The North Carolina Community College System

- Workforce Development and the BioNetwork

Taking the High Road to Matching Skills with Industry and Innovation

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The North Carolina Community College (NCCC) System is the third largest in the United States, and is also one of the most innovative in aligning the state’s workforce development systems with the present and future needs of industry. This report offers brief synopses of the history, funding, and current workforce development programs of the NCCC System. It then explores in greater detail the NCCCS BioNetwork program, an emerging network of biotech-related training centers designed to be closely aligned with current and predicted workforce requirements the biotech industry.

Introduction

_NCCC History and Mission_

After World War II, North Carolina’s economy—like that of much of the nation—shifted from an agricultural base to an economy rooted in industrial production. With this shift came the realization that education and training beyond high school would be needed to maintain a productive, competitive work force. In 1950, North Carolina’s Superintendent of Public Education called for a tax-supported community college system, and the state’s General Assembly passed the Community College Act in 1957. In addition to creating the NCCC System, which focused on a traditional arts and sciences curriculum, the Act created a system of Industrial Education Centers which would provide technical and vocational training to those students pursuing a career in industry. In 1962, these programs were consolidated under the State Department of Education and the current system of local boards and trustees was created. The key legislation for the system, G.S. 115A (now called 115D), was passed in 1963 and established the Department of Community Colleges under the State Board of Education.¹

The system grew quickly through the 1960s. By 1961, North Carolina had five junior colleges and seven industrial education centers; by 1966, it consisted of forty-three institutions with 28,250 students; and in 1969, it boasted fifty-four institutions and 59,329 students. By 1978, the system had reached its present size of 58 community colleges, each with its own mix of arts and sciences, occupational training, technical focus, and other resources.² In 1981, the State of Board of Community Colleges officially assumed control of the system, making it an independent department under the state governor.³
The State Board of Community Colleges held a major visioning initiative for the system in 1987, convening twenty-three business, civic, and education leaders in the Commission on the Future of the North Carolina Community College System. This commission released a set of recommendations in 1989, which have since guided the system’s leadership. For purposes of this report, the key recommendations considered are to place greater emphasis on supporting existing businesses and industries and to improve the quality of “workforce technology” through worker training. The current mission statement of the system is as follows:

The mission of the North Carolina Community College System is to open the door to high-quality, accessible educational opportunities that minimize barriers to post-secondary education, maximize student success, and improve the lives and well-being of individuals by providing:

- Education, training and retraining for the workforce, including basic skills and literacy education, occupational and pre-baccalaureate programs.
- Support for economic development through services to and in partnership with business and industry.
- Services to communities and individuals which improve the quality of life.

**NCCC System Governance**

The NCCC System is a hierarchically organized entity. The State Board oversees the NCCC President and System Office, which in turn oversee local boards, which oversee local presidents and colleges. The State Board consists of twenty-one members who are selected by North Carolina’s Governor and General Assembly from a pool of business, industry, education, and government leaders. Additional ex-officio members include, the Lieutenant Governor, State Treasurer, and NCCC student government president.
The Board meets ten times per year, and is responsible for funding distribution and fiscal oversight, setting priorities for the state, and approving programs and providing program accountability. The NCCC president and his office provide administrative guidance, technical support, program implementation assistance, data collection, and other services to individual colleges. In turn, each college has a local board that consists of 12 trustees, either elected by the local school board and commissioners or appointed by the Governor, who set local policy and oversee local colleges. Finally, local presidents oversee faculty, administration, and college employees.6
NCCC System Overview: Locations, Funding, Enrollment, and Curriculum

The NCCC System is organized such that all 100 counties in North Carolina are served by a local college; no locality in the state is beyond a half-hour drive to a college (see Figure 2, below). Compared to those of other states, North Carolina’s system is the third largest, ranking behind California and Texas (see Table 1, below).

Fig. 2. North Carolina Community College Map

Table 1: Number of Public Community Colleges, 2002-03 (top nine states)

<table>
<thead>
<tr>
<th>State</th>
<th>Community Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>111</td>
</tr>
<tr>
<td>Texas</td>
<td>67</td>
</tr>
<tr>
<td>North Carolina</td>
<td>59</td>
</tr>
<tr>
<td>Georgia</td>
<td>55</td>
</tr>
<tr>
<td>Illinois</td>
<td>48</td>
</tr>
<tr>
<td>Louisiana</td>
<td>47</td>
</tr>
<tr>
<td>Ohio</td>
<td>42</td>
</tr>
<tr>
<td>Minnesota</td>
<td>41</td>
</tr>
<tr>
<td>New York</td>
<td>39</td>
</tr>
<tr>
<td>United States Total</td>
<td>1,101</td>
</tr>
</tbody>
</table>
The NCCCS budget for FY 2004-05 is $891 million\textsuperscript{10} and comes largely from the NC general fund. For example, in FY 2002-03, the general fund contributed 67.3\% of the total budget, tuition supplied 15.7\%, local funds supplied 13.4\%, the federal government provided 3.2\%, and 4\% came from other sources.\textsuperscript{11} The state pays for more of the total in North Carolina when compared to the national average for public community colleges: in 2000, 42\% of the funding came from state funds, 23\% from tuition and fees, 18\% from local funds, 5\% from federal funds, and 10\% from other sources.\textsuperscript{12} All of the NCCC System colleges currently have private foundations with 501(c)(3) status to facilitate local donations, and the system’s main office has established the North Carolina Community Colleges Foundation which facilitates donations from large companies who depend on the system to train their workforce.

Total enrollment in North Carolina Community Colleges in 2003-04 was 779,132 (273,626 in Curriculum programs, 142,210 in Continuing Education).\textsuperscript{13} As discussed above, the NCCC System is unique in its commitment to student services and its working directly with industry through targeted training programs. The NCCC System currently offers over 2,500 curriculum programs within more than 290 curriculum titles, available at the certificate, diploma and the associate degree levels.\textsuperscript{14}

Currently, the NCCC System offers of four types of programs: curriculum, continuing education, student services, and specialized programming.\textsuperscript{15} While most NCCCS students pursue two-year technical degrees, the system also offers classes that will allow students to transfer to four-year programs in their junior year. Continuing education courses are non-credit and are designed for interested community members, workers who wish to upgrade their skills or students who need training in basic academic skills, GED training, or English as a Second Language. Students are offered a wide range of services, including academic support, career counseling, and workforce development training. Specialized programming—such as BioNetwork—is closely related to economic development objectives.
Workforce Development Programs

New and Expanding Industry Training (NEIT)

Based upon the understanding that sufficient workforce availability is crucial to the success of firms, the New and Expanding Industry Training program provides employee training at no cost to firms in selected industries. Eligible industry sectors include manufacturing, technology, telecommunications, warehousing and distribution, among others. Projects are chosen on a case-by-case basis with the minimum requirement being the expected creation of 12 or more jobs – beyond their previous three-year maximum employment level - as a result of the training. Jobs, therefore, are the key metric used to evaluate the program. Each training program is customized based on a firm’s needs and can include “instructors and training program development, video and other customized media programs, instructor travel costs and other training-related expenditures such as temporary training facilities, equipment, materials, and supplies.”

For projects costing less than $75,000, approval is determined by one of six NEIT program managers. Higher cost training projects must be approved by a two-person approval committee appoint by the NCCCS president and the North Carolina Secretary of Commerce. According to Susan Seymour of the NCCCS system, the greatest numbers of NEIT projects in recent years have been in textiles, transportation, wood/paper/printing, and pharmaceuticals/medical – a clear indication of the far-ranging scope of the program.

The NEIT program was formed in 1958, pre-dating the formal beginning of the statewide community college system, and was the first training program of its kind in the country. In recent years, NEIT has been recognized by The Wall Street Journal, The Chronicle of Higher Education, Site Selection Magazine, and the Associated Press and is commonly touted by the community college system as a key component of North Carolina’s reputation as a good state for business. Presently, NEIT is funded through general fund appropriations as well as state measure HB275 which draws funds through investment interest earned on the state’s
unemployment fund. The NEIT budget, therefore, is largely dependent on stock and investment markets and took a significant hit after the market crashes of 2001. The NEIT budget averaged just over $7 million between 1998 and 2001, but dropped to $5.4 million on the 2001-02 academic year and to $4.0 million in 2002-03. Accordingly, the numbers of projects and employees trained have dropped to 131 and 10,610 respectively in 2002-03, down from highs of 203 and 24,068 in 2000-01.

Of the 131 firms served in 2002-03, 79 were existing companies in the state while the remaining 52 were new companies recruited to the state. Of NEIT projects, 68% took place in rural versus urban counties and 72% of expenditures were for rural projects. A 2003 survey of NEIT firms conducted by the NCCCS found that an overwhelming number rated the impact and effectiveness of the program as either very good or excellent.

**Fig. 3. NEIT Program Expenditures**

<table>
<thead>
<tr>
<th>YEAR</th>
<th># OF PROJECTS</th>
<th>TOTAL EXPENDITURES</th>
<th># OF TRAINEES</th>
<th>AVG COST PER TRAINEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998–99</td>
<td>193</td>
<td>$7,614,677.69</td>
<td>19,969</td>
<td>$381.50</td>
</tr>
<tr>
<td>1999–00</td>
<td>197</td>
<td>$7,247,885.47</td>
<td>20,256</td>
<td>$357.81</td>
</tr>
<tr>
<td>2000–01</td>
<td>203</td>
<td>$7,024,819.47</td>
<td>24,068</td>
<td>$291.87</td>
</tr>
<tr>
<td>2001–02</td>
<td>155</td>
<td>$5,391,598.15</td>
<td>14,771</td>
<td>$365.01</td>
</tr>
<tr>
<td>2002–03</td>
<td>131</td>
<td>$4,005,104.75</td>
<td>10,610</td>
<td>$377.48</td>
</tr>
</tbody>
</table>

JobLink Centers

The United States Workforce Investment Act of 1998 spurred the creation of a statewide network of JobLink centers that provide training, education, and employment services for state residents. The legislation authorized the formation of a statewide Workforce Development Board and 24 local boards serving under the authority of the governor. The local boards are comprised of private industry employers and representatives of publicly funded employment training entities. The development of the JobLink program was funded in large part by a federal grant of $8.9 million.21

Fig. 4. NC WIA Principles

<table>
<thead>
<tr>
<th>North Carolina Workforce Investment Act: Main Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training and employment programs must be designed and managed at the local level where the needs of businesses and individuals are best understood.</td>
</tr>
<tr>
<td>Customers must be able to conveniently access the employment, education, training, and information services they need at a single location in their neighborhoods.</td>
</tr>
<tr>
<td>Customers should have choices in deciding the training program that best fits their needs and the organizations that will provide that service. They should have control over their own career development.</td>
</tr>
<tr>
<td>Customers have a right to information about how well training providers succeed in preparing people for jobs. Training providers will provide information on their success rates.</td>
</tr>
<tr>
<td>Businesses will provide information, leadership, and play an active role in ensuring that the system prepares people for current and future jobs.</td>
</tr>
</tbody>
</table>

Source: NC Community College System: http://www.ncccs.cc.nc.us/Business_and_Industry/workforc.htm

Funding and budget figures are not available on the aggregate level because each center’s funding structure is unique. For most JobLink centers, the Employment Securities Commission covers basic rent and infrastructure expenses with money originating from federal sources. For those centers located on community college campuses, these costs are covered by the college. Since the expiration of the Workforce Investment Act in 2004, Congress has been working to renew funding, but legislators have thus far failed to approve any of a variety of new versions of the program. To alleviate some of the funding inconsistencies most proposals contain provisions
for infrastructure funding and North Carolina officials are hopeful that this clause will make its way into the final version of the new bill.\textsuperscript{22}

A prime goal of the Workforce Investment Act was to create higher levels of local and customer control over workforce development initiatives. Training options were to be designed with the needs of local businesses in mind and individuals would be “empowered to obtain the training they find most appropriate.”\textsuperscript{23} This involved the creation of individual training accounts built by customers under the guidance of JobLink staff.

![Fig. 5. Locations of NC JobLink Centers](source)

Presently there are 110 JobLink centers statewide. Roughly 30 of the centers are co-located with community college branches, while others exist independently. As a whole, JobLink centers tend to operate according to the will and direction of the local board rather than the community college system or the state workforce development board. Consequently, no records of customers, trainees, or classes are kept at a statewide, aggregate level. Data therefore is not available for the entire system and limits the Department of Commerce’s ability to assess the strengths and progress of the JobLink program.\textsuperscript{24}

Also known as One-Stop Career Centers, JobLink facilities offer clients preliminary skill assessments, information about local training options, job-finding assistance, and help filing unemployment claims. The centers also interface with local firms with the goal of matching local
training and job-assistance programs with the needs of local employers. A 2000 analysis of the JobLink program conducted by MDC, Inc. of Chapel Hill, NC praised the program for establishing a “sound system infrastructure” but warned that the disaggregate nature of the program created a detrimental lack of central guidance and leadership and therefore inconsistencies in the effectiveness of the individual centers.25

**Small Business Center Network (SBCN)**

Unlike most other community college workforce and economic development programs, the Small Business Center Network works directly with firm owners rather than employees and job-seekers. The mission of SBCN according the 2004 Community College Factbook is “to help the many small businesses within its service area survive, prosper, and contribute to the economic well-being of the community and the state” (42).

The SBCN program began in 1985 with 8 centers and has grown gradually since.26 There are currently 58 small business centers throughout the state, most of which are located at community college campuses. Centers provide group seminars and individual consulting services to small businesses owners and potential entrepreneurs. Services offered include assisting with writing a business plan, identifying funding sources, marketing, and record keeping. Some workshops and seminars do require a minimal registration fee, but the majority of SBCN services are provided free of charge.27

The chart below shows the total numbers of SBCN services provided in the 2002-03 academic year by all centers combined. All numbers are roughly comparable to recent years with numbers of seminars, seminar trainees, and course trainees rising slightly and number of individuals counseled declining by about 2,000. The budget for the SBCN network was $3.96 million in 2002-03 and is supported exclusively by state funds. Each center receives an annual grant of approximately $66,000 with the remaining funds (roughly $132,000) going to general administration.
In addition to the services described above, the SBCN recently began offering new services, including the Export Ready program which walks business owners and entrepreneurs through a step-by-step description of the export process. Another new offering is the FastTrak 9-11 Project which aids individuals who have been unemployment since 2001 gain new skills and explore entrepreneurial opportunities. The SBCN also offers the New Opportunities for Workers (NOW) program which assists dislocated industrial workers who are looking to learn to start, operate, and finance a new business. The NOW program currently operates in 15 counties that have been particularly hard hit by layoffs in recent years and offers business counseling, loans, and scholarships for SBCN services.
**Focused Industrial Training**

Established in 1981, the NCCCS Focused Industrial Training Program (FIT) was the first NCCCS workforce development program to provide specific “apprenticeship” training for manufacturing jobs. Originally given the title of Cooperative Apprenticeship, the program was billed as being “a new type of training programs that [had] many of the features of formal apprenticeship, but [was] not as rigid in its requirements.”

Initially, eight colleges hosted Cooperative Skills Training Centers that targeted the production and manufacturing skills needed by local industry. Specifically, each of these initial centers focused on one or more of three skill sets: (1) tool and die making, (2) machining, and (3) industrial maintenance.

Today the NCCCS continues a tradition of targeting FIT programs to the needs of “veteran or incumbent workers in manufacturing industries who desire of need to renew their skills and technical knowledge.” The program has grown to the point that in 2002/2003 the NCCCS system had 37 FIT Centers and four FIT Consortium sites. Additionally, colleges with no dedicated FIT site were allocated funding to pursue FIT-related workforce development projects. FIT Centers and Consortia are staffed by a director “who works closely with local business and industry personnel in assessing training needs and developing customized training programs to fit those needs.

Funding for the FIT program has traditionally come from a mixture of General Fund Appropriations and interest earned on the North Carolina State Employees Retirement Fund. Such funding, however, has proved to be unpredictable. For example, in 1998, total funding for the program was $3.7 million, with half coming from the General Fund and half from Retirement Fund earnings. In 2003, in the face of a declining economy and increased need, funding had decreased to just over $3.7 million, with only $275,000 coming from retirement fund earnings. During the same period, average funding for individual FIT projects dropped from $90,000 to just over $80,000. The effects of these funding cuts are divergent, as the number of companies served by the FIT program has increased by 23 percent since 1998/1999, while the
corresponding numbers of trainees and classes offered have dropped by 43 and 19 percent respectively. (See Table 2)

Table 2. FIT Outcome Data

<table>
<thead>
<tr>
<th>Academic Year</th>
<th># of FIT Centers/Consortia</th>
<th># of Companies Served</th>
<th>Total # of Trainees</th>
<th>Total # of Skills Classes Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-1999</td>
<td>38</td>
<td>676</td>
<td>14,841</td>
<td>1,178</td>
</tr>
<tr>
<td>1999-2000</td>
<td>39</td>
<td>705</td>
<td>12,186</td>
<td>1,196</td>
</tr>
<tr>
<td>2000-2001</td>
<td>40</td>
<td>630</td>
<td>13,404</td>
<td>1,519</td>
</tr>
<tr>
<td>2001-2002</td>
<td>40</td>
<td>754</td>
<td>10,488</td>
<td>1,100</td>
</tr>
<tr>
<td>2002-2003</td>
<td>40</td>
<td>834</td>
<td>8,438</td>
<td>955</td>
</tr>
</tbody>
</table>

Source: NCCCS Factbook 2004, p. 35

In spite of these recent funding cuts to FIT programs, both industry and trainees appear to be satisfied with the training received. In 2002/2003, 100 percent of employers surveyed indicated that they were satisfied with the customized training programs offered at NC Community Colleges. Employment figures show similar positive outcomes, with 99.47 percent of all graduates in the 2001/2002 academic year reporting that they were employed. These figures, however, may be deceiving; as they do are not an indication of the type of employment held by these graduates. Also, it is unclear as to how long the FIT system can withstand the competing forces of funding cuts and increased demand by employers and trainees.
Occupational Continuing Education

The NCCCS Occupational Continuing Education Program (OCE) is by far North Carolina’s largest workforce development program. As of 2002/2003, the OCE program offers over 1400 short-term occupational training and retraining courses statewide. OCI courses “can be offered on demand and customized for specific training needs and are often the first response for meeting critical training needs in communities.”33 OCE course fees are extremely low, only $50 to $65 per course per student. Also, free customized OCE training is available for businesses that produce twelve or more jobs per year.

Compared to other NCCCS workforce development programs, OCE programs are largely receipt-driven. For example, in 1998 total expenditures for OCE programs was approximately $31 million, only $20.5 million of which was paid for with course fees.34 Current spending has been expanded to $50 million, a significant portion of which will be paid for with per course per student fees.

Student enrollment in OCE programs has fluctuated in recent years, as shown in Table 3.

Table 3. OCE Enrollment by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Enrollments (Unduplicated Headcount)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>262,516</td>
</tr>
<tr>
<td>1999</td>
<td>241,700</td>
</tr>
<tr>
<td>2000</td>
<td>230,320</td>
</tr>
<tr>
<td>2001</td>
<td>226,596</td>
</tr>
<tr>
<td>2002</td>
<td>219,506</td>
</tr>
</tbody>
</table>

Source: NCCCS Factbook, 2004 p. 76

Enrollments in these programs were clustered primarily in three areas. Health and safety programs accounted for 25% of enrollment, while public safety programs accounted for 41%. The remaining programs were clustered in education, agriculture/natural resources and business/industry skills training.35 Note that of these three clusters, public safety programs have
shown consistent enrollment increases since 1998, the agriculture/business skills cluster has displayed fluctuations and overall decreases in enrollment.

OCE programs typically service students who wish to develop skills to obtain a job or improve their skills for a current job. A profile of 2002 OCE students bears this out: of the nearly 220,000 OCE students enrolled in 2002, seventy-nine percent were between the ages of 25 and 49, seventy-one percent were employed full-time, eight percent were employed part-time, and twenty-one percent were unemployed.\textsuperscript{36}

As previously indicated, in 2002/2003, 100 percent of employers surveyed indicated that they were satisfied with the NCCCS training programs offered at NC Community Colleges.\textsuperscript{37} Additionally, 94\% of employers surveyed reported that they were satisfied with NCCCS graduates.\textsuperscript{38} While these numbers are impressive, a more fine-grained approach to determining outcomes for the OCE programs would be examining how the program is meeting \textit{specific} employment needs of North Carolina. This type of investigation has yielded promising outcome indicators for the program, as in 2002 it produced approximately trained approximately 48,000 students to work in the burgeoning IT field and certified over 200,000 Fire/Rescue, Law Enforcement, and EMT personnel.\textsuperscript{39} During this period the OCE program “generated more than 14 million membership hours in workforce continuing education with more than 1.3 million hours in computer science applications, 1.8 million hours in emergency medical services, and 1.3 million hours in health and safely occupations.”\textsuperscript{40}

\textbf{Human Resource Development}

The NCCCS Human Resource Development Program (HRD) was initiated in 1969 by then Governor Bob Scott, who later served as NCCCS President. Governor Scott partnered with Manpower Development Corporation (MDC) to develop an initiative that was then called the Manpower Development Program.\textsuperscript{41} The program has evolved since its inception and now offers a series of courses, approved by the State Board of Community Colleges that are “student centered” and address six core workforce components:\textsuperscript{42}

1. Assessment of an individuals assets and limitations
2. Development of a positive self-concept
3. Development of employability skills
4. Development of communication skills
5. Development of problem solving skills
6. Awareness of the impact of information technology in the workplace

The basic mission of HRD programs is to give individuals the skills they need to find employment and thus reduce their consumption of public services such as welfare, food stamps, etc. Reflecting this philosophy, HRD funding is based on a formula which calculates an “Earnback Index” for program graduates that uses the increased earning potential and resulting decreased consumption of public services as a means of calculating funding for HRD programs. Such an index is surely based on contentious assumptions regarding employment opportunities, earning potential, and changing need for public services. As such, it is likely that as these assumptions change or are negotiated by decision makers, HRD program funding will change as well. Recently, the HRD program has seen severe decreases in funding, as the total program budget was dramatically reduced in FY 01-02 by over one-third. (See fig 7)\textsuperscript{43}

![Fig. 7. HRD Funding by Year](image-url)
According to the 2004 NCCCS Fact Book, HRD program outcomes are positive overall (36-37). In terms of HRD core mission of reducing consumption of unemployment compensation and other social services, NCCCS data suggests that HRD programs result in decreased service consumption of $40 to $50 million per year. Since 1975, HRD programs have enrolled over 300,000 students, and during the 2002-2003 academic year, over 50,000 students enrolled. As indicated in figure 4, the number of students served by HRD programs has increased steadily since academic year 1994-1995, with especially high increases in demand since 2000-2001. Whether the program can withstand this increased demand for its services in light of recent funding cuts remains to be seen.44

BioWork—An Integrated Approach to Workforce Development

At first glance, the number and types of Workforce Development Initiatives undertaken by the NCCCS system may appear cumbersome and uncoordinated. Programs are supported by a variety of state, federal, and non-profit funding sources, pursue missions that may be distinct or redundant, and serve a wide range of constituencies. These seemingly divergent programs, however, are coordinated by NCCCS Workforce Development to yield integrated systems that train workers in specific skill-sets, give access to crucial formal and informal employment networks, and provide opportunities for ongoing training for workers wishing to update their skills in the face of rapidly changing technologies and production methods.
An excellent example of such forward-looking coordination of Workforce Development programs is the BioWork Initiative.\textsuperscript{45} Originally a product of the New and Expanding Industries Training program, BioWork has expanded to incorporate aspects of Human Resource Development and is closely related to the BioNetwork initiative. Students that complete the BioWork program not only receive training for entry level positions in biotechnology manufacturing, but they also have the option to participate in industry-specific employment networks. Moreover, those same students are uniquely positioned to take advantage of continuing workforce training through the emerging BioNetwork initiative. Currently, the BioWork program is offered through 11 NCCCS institutions.\textsuperscript{46} Following is a description of this innovative, integrated program.

The BioWork originated from a NEIT program in which Wake Tech provided customized training for BioGen, a Triangle company that needed workers trained in clean-room biomanufacturing and maintenance.\textsuperscript{47} Taking into account the actual and forecasted growth in employer demand for such workers, Wake Tech expanded the program, offering training to students interested in working in pharmaceuticals, bioprocessing, and chemical manufacturing. With the help of a federal grant, the Wake Tech/BioGen partnership became North Carolina’s first BioWork program. The additional federal funding not only allowed displaced workers to receive BioWork training at no cost and provided all training materials (textbooks, calculators, etc.), but also permitted the program to integrate an optional HRD component to give targeted employment resources to BioWork graduates. These resources include opportunities to network with biomanufacturing human resources personnel, receive industry- and firm-specific resume training, participate in industry- and firm-specific mock interviews, and attend bi-annual biotechnology job fairs.\textsuperscript{48}

The BioWork program is open only to unemployed and displaced workers and admission is competitive. Potential students must possess either a high school diploma or equivalent and demonstrate at least a 9\textsuperscript{th} grade proficiency on a math and verbal placement test. Once admitted to the BioWork program, students must score at least 80\% (note that this is a minimum score on each exam, not an overall average) on each of 9 unit exams and must attend at least 80\% of the scheduled class sessions. Should a student fail to meet either criteria, that student would be removed from the program.\textsuperscript{49}
The BioWork curriculum was designed by the North Carolina Biotechnology Center and consists of 128 hours of instruction. Classes meet once per week for four hours. Course content is divided into 9 units (see Table 4):\(^5\)

**Table 4. BioWork Curriculum Units**

<table>
<thead>
<tr>
<th>Unit Number</th>
<th>Unit Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td><em>Your New Job</em></td>
<td>Orientation to the process manufacturing industries (4 hours plus 2 field trips)</td>
</tr>
<tr>
<td>Unit 2</td>
<td><em>Working Safely</em></td>
<td>Basic safety attitudes and approaches (4 hours)</td>
</tr>
<tr>
<td>Unit 2</td>
<td><em>Building Quality Into the Product</em></td>
<td>Say what you do and do what you say (12 hours)</td>
</tr>
<tr>
<td>Unit 4</td>
<td><em>Measuring Process Variables</em></td>
<td>The metric system and variables critical to controlling the manufacturing process (20 hours)</td>
</tr>
<tr>
<td>Unit 5</td>
<td><em>Transforming Matter</em></td>
<td>Basic chemistry for process technicians (20 hours)</td>
</tr>
<tr>
<td>Unit 6</td>
<td><em>Learning the Nuts and Bolts</em></td>
<td>Process manufacturing equipment, systems, and plant utilities (20 hours)</td>
</tr>
<tr>
<td>Unit 7</td>
<td><em>Controlling the Process</em></td>
<td>Basic principles of feedback control systems (8 hours)</td>
</tr>
<tr>
<td>Unit 8</td>
<td><em>Maintaining Sterile Processes</em></td>
<td>Working in aseptic manufacturing environments (12 hours)</td>
</tr>
<tr>
<td>Unit 9</td>
<td><em>Growing Living Cells</em></td>
<td>Bioprocess manufacturing principles and operations (12 hours)</td>
</tr>
</tbody>
</table>

Source: www.ncbiotech.org

From the perspective of students completing the training regimen, the NCCCS BioWork program may be deemed a success. Despite the strict test score and attendance requirements, student attrition is quite low and roughly 85 to 90 percent of trainees complete the program. However, there are many qualified students who are unable to participate in the program due to limited availability of seats. For example, the Wake Tech version of the BioWork program is offered only twice per year. Each offering consists of one day and one evening class with 16 seats each. This limited number of slots regularly eliminates otherwise qualified candidates from training. For example, competing for the 32 seats in the Spring 2005 course were no less than 200 potential trainees. While it is true that some of these would be screened out by testing requirements or required status as a displaced or unemployed worker, many other qualified candidates will simply be shut out. Qualified applicants are admitted on a first-come, first-served basis and program official indicate that waiting lists to get into BioWork classes are both long and ubiquitous.\(^5\)
One firm that has been using BioWork for several years, the Novo Nordisk facility in Clayton, NC, reported satisfaction with the program and is looking forward to its involvement with BioNetwork as a result of this experience. From the perspective of students that have completed the Wake Tech BioWork program, perceptions of program success are mixed. Approximately 75% of the students that completed the program from 2002 to 2003 and attended the optional HRD component reported that they were employed in the industry. The percent of students employed in the industry falls to 30% when those students that did not complete the HRD component are included. Such a precipitous decline may indicate that additional effort and resources be devoted to the HRD component.

Compounding the difficulties of limited space in BioWork classes is a looming funding crisis. The federal grant that has been funding the expanded, integrated activities of the program will expire in Spring 2005. This loss of federal dollars, combined with the NEIT funding cuts of over $3 million from 2000 to 2003 suggests that the continued success of the BioWork program may require additional funding sources be identified.

One such funding source may be the Golden Leaf Foundation. The importance of Golden Leaf funding to the emerging BioNetwork has been alluded to earlier and will be discussed in more detail below. Golden Leaf, however, also plays an important role in BioWork initiatives at many NCCCS institutions. For example, Alamance Community College recently received a grant of over $50,000 to develop a continuing training program targeted specifically toward upgrading the skills of BioWork graduates. Similarly, Piedmont Community College recently received a grant of $56,000 to upgrade its instrumentation training facilities for its lab tech program. Given Golden Leaf’s obvious focus on building workforce expertise in biotechnological manufacturing processes, and its demonstrated willingness to fund BioWork and BioWork-related programs, it may be that this funding source could be successfully mined to continue the success of the BioWork Initiative.

BioNetwork: a Cluster-Based Approach to Biotech Competitiveness

The BioNetwork Design

Just as agriculture declined and manufacturing rose fifty years ago, North Carolina manufacturing is now on the decline and biotechnology is becoming part of the state’s economic
strength. North Carolina boasts the third biggest biotech industry in the US and employs 5,000 in biomanufacturing alone. In 2003, NCCCS President Martin Lancaster reported that there were with a total of 32,000 employed in 228 bio-related companies that produce over $7 billion in annual revenue. In a May 2003 report to the NCCC System and the Golden Leaf Foundation, by Regional Technology Strategies, Inc. (RTS), the authors outline a plan for the BioNetwork, a new cluster-based system of biotech centers in the NCCC System funded by Golden Leaf. Building on the legacy of BioWork, BioNetwork is designed to align the state’s workforce with biotech employers’ needs. The report estimates the demand for biotech workers and skills, assesses the NCCC System’s capacity to fulfill that demand, and then recommends the BioNetwork as a way for the system to better meet that demand.

In the report, RTS predicts that the biotech industry is likely to grow in North Carolina due to a projected increase in national demand for biotech products and because of the state’s existing biotech cluster in the Triangle area. However, the report found the system deficient in terms of its ability to meet increasing demand for biotech workers and skills. RTS notes that employers who used BioWork regarded it as a good baseline training program in biomanufacture, but few employers knew enough about the program to use its services. Additionally, the NCCC System lacked adequate training facilities and equipment for students. The report also noted inappropriate recruiting strategies for biotech students (most are continuing education students, but recruitment was focused on high school graduates) and a lack of systematic evaluation or tracking system for biotech graduates.

In terms of matching skills to employer needs, the report cites a discrepancy between existing NCCC graduates’ training and needed skills (though some of this could be stigma against prospective employees with two-year degrees, as opposed to those with bachelor degrees). For example, over half of the biotech employers surveyed said employees with Associates Degrees were deficient in writing skills, problem solving skills, communication skills, and good manufacturing practices (GMP). However, many biotech employees felt that they were not using their training in their jobs and also did not have the opportunity to upgrade their skills.

In light of these findings, the authors recommend the creation of a “BioNetwork”—an integrated system of biotech training colleges centered on the concept of industrial clusters. The BioNetwork concept is a continuation of previous RTS research on aligning community colleges with a cluster strategy, which on the one hand links cluster success to a workforce with
appropriate skills within commuting distance, and on the other links clusters with providing high-road jobs that have a career ladder for local workers.\textsuperscript{60} Structuring community college offerings around industry clusters, rather than around individual industries or technologies, is a relatively new specialization strategy that emphasizes innovation as an economic development goal, and is perhaps most appropriate for a knowledge-based economy.\textsuperscript{61}

According to Stu Rosenfeld, a principal at RTS, one of the major challenges with the BioNetwork project was creating a workforce development program oriented towards a cluster, while at the same time maintaining the dispersed accessibility of the NCCC System.\textsuperscript{62} In addition to noting that industries are unevenly dispersed, RTS also realized that not every community college could have the same level of services. Accordingly, the BioNetwork plan recommends a two-prong approach: first, a few lead schools should be established as centers for cluster-specific programs, including a BioNetwork Learning Center; and second, all system colleges would form their own creative and innovative programs based on their unique needs and capabilities, and their students would be able to access resources at the specialized schools. Focusing on the demands of the cluster, as determined by the cooperative efforts of an advisory board, individual BioNetwork centers, and client companies is a crucial guiding principle for BioNetwork.\textsuperscript{63}

As of May 2003, only seven NCCC System colleges offered biotech related programs, though many institutions had negotiated transfer agreements with these programs.\textsuperscript{64} The BioNetwork plan calls for a much more comprehensive, systematic program, including: A BioNetwork Learning Center with bioprocessing equipment and other dedicated space; a mobile learning lab; a BioNetwork management office at the NCCC System Office; Cluster Centers at select colleges; a Biotech Industry Cluster Skills Council/Advisory Board; a Biotech Innovation and Improvement Fund for program development at colleges; a Biotech Capital Equipment and Facilities Improvement and Expansion Fund; and a system for program evaluation.

The BioNetwork Learning Center (BLC) would house some program administration, special courses, equipment and special classrooms, distance learning facilities, the BioWork, BioQuality, and BioOps (a new program to introduce the bio-production environment) and culminating courses for Associates Degrees. The BLC would also house training programs for industry clients under the FIT and NEIT programs, or other training needs; it would provide some biotech incubation space; and it would provide training for dislocated workers, faculty, and staff in BioNetwork related programs.\textsuperscript{65}
In addition to the BLC, the proposal recommends at least five Cluster Centers at specified colleges. Two of these centers would be “Functional Centers” that would offer services to support BioNetwork degree and certificate programs: one would focus on development short courses and training programs, while the other would serve as a business incubation center and would provide expertise on the industries linked to biotech. The other three centers would be “Sector Skills Centers” that would respectively focus on Bioprocessing, General Pharmaceutical Manufacturing, and Agricultural Biotechnology. These centers would be responsible for cluster-specific curriculum development, monitoring industry trends, marketing the program, supporting other colleges with cluster-related and collaborating with other departments to develop bio-related support courses.66

**Fig. 9. BioNetwork System**

**Description of BioNetwork System** (Source: Regional Technology Strategies, Inc., *Meeting the Long-Term Skill Needs of North Carolina’s Biomanufacturing Industries and Biotechnology Cluster*, May 2003, page 57)

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**BioNetwork: Funding and Current Status**

In the summer of 2004, BioNetwork garnered a grant of $8.7 million from the Golden Leaf Foundation to implement the above plan, which was part of a $60 million commitment from
the foundation to support the biotech industry in the state. Industry is also contributing in-kind support valued at $700,000 to the BioNetwork program. BioNetwork recently announced the following grants to the Centers, which account for $4.3 million of the total money committed:

- **$320,000** for a collaboration of Forsyth Technical Community College and Guilford Technical Community College for a general pharmaceutical manufacturing skills center.
- **$320,000** to Robeson Community College for an agricultural biotechnology skills center.
- **$320,000** for a continuing education and short course development center at Gaston College.
- **$320,000** for a BioNetwork competitiveness center at Asheville-Buncombe Technical Community College.
- **$1,115,817** for the BioNetwork Central Learning Center Consortium, which is made up of seven community colleges in the Research Triangle Region to support college training and education at a facility planned at N.C. State University.

Golden LEAF also approved **$339,288** for 10 biotechnology innovation funds. These grants will be used for updating or creating new curricula, faculty development, student recruitment and retention, and initiatives to expand outreach and access to rural areas. Golden LEAF also approved **$1,271,024** for 13 biotechnology equipment and facility enhancement grants. These funds will be used to purchase new or used equipment, laboratory supplies, upgrade outdated equipment, improve facilities and prepare community college space for newly acquired equipment needed for hands-on training.

**BioNetwork Implementation Progress**

As of December, 2004 BioNetwork is still in the early stages of a multi-year implementation process. Three centers at community college campuses have opened with the remainder expected to begin operations in the next few months. Presently in operation are the BioEducation Center at Gaston Community College, the BioProcessing Center at Pitt College, and the BioEnterprise Center at Asheville-Buncombe Technical College. Planning is also ongoing for the BioManufacturing Training and Education Center (BTEC) which eventually will be housed on the North Carolina State University Campus, but is presently looking for an interim
facility. Still to come are the Pharmaceutical Center and the BioAgriculture Center which may be open by the end of the year.

**BTEC: The BioNetwork Learning Center**

A landmark development in the ongoing implementation of the BioNetwork Learning Center (also known as the Capstone Center) was the recent hire of Dr. Lin Wu who formerly served as the president and chief operations officer at Fresenius Kabi. Dr. Wu has been charged with making the earliest faculty hires for the center as well as searching for an interim facility while the Capstone Center is being constructed. The center, expected to be roughly 96,000 square feet, with a 16,000 square foot aseptic fermentation facility, will be on the campus of North Carolina State University and is expected to open in 2007. In the meantime, the Center is looking for an interim facility within the Research Triangle region.

At a December 3, 2004 meeting of the chief academic officers of seven Triangle-area community colleges, Dr. Wu presented an update on the progress of the Center, whose offices for the moment are on the campus of Wake Technical College in Raleigh. Since being hired to run the Learning Center, Dr. Wu has met extensively with industry leaders to determine the precise nature of their training needs. He stressed repeatedly that biotech firms are the primary customers in the BioNetwork and that meeting their needs is crucial to the success of the program. He also explained that local biotech firms are likely to fall into one of three general industry categories: pharmaceuticals, traditional bio-manufacturing, and recombinant DNA processing. The Center has formed an advisory board that includes representative from firms in all three of these categories and these individuals will play a significant role in the shaping the Learning Center’s curriculum.

Though the educational offerings will eventually expand to cover many facets, industry representatives were largely in agreement over which programs should be offered first, as determined at a recent Advisory Board meeting. The course most requested by representatives was “Elements of Bioprocessing” which provides an overview of the basic concepts involved in safely disrupting a cell membrane and filtering human protein. Two other courses, “Elements of Aseptic Manufacturing” and “Clean Room Operations” were also requested by industry and will be among the first courses offered. Both of these courses deal primarily with issues of safety and cleanliness which are essential to biotech operations.
Because BioNetwork courses are considered part of Continuing Education rather than a degree-based curriculum program, the colleges will have significant flexibility over course scheduling and lengths. Still, most continuing education programs have traditionally required several weeks for completion. The BioNetwork course, by contrast, will likely involve eight to ten hours of classroom instruction with an additional lab component (although it is likely there will be multiple levels of course lengths offered, depending on depth of training required and time available). The quick turnaround has been deemed crucial by firms which cannot afford to be without their employees for extended periods of time. BioNetwork officials, therefore, needed to adjust their original plan for three-week courses and offer a more concise option.

Questions from the representatives of the community colleges generally concerned practical implementation issues. At present, it is expected that courses will have the usual Continuing Education enrollment costs of $55-60 per course, though costs to firms for customized training will vary. College representatives were also eager to collaborate with their local economic development and workforce development officials in using the center to aid efforts to recruit new biotech firms to the region. They requested printed materials and brochures to be used in marketing activities and are awaiting the rollout of a new BioNetwork website.

**The BioNetwork Bus**

Another component of Dr. Wu’s work has been coordinating the organization and eventual rollout of the BioNetwork bus which will be a mobile training facility equipped to visit biotech firm locations, rural community colleges, and high schools through the state. Though the bus is extremely popular with the state legislature and the Golden Leaf Foundation – key funding sources that must be continually appeased – industry executives have offered a mixed reaction. An executive from Novo Nordisk, for example (as related during the December 3 meeting), has told Dr. Wu that the firm sees no real use for the bus, which seems to also be the general consensus among local firms. Only one firm, Wyeth, which will soon need to train 300 new employees in a short period of time, indicated interest in using the bus. Because of the tepid interest from industry, the bus is most likely to be used for traveling “gee-whiz” experiments at high schools and community colleges, designed to get prospective BioNetwork students interested in the field without going into great depth in its teaching.
Presently, the BioNetwork is taking bids on construction of the bus’ shell which is expected to cost somewhere around $350,000. It is not expected to be ready to operate until 2006 at which point it will need to be outfitted with the necessary equipment needed to run its training and education programs. Because this development is likely to coincide with the opening of the Learning Center, Dr. Wu is hopeful that he can outfit the bus with equipment from the interim facility, which is scheduled to open in early 2005.

**The BioEducation Center at Gaston College**

Operating largely independently of the BioNetwork Learning Center is the BioEducation Center at Gaston Community College. Though none of the community college representatives at the consortium seemed to have a strong sense of its workings or plan, the BioEd center – funded with a $320,000, three-year grant from Golden Leaf - is charged with developing short courses and training programs to be used at multiple community colleges throughout the BioNetwork system. In his first three months on the job as director of the BioEd center, Dr. David Brigham has been working on the development of the BioNetwork’s first educational module, which he says will cover a broad range of biotech basics rather than specific aspects of the industry. He states that the intent of this module is to prepare students for a variety of lab positions with a general educational framework that will focus largely on FDA regulations concerning safety and the laboratory environment. Though most biotech training sources, both within and independent of firms, have traditionally needed nine to twelve months to give students basic competence in lab procedures, the goal of this module is to condense this process into about three months. In addition to obvious benefits of saved time, this can also bring about tremendous cost advantages for firms that are used to longer, more expensive training options. Dr. Brigham states that in other states, firms commonly pay up to $75,000 per employee for basic training. Though the precise costs of this program have not yet been determined, they are certain to represent a dramatic decrease from that figure. If all goes well, the first module will be offered in March, 2005. Three more modules will be developed in later in the year and will offer greater depth into targeted industry skill sets. Eventually the center will also work on distance learning programs that will utilize internet and satellite-based training.

Dr. Brigham has also been working on forming an advisory board of industry leaders with whom he will collaborate on curriculum development. From previous experience in other
states, Dr. Brigham believes multiple iterations of feedback between the BioNetwork and the firms will be needed to create an optimized training program that best serves all needs. He expects the educational modules will need to be offered and refined at least three times before the program can be truly efficient, and that continual feedback will be required to keep up with changing industry trends. Even so, he is confident that the early rounds of training will still represent a significant improvement over existing options.

Conclusion

While the prospects for BioNetwork look promising, a few words of caution are in order. First, although the original plan emphasizes that BioNetwork is more about building a “high road” skills training program than firm recruitment, the program will likely still be used by local economic development practitioners as part of incentives packages that many argue ultimately take resources away from regions. Secondly, and perhaps most importantly, even biotech is not impervious to the danger of outsourcing. Pharmaceutical manufacture can occur almost anywhere, and with labor costs relatively high in the US, much of this business may well relocate overseas. Finally, because of shifts away from manufacturing in North Carolina, jobs added by biotech are unlikely to offset job losses the state has seen in recent years. However, to the extent that much of the biotech value chain is “sticky,” or geographically rooted around industry clusters, the BioNetwork program will be both an important component in keeping North Carolina’s cluster competitive and in creating high-road opportunities for the state’s workforce.
Appendix 1: NCCCS Value Chain

Appendix 2: List of Interviews


Giddens, Danny. Policy Associate, North Carolina Department of Commerce, Commission on Workforce Development. Telephone Interview, 30 November, 2004


Notes

2 Since 1991, the system has also administered the Center for Applied Textile Technology.
7 It is important to note that North Carolina is home to the oldest public university system in the nation, founded in 1789, with 16 campuses. The community college system fits into these campuses in that its students could transfer to a UNC campus after completing the two-year degree.
18 Ibid.
19 Ibid.
28 Ibid.
40 Ibid
47 BioWork Presentation at Wake Tech, Cary, NC 12-1-04
48 Ibid
49 Ibid
51 BioWork Presentation at Wake Tech, Cary, NC 12-1-04
52 Sharon Pastarik. Human Resources Director, Novo Nordisk, Clayton. Telephone interview. December 2, 2004
53 Ibid.
55 Woodruff, William. Department Head, Biology/Biotechnology, Alamance Community College. Phone interview. December 2, 2004
56 Seamster, Deborah. Director, Industry Training Services, Peidmont Community College. Phone interview. December 2, 2004
61 Ibid.: 7.
63 Regional Technology Strategies, Inc. 2003: 56.
64 Ibid.: 62.
65 Ibid.: 66.
69 Ibid.
70 The bulk of the information presented in this section was acquired through our attendance of a meeting at Wake Technical College. At this meeting, attended by representatives of seven triangle area community colleges, Dr. Wu gave a detailed presentation on the status of the BioLearning Center and BioNetwork Bus.