking to relocate or to expand their operations. In some regions, activities have focused on tourism (e.g., Northeast Partnership). The map on the following page shows the seven economic development regional partnerships, with UNC and NCCCS institutions superimposed on the map.

The study mandated in HB 1264 directed that the analyses of demographic, economic, and educational information be done on a state-wide basis and also on a regional basis. The seven economic development partnerships served as the basis to obtain regional data and information.

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Challenges

The analysis of regional information was performed by Regional Triangle Institute (RTI). The major challenge encountered during the analysis of information from the regional partnerships was the unevenness and quality of the information. In general, the three older partnership organizations in the urban regions had better information (Research Triangle Partnership, Charlotte Regional Partnership, Piedmont Triad Partnership). Advantage West that serves 23 western counties also had useful information. The other three partnerships, serving rural regions, were not as far along in developing strategic plans or in presenting information that was beneficial to the study.

The State Auditor has recently conducted performance audits of some of the regional partnerships. An audit report that was critical of the Northeast Partnership was released in March 2006 and included numerous recommendations concerning organizational and fiduciary problems. This report has been widely publicized in the media, with several prominent legislators indicating that the problems will be "fixed" in the 2006 legislative session. Though specific changes have not been mentioned, one possibility is that the North Carolina Department of Commerce will be required to provide more oversight of the partnerships. Currently, they operate relatively independently of such oversight.

Though an evaluation of the regional partnerships is beyond the purview of this study, there are some general recommendations that would add value to the work of these organizations as it relates to the University of North Carolina and the North Carolina Community College System.

Recommendations

1. UNC and NCCCS leadership should request that each partnership governing board include UNC and NCCCS representation (chancellor or president). With the changes the legislature may be making, such a request would be timely. This could be incorporated into legislation.

Each of the regional partnerships has a governing board. The appointment process varies across the seven organizations. Regardless of how board members are appointed, representation from the UNC and NCCCS institutions would add value to the work of the organizations, including "letting the right hand know what the left hand is doing." Information on the partnerships' websites is sketchy in most cases regarding board membership, though the older partnerships have higher education membership (e.g., Research Triangle and Charlotte partnerships).

2. If North Carolina policymakers keep the current economic partnership structure (i.e., seven regions), the Employment Security Commission should be directed to provide employment projections to the seven economic development partnerships.

A large challenge in RTI's analysis of regional employment data, especially employment projections, was that the North Carolina Employment Security Commission does not disaggregate data on a regional basis. For example, employment projections are made based on the state's 25 workforce delivery areas. Federal law requires this type of breakdown of the projections. The problem encountered by RTI is that the workforce delivery areas do not neatly overlay the seven partnership boundaries. Considerable time was spent manipulating data to provide regional projections.

Summary

Every state in the nation is seeking a strategic advantage as it competes for new businesses. Economies tend to be regional in nature. North Carolina has very strong public university and community college systems; the regional approach to economic development developed over the past decade is also cited as one of the best in the nation. Leadership at the highest level in all of these programs should push to build more collaborative endeavors, which has the potential to give North Carolina a distinct strategic advantage as it competes with other states.

E. Rural Economic Transformation

Background

North Carolina's population is almost evenly divided between urban and rural. While there have been modest shifts towards more urban and suburban living, the fact remains that, even with substantial challenges to agriculture, North Carolina is likely to continue to be a significantly rural state. The 2000 census showed that in the previous decade the urban areas of the state had grown 25%, while the rural areas had grown 18%; that 18% represented 600,000 people. Interestingly, this pattern of population choice is reflected in the in-migration choices of Hispanics, 45% of whom settled in rural counties in the 1990s.

Yet even the term "rural" is a generalization, with the variations among rural communities being substantial. Many of the fastest growing rural counties (Franklin, Johnston, Hoke, and Union) are next to urban areas and, therefore, have economies linked to those areas. Other fast growing rural counties (Brunswick, Dare, and Henderson) have been positively impacted by their attractiveness to retirees. Yet other rural counties have no link to an urban area and no significant in-migration. Indeed, many of these counties have either lost population or not grown at all in recent years. As this data from the North Carolina Rural Economic Development Center indicate, the demographics and geography of the state's rural counties vary considerably.

Challenges

Rural economic development is a conundrum. The variations cited above mean that there are no one-size-fits-all solutions. And the strategies that did work in the past for rural counties, including the exchange of land for jobs (often small manufacturing or small textile plants), no longer work consistently. States have sought to help with initiatives such as placing prisons increasingly in rural areas to increase employment opportunities or investing part of their tobacco settlements as venture capital for rural communities. Yet these efforts have limitations as long-term strategies.

In general, at a time when education and skilled workforces are a premium for economic development, rural counties often have relatively low educational attainment. In addition, frequently the best educated young people in a community are attracted to the economies and the cultural amenities of urban areas, thereby further compounding the demographic, educational, and poverty challenges of rural communities. The social and family impacts of such out-migration also have human consequences.

North Carolina has been responsive to the rural challenges and has assets and initiatives that have been valuable. The North Carolina Rural Economic Development Center provides data and analysis. The geographic distribution of higher education has proven to be an asset and is likely to be of increasing importance in the future. The efforts of e-NC, created as a result of Governor Hunt's 1999 North Carolina Rural Prosperity Task Force, has insured that "the digital divide" between rural and urban areas has been minimized by helping rural communities become e-communities. Yet the state will need to be increasingly intentional about rural economic development if it is indeed going to transform the economy of the entire state.

Recommendations

1. The state of North Carolina, UNC, and NCCCS should establish three pilot regional, rural enterprise zones with substantial funding. Each zone would focus on a different strategy; the three strategies would be:

- (i) Rural business clusters
- (ii) Non-agricultural entrepreneurship
- (iii) Redirection of agriculture

These pilots should receive five year funding with substantial accountability requirements, including rigorous assessment of the return on the state's investment and on assembling best practices for other rural regions.

The three recommended strategies have all been tested and have successful track records around the country. These are detailed in "Innovative State Policy Options to Promote Rural Economic Development," produced by the National Governors' Association (NGA) Center for Best Practices (February 2003).

Rural Business Clusters utilize the same philosophy as the better-known urban clusters (which are often fueled by university research, as North Carolina has well demonstrated). NGA defines a cluster as: "a concentration of similar, related or complementary businesses, with active channels for business transactions and communication."

The application of clusters in rural areas has had promising results in states like Minnesota (for example, in northwest Minnesota there is a recreational transportation equipment manufacturing cluster), Ohio (for example, specialty foods), and Connecticut (for example, bioscience). North Carolina also has experience in rural clusters with the Hosiery Technology Center (HTC) and Arts and Crafts in western North Carolina.

There are lessons to be learned from this first generation of clusters. Key to this study is the fact that higher education is the central component, along with substantial initial state seed money. For higher education, it has required some realignment of approach. Community colleges, for example, tend to have more experience in workforce training than in developing entrepreneurs. For states, it has been the realization that investment at the front end is essential. The HTC, for example, receives about \$600,000 per year from the state. Housed at Catawba Valley Community College (collaborating with Randolph Community College), the HTC has been a crucial element for an industry under duress.

Non-agricultural entrepreneurship has great potential for rural economic development as long as any program has these key elements:

- Highly focused (see, for example, Kansas Rural Enterprise Facilitation program).
- Undergirded with higher education training (see, for example, Nebraska EDGE, Enhancing, Developing, and Growing Entrepreneurs).
- Access to initial capital (see, for example, the Kentucky Rural Innovation Fund and the Wisconsin CapVest).

Redirection of agriculture helps farmers diversify, as is already happening in North Carolina because of reductions in tobacco production. Once again, education (and technical expertise) and capital are key components. North Dakota, through its Agricultural Products Utilization Commission, provides interesting examples, with diversification of livestock (adding bison, elk, and emus), crops (adding chick peas), utilization of crops (adding candle oil as a derivative from soybeans), and land use (cabins for out-of-state waterfowl hunters; out-of-state permits increased from 4,233 in 1998 to 30,028 in 2001). Other states cited by NGA include Kentucky (Agricultural Development Fund), South Dakota (Value-Added Agriculture Subfund), and Iowa (Value-Added Agriculture and Product Branding).

All three strategies need to optimize the use of technology to reduce the rural challenges of distance and communications, particularly through their use of robust networking.

2. The three pilot regional, rural enterprise zones should be selected through a Request for Proposal Process (RFP) with the requesters being consortia of UNC and NCCCS institutions. The regions should be self-defined and not constrained by existing structures.

Placing higher education at the center of this process and requiring consortia of UNC and NCCCS institutions will insure that these zones receive the full engagement of higher education (including a wide range of the assets of higher education such as marketing research, which is crucial for all three strategies). The governance and oversight of the zones should include a broad cross-section of the region.

Summary

As the NGA report concludes:

“However they are formed and implemented, rural economic development policies must build upon the inherent strengths of rural America – abundant natural resources, close-knit communities, strong local business networks, and a largely untapped tradition of entrepreneurial creativity.”

The recommendations recognize that differences among rural regions require multiple approaches. Rigorous pilot programs allow the state to have a measured investment before scaling up based on best practices. Without intentionality of purpose, North Carolina is likely to experience further divides between urban and rural areas and between prosperity and poverty. Rural enterprise zones create that intentionality.

VII. LEGISLATIVE ACTIONS

1. The funding formulas for both UNC and NCCCS should be reviewed and revised so as to fund fully all instruction regardless of when or how it is offered. Specifically, summer instruction and e-learning should be fully funded so as to maximize opportunities for students and the return on the state's investments in facilities and technology. Such funding would be consistent with that of competitor states.

2. NCCCS should be immediately removed from the administrative rule-making requirements of the state (the Administrative Procedures Act) so as to increase its nimbleness to respond to state needs. It should be noted that UNC is exempt from the APA requirements.

3. North Carolina should pass legislation to permit out-of-state students in counties that border North Carolina to pay in-state tuition, as many competitor states do. This could be done on a pilot basis to allow a study to be conducted to see what percentage of those students then enter the North Carolina workforce.

CONCLUSION

When HB1264 was passed, it perhaps anticipated that there would be considerable gaps between the graduates produced and the needs of North Carolina's economy. Except in the areas cited in this report (nursing, teaching, and computer science), this largely did not turn out to be the case, which is a compliment to the anticipation, planning and responsiveness of UNC and NCCCS and their respective institutions. In emerging industries, which are likely to be a crucial factor in a state that needs to transform not just develop its economy, there is not yet data to make that determination about gaps. However, it appears that both UNC and NCCCS are significantly involved with those emerging industries. With more formalized structures to work with these industries, and with adjustments and realignments of the curriculum (such as greater interdisciplinary and the teaching of 21st Century skills), higher education seems likely to be responsive. However, as the recommendations illustrate, it will need to be made more nimble (in program approval, for example), more collaborative (both within and across systems, including K-12), and more risk tolerant (with incubator degrees and on-line consortial degrees, for instances).

The recommendations include general priorities for future facilities, although they do not at this point include specific building recommendations. The legislature and the leadership of UNC and NCCCS will need to determine the appropriate time to consider any new major bond initiative. In the meantime, though, they must increase the annual activity in capital construction with priority given to reducing deferred maintenance, improving the technology infrastructure (a potential capital cost reduction/avoidance investment), and recognizing the importance of facilities for academic programs that serve the direct economic transformation needs of the state. At the same time, the state cannot afford (both literally and figuratively) to fall behind on the infrastructure needed to support the documented enrollment projections (see Appendix 6) called for in HB1264.

North Carolina has many assets, including world class research universities (both public and private) and a well distributed community college system. In addition, UNC and the legislature have visionary commitments to the HMIIs and have been bold and innovative in emphasizing science and technology degrees within the HMIIs (nationally Blacks consist of about 11% of the population but only contribute 6.9% of the science and engineering workforce). At the same time, UNC has honored the history of the HMIIs by, for example, strengthening their teacher education programs. In an increasingly diverse state, the attention to the achievement of minority students at all institutions has to be a priority. An educated diverse workforce is a competitive asset.

North Carolina has liabilities as well. Although outside the purview of this study, the pipeline from K-12 seems suspect in size (dropouts), preparation (need for remediation), and interests (math and science). That is why there are strong recommendations to build on the recent initiative creating a joint UNC/NCCCS cabinet by forming a genuine P-16 structure and environment in the state. Best practices elsewhere (particularly in southern states) demonstrate the return on investment in P-16.

The report contains many recommendations for a simple reason: There is no "magic bullet" in economic transformation. True transformation comes about when people across and within all sectors (government, education, business/industry, not-for-profit, arts and culture) come together in genuine partnerships for the common good. It comes about when processes are improved. It comes about when bureaucratic impediments are swept aside. It comes about when, intertwined with basic improvements, a few bold experiments are launched. And it comes about when the state and the private sector come together to invest the resources needed to stimulate transformation.

While this study does not include specific dollar recommendations in the facilities area, it does do so in general programmatic areas. Whenever feasible, the recommendations urge start-up funding for both new or expanded academic programs and for rural economic transformation pilot programs. Start-up funds typically stimulate early innovation and creativity that long-term rebounds to the benefit of the state.

Many of the recommendations can be implemented immediately and most do not require new dollars. A few of the recommendations are intended to stimulate debate and further brainstorming that will hopefully lead to creative modifications and additions. Taken together, the recommendations should significantly enhance higher education's capacity to be both a catalyst and creator for North Carolina's economic transformation, a transformation that will not only improve the state's global competitiveness, but will also improve the quality of life for all North Carolinians.

**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:".

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**STAYING A STEP AHEAD: HIGHER EDUCATION
TRANSFORMING NORTH CAROLINA'S ECONOMY
FINAL 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 final interim report, Attachment 6.)

The legislation had seven requirements:

1. Analysis of state and regional demographic, economic, and educational data. (See final interim report, Section 3. A, B, C and Section 5. A, B, C, D.)
2. Enrollment projections for UNC and NCCCS. (See final 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 final 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 final 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 final 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 final 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 final interim report establishes the baseline and includes findings. It does not include recommendations; those will be included in the Final Report due no later than December 2006.

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 (projected to increase by about 16% 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 the population 18 years and older without a high school diploma (19.8% versus 15.8%) and without a bachelor's degree or higher (78.9% versus 74.8%). 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 Carolinians. 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 nearly 700,000 people to the workforce by 2012. 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 250,000 by 2012) 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 bachelor's 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 about 1 million, slightly over a 20% 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 (or both) 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. Over 290 distinct degrees, diplomas, and certificates address a wide range of workforce education requirements. The curriculum programs include associate in applied science, diplomas, certificates, and associate in arts, associate in fine 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. A major purpose of the NCCCS is to help support North Carolina's economic development and the education and training needs of the state's business community. Non-credit offerings play a major role in this area, enrolling approximately two-thirds of the total NCCCS students.

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.

At the masters degree level, significant gaps exist for **rehabilitation counseling** and **physical therapy**. It does appear that the masters degree will increase in importance in the knowledge economy. There are also likely gaps for **pharmacists, doctors (especially doctors of family medicine), lawyers, veterinarians, and dentists** and for doctorates for future faculty in fields such as: **education, computer science, nursing, 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. Two professional doctorates are likely to experience gaps: **medical sciences** and **clinical counseling/school psychologist**.

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

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 an increased need for **art** and **design** graduates who not 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 final 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.

This final interim report also includes preliminary findings. There are no recommendations at this stage. They will be the focus of a preliminary report to be issued no later than December 31, 2005 and a Final Report to be issued no later than December of 2006. While there are a large number of findings included in the final 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. (Please note the General Assembly voted to extend the due date of the final report to December 2006 to take into account the leadership transition of the UNC Presidency.)

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. That Interim Report deadline was extended to May by the original legislation further stipulated that a Final Report with appropriate recommendations would be submitted no later than December 31, 2005.

(Note: The 2005 General Assembly modified the reporting dates in a special provision to the budget bill, Senate Bill 622. This special provision states ""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 June 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, 2006."")

Based upon the original 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 final interim report. This final 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 final 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 included 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. 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, as several authors have strong national reputations, 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. As of November 1, 2005, the vision plan for the Charlotte region was not complete, but a list of the region's current industry targets is included in Table 3.A.1. The vision plan for the East region is also not complete and the authors chose not to share their work in progress with us. The vision plan for the Southeast is not available.

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

[illegible]

This includes all sectors mentioned in Regional Strategic Planning Reports published after 2000. It includes the RTP, Advantage West, Piedmont Triad and Northeast vision plans, available as of September 1, 2005, and input from the Charlotte Partnership.

Occupational Forecasts 2002-2012

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.

In making projections for the occupations, LMI selects from various projection models to find the best fit for the trends over the 1978-2002 time period. Therefore, for any given occupation a specific model is used to make a forecast to 2012.

Analysis of The Data

The NCES 2002-2012 data were subjected to several analyses. For the North Carolina statewide occupational data, the list of all occupations was sorted by percent change and by educational level. Referenced in Attachment 5 as Appendix 3.A.9 are the top 10 occupations sorted by annual percent change. Also referenced in Attachment 5 as Appendix 3.A.10 are all occupations with more than 500 positions projected for 2012 sorted by educational level and then by annual percent change. Appendix 3.A.11 sorts the same data by educational level and then by the actual change in the number of jobs over the 10-year period.

The second analysis developed projections for the seven economic development regions. This analysis was hampered by the fact that the data were 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 (Table 3.A.2.) was created to match each county to its respective WDB region and economic development region. 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		- Region A (Southwest) - Mountain Area - Region C - High Country - Western Piedmont
Charlotte		- Charlotte-Mecklenburg - Gaston - Centralina
Piedmont Triad		- NW Piedmont - Davidson - Guilford - Regional Partnership
Research Triangle		- Central Piedmont - Capital Area - Kerr-Tar - Mid-Carolina

Economic Development Region		WDB(s)
Northeast		• Region R (Northeast) • Region Q (Mid-East)
Eastern		• Region L • Eastern North Carolina
Southeast		• Cape Fear • Lumber River • Pee Dee • 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 2002-2012 for all of North Carolina for these major occupational groups. Appendices 3.A.14 to 3.A.20 show the occupational forecasts for 2002-2012 for these major occupational groups for each of the seven economic development regional partnerships.

PRELIMINARY FINDINGS

The NCESC occupational forecasts for 2002-2012 can be sorted by annual percentage change and absolute change for the period. The NCESC data were used to calculate the change between 2002 and 2012. 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. Similarly, the NCESC top ten occupations by absolute change are shown in Table 3.A.5. It should be emphasized that Table 3.A.4 gives annual percent change and in most cases deals with occupations with low absolute numbers (e.g., postsecondary law teachers). Table 3.A.5, giving absolute changes, has more implications for overall workforce education and training needs.

Table 3.A.4 Top Ten Occupations by Annual Percent Change 2002-2012

Occupation	Annual Percent Change 2002-2012
Medical assistants	5%
Post-secondary art, drama, music teachers	4%
Biomedical engineers	4%
Cardiovascular technologists, technicians	4%
Dental assistants	4%
Dental hygienists	4%
Environmental engineering technicians	4%
Fitness trainers and aerobics instructors	4%
Home health aides	4%
Post-secondary law teachers	4%

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

Occupation	Absolute Change 2002-2012
Registered nurses	23,100
Cashiers	22,040
Retail salespersons	21,600
Waiters and waitresses	17,290
Combined food preparation and serving workers	16,620
Nursing aides, orderlies and attendants	14,640
Truck drivers, heavy and tractor-trailer	14,220
Customer service representatives	13,980
General and operations managers	13,040
Janitors and cleaners except maids and housekeeping cleaners	12,310

According to the NCESC projections, total employment in North Carolina is projected to increase to 4.8 million by 2012, adding 700,000 people to the workforce. This translates into a growth rate of 1.7% for the period. Employment growth is expected in all occupational sectors except for Manufacturing, and Natural Resources and Mining. The Natural Resources and Mining sector is projected to decline about 16% for the period, but Manufacturing will lose the largest number of jobs (32,600).

Growth by Occupational Category to 2012

Of the top 10 largest employment-gaining industries, three are related to healthcare: Hospitals, Ambulatory Health Care Services, and Nursing & Residential Care Facilities. Educational Services has the largest employment base but ranks second behind Administrative and Support Services for largest employment gain projected for 2002-2012.

The most growth is likely to occur in healthcare-related occupations, and these positions require some degree of training at the community college level or above. The next group of moderately high-growth occupations is dominated by education-related occupations, most of which require a masters, if not a doctoral degree.

Growth by Educational Requirements to 2012

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 annual growth will be for lawyers (430); pharmacists (300 growth and replacement positions); and family and general practitioners (180 positions, new and replacement).

For occupations requiring a doctorate, the fastest growing occupations measured by average annual openings, new and replacement, are medical scientists (140); clinical, counseling and school psychologists (120); postsecondary education teachers (100); postsecondary computer science teachers (100); nursing instructors and teachers (90); and post-secondary faculty in biological sciences (70).

Occupations requiring masters degrees that are fast growing in North Carolina are: health specialties teachers (330); rehabilitation counselors (300); educational, vocational and school counselors (180); physical therapists (170); postsecondary business teachers (170); librarians (150); postsecondary English language teachers (140); and postsecondary art, music and drama teachers (120).

Numerous management occupations will require a BA plus some work experience. The general management category is projected to experience an average annual growth of 2500 jobs, including both new and replacement opportunities.

Occupations requiring a BA are numerous. The major category of positions requiring a BA are pre-school through high school teachers, totaling 4390 average annual positions during the ten-year period. This category includes special education and vocational teachers. The computer field projections are lower than those reported for 2000-2010. Indeed, this analysis through 2012 projects the need for 390 new computer and information service managers annually. All in all, however the computer field continues to be strong, with a total of 2,490 average annual openings.

Other positions requiring a BA are varied: business operations specialists (840); accountants and auditors (890); recreation workers (530); construction managers (480); loan officers (350); financial analysts (330); and insurance agents (420).

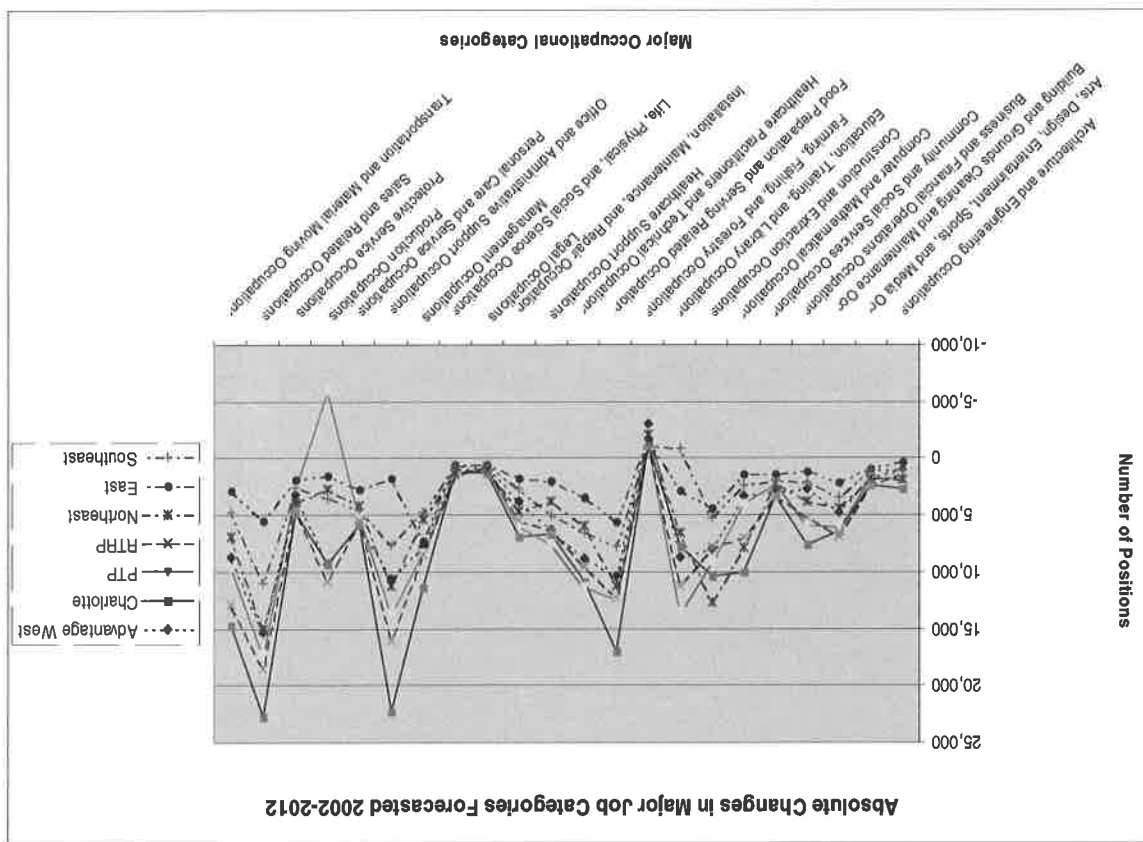
Associates degrees are also in large demand, leading with registered nurses at 3760 average annual openings over the ten-year period. Other significant projections are health related: medical records technicians (340); dental hygienists (300); radiologic technicians (300); respiratory technicians (200) and medical and clinical laboratory technicians (250). Several computer related occupations have high demand, including computer support specialists (620); and computer specialists (130).

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 2012

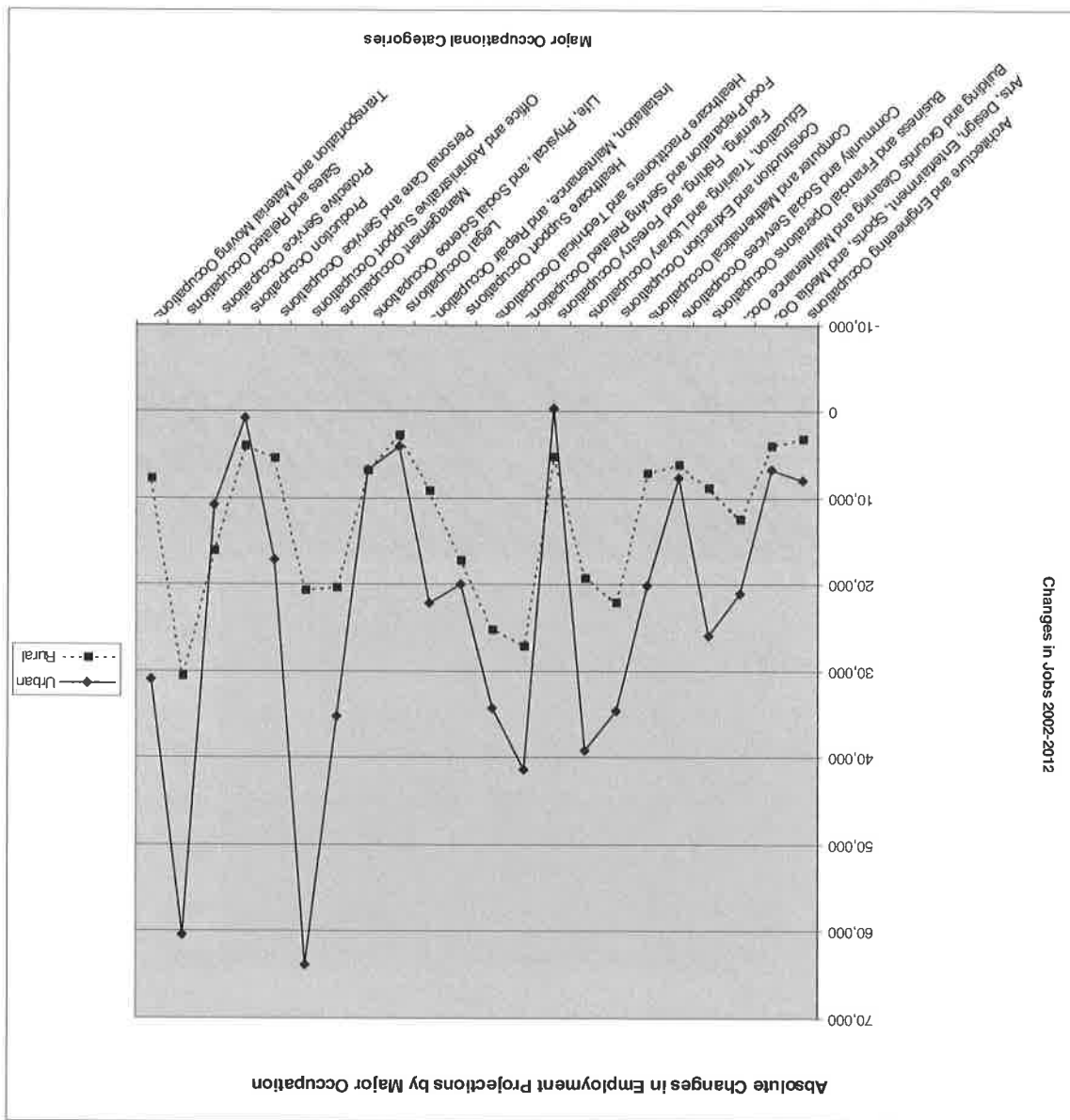
The growth of the various occupations among the regions is remarkably similar, especially given the diversity of the seven regional economies. As Figure 3.A.6 demonstrates on the next page, the percent change in each occupational grouping is very similar for each region. Figure 3.A.7 illustrates the differences between the rural and "urban regions" also contain significant rural counties, this distinction may not be particularly meaningful in the final analysis.

Figure 3.A.6 Absolute 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 2002-2012 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 a 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.⁴

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. All of the target industry occupations that have the highest growth rates require at least an associates degree and several require advanced training past the B.A.

⁴ <http://www.bls.gov/oco/cg/home.htm>

Table 3.B.1 Top Ten Occupations by Annual Percent Change 2002-2012

General Occupation	Annual Percent Change 2002-2012	Target Industry Occupations	Annual Percent Change 2002-2012
Medical assistants	5%	Biomedical engineer	4%
Post-secondary art, drama, music teachers	4%	Network systems and data communications analysts	4%
Biomedical engineers	4%	Biological technician	3%
Cardiovascular technologists, technicians	4%	Medical scientists	3%
Dental assistants	4%	Microbiologists	3%
Dental hygienists	4%	Computer software engineers (applications)	3%
Environmental engineering technicians	4%	Computer software engineers (systems software)	3%
Fitness trainers and aerobics instructors	4%	Network and computer systems administrators	3%
Home health aides	4%	Database administrators	3%
Post-secondary law teachers	4%	Computer systems analysts	3%

Similarly, Table 3.B.2 compares the NCESC top ten occupations by absolute change with those identified through the targeted industry clusters. The targeted industry occupations tend to require higher education levels, but are not as numerous as the service jobs identified in the overall analysis.

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

Occupation	Absolute Change 2002-2012	Target Industry Occupations	Absolute Change 2002-2012
Registered nurses	23,100	Truck drivers	14,220
Cashiers	22,040	Computer systems analysts	4,880
Retail salespersons	21,600	Electricians	4,280
Waiters and waitresses	17,290	Computer support specialist	4,160
Combined food preparation and serving workers	16,620	Computer software engineers (applications)	2,690
Nursing aides, orderlies and attendants	14,640	Packaging and filling operators	2,540

Absolute Change 2002-2012	Target Industry Occupations	Absolute Change 2002-2012	Occupation
	Computer software engineers (systems software)	14,220	Truck drivers, heavy and tractor-trailer
2,330	Network and computer systems administrators	13,980	Customer service representatives
2,330	Network systems and data communications analysts	13,040	General and operations managers
2,080	Machinists	12,310	Janitors and cleaners except maids and housekeeping cleaners

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 Handbook⁷ 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 2002-2012 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,⁸ 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.^{7,8,9}

⁵ <http://www.bls.gov/oco/home.htm>

⁶ <http://www.bls.gov/oco/home.htm>

⁷ 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.)

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

3.B1. ADVANCED MANUFACTURING

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.

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."¹⁰

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.¹¹

⁸ 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.

⁹ National Skill Standards for the Chemical Process Industry. National Chemical Society. Monika Aring, Advisor.

¹⁰ <http://www.nccommerce.com/categories/aboutus.htm>, accessed March 28, 2005.

¹¹ 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, Eastern and Piedmont Triad); 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.¹²

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, engineers and 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 NCESC forecast for 2002-2012 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 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 1978-2002 data.

Table 3.B.3

North Carolina Occupation Trends 2002-2012
Employment in Production Occupations

Region	2002 Employment	2012 Employment	Change	% of total 2002	% of total 2012	Annualized Change %
North Carolina	460,310	454,970	-5,340	11.4%	9.49%	-0.12%
West	52,478	52,825	347	12.69%	10.78%	0.07%
Charlotte	79,252	81,587	2,335	9.97%	8.19%	0.29%
Eastern	37,013	39,071	2,058	9.91%	8.86%	0.54%
Northeast	14,578	15,249	671	11.79%	10.42%	0.45%
Piedmont	110,500	104,629	-5,871	13.75%	11.17%	-0.54%
Triad	62,965	67,275	4,310	8.07%	7.09%	0.66%
RTRP	37,644	38,412	768	14.03%	12.22%	0.20%
Southeast	37,644	38,412	768	14.03%	12.22%	0.20%

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 2002-2012
Employment in Vehicle Parts Manufacturing Related Occupations

	2002 Employment	2012 Employment	Change	% Annualized Change
Commercial and industrial designer	1,170	1,310	140	1%
Mechanical engineer	4,130	4,690	560	1%
Electrical engineer	4,030	4,350	320	1%
Industrial engineer	4,530	4,930	400	1%
Computer programmer	13,960	15,130	1,170	1%
Assembly and fabricators	11,670	12,540	870	1%
Welding, soldering and brazing	1,040	1,170	130	1%
Machinists	13,060	15,140	2,080	1%
Tool and die makers	1,940	2,050	110	1%
Inspectors, testers, etc.	25,170	23,710	-1,460	-1%
Truck drivers	58,580	72,800	14,220	2%
Electricians	18,520	22,800	4,280	2%
Millwrights	1,860	2,080	220	1%
Industrial machine mechanics	11,190	9,630	-1,560	-1%

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 2001,¹³ 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.

¹³ Reported in NACFAM, 2003, "The Case for Enhancing American Workforce Skills," pages 12-13. PCG/U/NC/FINAL interim report-JAN.doc/RB.PC.CR.ATP.SP.3/CC.CS.CC.22/17January06
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3.B2. ADVANCED MATERIALS: CHEMICAL AND PLASTICS

Five of the seven regions identified chemicals and/or plastics as a target industry.¹⁴ This cluster already has a significant presence in the state. Feser and Renski¹⁴ 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 2002¹⁵ 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 who are 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.

¹⁴ Feser, Edward and Renski, Henry. 2000. High-Tech Clusters in North Carolina. North Carolina Board of Science and Technology.
¹⁵ MIT Sloan School of Business. 2002. "Industry Cluster Analysis for Forward Greensboro Economic Development Partnership."
PCG/UNCG/NC FINAL interim report-JAN.doc/RB.PC.CR.ATP.SP.3/CC.CS.CC.22/17January06
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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 2002-2012
Employment in Selected Advanced Materials-Related Occupations

	2002	2012	% Annualized Change
Chemical plant and system operators	2,140	2,250	1%
Helpers, industrial machinery install, repair and maintenance	5,550	6,630	2%
Inspectors, testers, sorters, etc.	25,170	23,710	-1%
Packaging and filling operators	16,410	18,950	1%
Chemical engineers	970	1,040	1%
Material scientists	130	160	2%
Chemists	3,950	5,020	2%
Chemical technicians	2,870	3,110	1%

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 will 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.¹⁶ 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.¹⁷

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.

¹⁶ Salek, Jeffrey. "How to Prepare for a Career in Industry." Chemical and Engineering News.

<http://pubs.acs.org/cen/125th/pdf/7913salek.rxi.pdf>. Accessed March 18, 2005.

¹⁷ 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. PCG/UNC/NC FINAL interim report-JAN.doc/RB.PC.CR.ATP.SP.3/CC.CS.CC.22/17January06

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 was estimated that over \$1.2 billion of venture capital was invested in the technologies.¹⁸

Nanotechnologies are emerging into products at a rate faster than biotechnology products did, given the amount of R&D and patents.¹⁹ 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

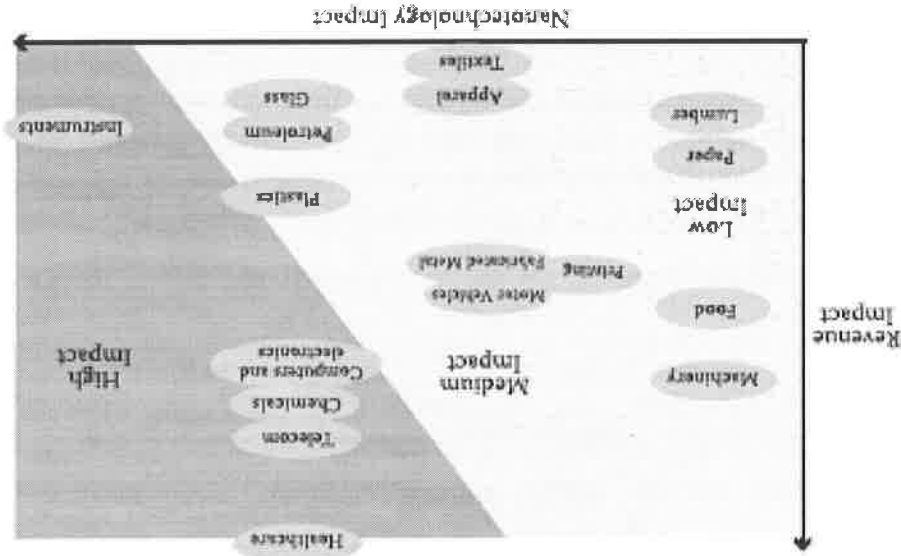


Figure 3.B.6. Nanotechnology's Probable Business Impact in 2007
Source: Larta, 2003

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.

¹⁸ 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."
¹⁹ 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.
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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.²⁰

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."²¹ 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 NCEESC do not have any occupations specifically related to the advent of nanotechnology. The occupation categories 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.

²⁰ Roco, M.C. and Bainbridge, W. (eds.) 2001. "Societal Implications of Nanoscience and Nanotechnology." Arlington, VA: National Science Foundation.

²¹ 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 2002-2012
Employment in Life, Physical and Social Science Occupations Plus Architectural and other Engineers

Region	2002 Employment	2012 Employment	Change	% of total 2002	% of total 2012	Annualized Change %
North Carolina	95,480	112,530	17,050	2.33%	2.34%	1.66%
Advantage West	18,904	21,524	2,620	4.38%	4.39%	1.75%
Charlotte	22,023	27,105	5,082	2.77%	2.72%	2.10%
Eastern	8,314	9,967	1,653	2.23%	2.26%	1.83%
Northeast	6,961	8,699	1,738	5.63%	5.94%	2.25%
Piedmont Triad	14,027	17,071	3,044	1.75%	1.82%	1.98%
RTRP	28,372	34,865	6,493	3.64%	3.67%	2.08%
Southeast	14,971	17,975	3,004	5.58%	5.72%	1.85%

Source: NC Employment Security Commission

This table shows that roughly 2.3% of all North Carolina occupations fit into this field, and are potentially growing between 1.66% and 2.25% 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. Fonash²² states the need for a revamping of traditional science and engineering curricula to emphasize the broad and integrative nature of the

²² 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.²³

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 positions.²⁴ 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,²⁵ fourth in pharmaceuticals and the national leader in clinical research organizations. 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 skills required by biotechnology, pharmaceutical and biomanufacturing companies are emerging as are the skills required by other, related industries.²⁶

²³ California Council on Science and Technology.
²⁴ Milken Institute, 2004. *Biopharmaceutical Industry Contributions to State and US Economies*.
²⁵ 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.

²⁶ 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>
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Occupations

According to the Bureau of Labor Statistics, 28% of the positions in the pharmaceutical and biomanufacturing fields are in professional and related occupations.²⁷ 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 <http://www.bls.gov/oco/ocgs009.htm>, accessed March 21, 2005.
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Employment Forecast

The North Carolina Biotechnology Center estimates the following annual job openings per year in the Biopharmaceutical Industry:²⁸

Pharmaceutical	Biomanufacturing	
New job creation	490	500-1,400
Turnover	490	1,720-1,890
TOTAL	980	2,220-3,290

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.²⁹

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 2002-2012 forecast for selected professional occupations for the state as a whole. This forecast shows that the almost 27,700 positions represented in biotechnology and pharmaceuticals in North Carolina in 2002 correspond with the Milliken report of 25,000 positions in 2003. Further, the NCESC forecasts 5,350 new positions in these fields by 2012, a number that is fairly consistent with the Milliken 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 15,600 jobs out of a total of over 33,000 by 2012. 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.

²⁸ 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>

²⁹ Regional Technology Strategies, 2003, "Meeting the Long-term Skills Needs of North Carolina's Biomanufacturing Industries and Biotechnology Cluster."

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Interestingly, the NCESC forecasts significantly understate the forecasts made by the North Carolina Biotechnology Center in 2004 and those reported by Duke University.³⁰ 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 2002-2012
Employment in Biotechnology and Pharmaceutical-Related Occupations

	2002	2012	Change	% Annualized Change
Biomedical engineer	100	140	40	4%
Chemical engineer	970	1,040	70	1%
Industrial engineering technician	1,960	2,100	140	1%
Industrial engineer	4,530	4,930	400	1%
Agricultural and food science technician	850	950	100	1%
Biological technician	2,370	3,080	710	3%
Chemical technician	2,870	3,110	240	1%
Chemists	3,950	5,020	1,070	2%
Life scientists, all other	1,840	2,290	450	2%
Life science, other technicians	5,360	6,400	1,040	2%
Medical scientists	2,620	3,600	980	3%
Microbiologists	270	380	110	3%

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 U.S. 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.³¹ 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.

³⁰ http://www.soc.duke.edu/NC_GlobalEconomy/biotech/, accessed March 28, 2005.

³¹ <http://www.bls.gov/oco/ocgs009.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.³² 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.

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
Manufacturing workforce (skills needed for biomufacturing 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.)	High School plus one year or work experience	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.	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 biomufacturing 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.	GMP guidelines cover every phase of the production process, usually FDA approval hinges on it. Requires a mind-set and behavior consistent with compliance.

Source: 1. Creating a Bio-science Workforce: National Skills Standards for Entry into the Bioscience Industry. EDC 1995. Monika Arling 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 Biomufacturing Workforce. March 2003. NC Biotech Center Education and Training Program.
<http://www.ncbiotech.org/pdf/files/goldenleaftrpt.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 Review³³ 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.³⁴ 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.³⁵ Technology-enabled organizations see an increasing need for information technology workers (such as health care,

³³ 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.

³⁴ Information Technology Association of America. 2004. "Adding Value...Growing Careers: The Employment Outlook in Today's Increasingly Competitive IT Job Market. <http://www.itaa.org>, accessed March 22, 2005.

³⁵ National Workforce Center for Emerging Technologies, 2004. "Applications of Information Technology: Trends Assessment for 2004." www.nwccet.org/products/trends2005.asp, accessed March 22, 2005.

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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 Forecast

The employment forecast for selected information technology occupations in North Carolina is shown in Table 3.B.10. The growth rates are high, but lower than our earlier analysis based on 2000-2010 data. Table 3.B.11. shows the overall levels of employment forecast by the seven regions in the state.

Others⁴³ have refined these definitions further 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. Art Facilitators includes occupations such as: advertising and promotions managers; public relations managers; audio and video equipment technicians; costume attendants; agents and business managers of artists; postsecondary art, drama, and music teachers; and musical instrument repairers and tuners.

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 2012. The 1.91% annualized change for North Carolina as a whole is the eleventh 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 all but one of the other regions. Table 3.B.13, on the next page shows the forecasts for selected Arts and Design occupations statewide.

⁴³ 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. PCG/UNNC/NC FINAL interim report-JAN.doc/RB.PC.CR.ATP.SP.3/CC.CS.CC.22/17January06

Table 3.B.12.
North Carolina Occupation Trends 2002-2012
Employment in Arts, Design, Entertainment, Sports and Media Occupations

Region	2002 Employment	2012 Employment	Change	% of total 2002	% of total 2012	Annualized Change %
North Carolina	42,950	51,880	8,930	1.05%	1.08%	1.91%
Advantage West	5,374	6,887	1,513	1.30%	1.41%	2.51%
Charlotte	10,504	13,398	2,894	1.32%	1.34%	2.46%
Eastern	3,691	4,524	833	0.99%	1.03%	2.06%
Northeast	1,892	2,407	515	1.53%	1.64%	2.44%
Piedmont Triad	8,346	10,066	1,720	1.04%	1.07%	1.89%
RTRP	8,120	10,176	2,056	1.04%	1.07%	2.28%
Southeast	3,950	4,941	991	1.47%	1.57%	2.26%

Source: NC Employment Security Commission

Table 3.B.13.
North Carolina Occupation Trends 2002-2012
Employment in Selected Arts and Design Occupations

	2002 Employment	2012 Employment	Change	Annualized Change %
Fine artists	500	590	90	2%
Multimedia artists and animators	780	940	160	2%
Art directors	830	960	130	1%
Commercial and industrial designers	1,170	1,310	140	1%
Graphic designers	4,010	4,870	860	2%

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.

Table 3.B.14.
North Carolina Occupation Trends 2002-2012
Employment in Transportation and Material Moving Occupations

Region	2002 Employment	2012 Employment	Change	% of total 2002	% of total 2012	Annualized Change %
North Carolina	318,500	363,100	44,600	7.78%	7.58%	1.32%
Advantage West	29,486	31,763	2,227	7.13%	6.48%	0.75%
Charlotte	68,946	81,801	12,855	8.67%	8.21%	1.72%
Eastern	28,078	30,858	2,780	7.52%	7.00%	0.95%
Northeast	8,276	8,780	504	6.69%	6.00%	0.59%
Piedmont	69,552	79,197	9,645	8.66%	8.46%	1.31%
Triad						
RTRP	51,400	59,919	8,519	6.59%	6.31%	1.55%
Southeast	21,240	23,280	2,040	7.92%	7.41%	0.92%

Source: NC Employment Security Commission

Table 3.B.15.
North Carolina Occupation Trends 2002-2012
Employment in Selected Transportation and Material Moving Occupations

	2002 Employment	2012 Employment	Change	Annualized Change %
Transportation, storage and distribution managers	2,900	3,450	550	2%
Truck drivers	58,580	72,800	14,220	2%
Helpers, installation, maintenance and repair	5,550	6,630	1,080	2%

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.⁴⁷

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 courses in logistics management.

Gammelgaard and Larson define the new skill sets required to succeed in the logistics industry⁴⁸. 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.

⁴⁷ <http://www.fts5.info/logistics/jobHunts/janneWS2.html>, accessed March 24, 2005.
⁴⁸ Gammelgaard, Britta and Larson, Paul D., 2001, "Logistics Skills and Competencies for Supply Chain Management," Journal of Business Logistics, 22 (2):27-53.
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REPORT	SKILL REQUIREMENTS EXPRESSED
Skills Gap 2001: National Association of Manufacturers	78% say public schools not teaching basic academic and employability skills; 26% say workers lack math skills; 30% report deficiencies in basic comprehension and writing skills; 59% 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. continue to be 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.”⁵⁰

The Business-Higher Education Forum notes that jobs requiring science, engineering or math training are growing at over 51%, 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.⁵¹ (Please note the NCEC 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.⁵²

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 40.⁵³

⁵⁰ 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.

⁵¹ Ibid.

⁵² American Electronics Association, 2005. “Losing the Competitive Advantage: The Challenge for Science and Technology in the United States. www.aeanet.org/publications/IDJ1_AeA_Competitiveness.asp, accessed March 23, 2005.

⁵³ Taskforce on the Future of American Innovation, 2005. “The Knowledge Economy: Is the U.S. Losing its Competitive Edge?” www.futureofinnovation.org/PDF/Benchmarkmarks.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 about 16% from 2000-2010, compared to 10% for the U.S. as a whole.⁵⁴ As shown in Table 3.C.1, 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 45.⁵⁵

The 2000 census indicated that 10% of the state's population was 65 and older, a joint result of the aging of baby boomers and an influx of retirees.⁵⁶ 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, as in Moore County (Pinehurst and Southern Pines) in the east and Henderson County in the west.⁵⁷

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

Cohort	Population – 2000 Census	Forecasted Population in 2010*	Change	Percent Change
0-9	1,102,062	1,242,456	140,394	12.7%
10-17	861,985	979,655	117,670	13.7%
18-24	806,821	964,080	157,259	19.5%
25-34	1,213,415	1,237,389	23,974	2.0%
35-44	1,287,120	1,333,924	46,804	3.6%
45-54	1,085,150	1,333,109	247,959	22.9%
55-64	723,712	1,067,058	343,346	47.4%
65+	969,048	1,157,470	188,422	19.4%
Total	8,049,313	9,315,141	1,265,828	15.7%

Source: <http://demog.state.nc.us>
* Forecast for April 2010

The population of college-age North Carolinians in 2010 will reach almost 1 million, growing 19.5% over the ten-year period. This reflects significant growth over the current college-age population.

⁵⁴ 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.
⁵⁵ National Science Board, Science and Engineering Indicators 2004. www.nsf.gov/statistics/seind04/c3/c3s3.htm, accessed 4/18/05.
⁵⁶ NC Rural Center, www.ncruralcenter.org, accessed 1/31/05.
⁵⁷ www.ncatlantisrevisited.org, accessed 1/31/05