

2006-356: A WORK FORCE DEVELOPMENT SUCCESS: DISTANCE BASED BS PROGRAM IN BIO MANUFACTURING

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A Work Force Development Success: Distance Based BS Program in Bio-Manufacturing

Introduction

A well-trained workforce is an essential factor when manufacturers analyze and decide where they will locate, expand or maintain production facilities. Bio-manufacturing, which includes diverse areas such as biotechnology, pharmaceutical and life sciences industries, is a growing and competitive area that has the potential to replace some manufacturing operations in many states that have been lost to global economics. To maintain a competitive position for this industry segment, North Carolina implemented the BioNetwork initiative which connected community colleges across the state to provide the specialized training, curricula and equipment needed to develop a world-class workforce in bio-manufacturing.

Although the BioNetwork provides a focal point for development of the North Carolina bio-manufacturing work force, its benefit could be enhanced by creating a formal pathway for associate degree graduates to continue to a baccalaureate program. To complicate the situation, many BioNetwork former and current students are working adults and are geographically bound due to family and employment commitments. To address this need, East Carolina University and the North Carolina Community College System partnered to create a Bachelor of Science Degree in Industrial Technology with a concentration in Bioprocess Manufacturing that would be delivered through the ECU distance education network. Students in this program complete the first two years of a bio-manufacturing curriculum at one of several participating community colleges in the North Carolina BioNetwork and obtain an associate degree. The students will then have the opportunity to continue their studies through the ECU distance learning network and complete the aforementioned Bachelor of Science Degree.

This paper examines the bio-manufacturing industry and the development of the North Carolina BioNetwork. It then explains how the 2+2 degree completion program was developed, the identification of learning objectives, and the process of building a collaborative relationship with a community college system.

Bio-manufacturing Industry

The United States Department of Labor Employment and Training Administration reported that the biotechnology industry would have an employment level of 814,900 by 2007¹⁰. Not only will there be a rise in biotechnology jobs, but bio-manufacturing positions excellent pay helps with the recruitment of a workforce. Annual salaries for entry-level technicians start at \$25,000 to \$30,000 and can progress to \$50,000 in as little as five years⁸. The average salary for all

biopharmaceutical manufacturing jobs is \$70,567 in North Carolina. A recent study found “Biotechnology occupations are attractive because they are located across the nation, provide professional work environment, and include a range of higher wage levels above many traditional occupations”⁷.

The economic impact of bio-manufacturing is significant. For example, for each biotechnology job created, four other direct or indirect jobs are created. Obviously, this constitutes a clear economic impact to be gained from this growing industry. For example, biotechnology companies currently generate about \$3 billion in annual revenue in North Carolina and revenues for the projected biotechnology industries in 2007 are \$24 billion. Additionally, North Carolina biotechnology employees represent a payroll of \$1.7 billion and \$100 million in state income taxes each year^{8, 2}. This growth of the bio-manufacturing sector as an engine for economic development must be fueled by the need for quality workers from the Ph.D. level scientist down to the technician and production line employee⁷. The next section discusses the BioNetwork as a strategic tool to help development of the needed bio-manufacturing workforce.

Development of the BioNetwork

North Carolina is a leader in biotechnology and bio-manufacturing, ranking third nationally in the number of bio-manufacturing companies, second in the number of agricultural research interests, and first in Contract Research Organizations (CRO’s). In total, North Carolina has 350 bioscience and related companies in the state, employing about 45,000 people. With a growth rate of 10-15% per year, the biotechnology industry in North Carolina will grow from 45,000 to 125,000 trained workers by the year 2025⁸. Consequently, North Carolina is a prime region for attracting new and expanding industries and the creation of a vehicle such as the BioNetwork initiative was an essential and visionary step to continue to develop a well-trained workforce to strengthen this growing industry sector.

Bio-manufacturing has many unanticipated spin-off industries and will impact across other economic sectors. For example, there has been a great deal of interest recently in the medicinal benefits derived from extracted compounds in various agricultural crops. These extracts, sometimes referred to as nutraceuticals, can provide health benefits ranging from controlling hypertension, heart and kidney disease and even various forms of cancers. One example of such a spin-off company is the new North Carolina Research Center in Kannapolis. This facility plans to explore the compounds extracted from berries and other crops and how they can better the health of people worldwide⁵. This will result in significant synergy with agricultural interests which contribute in excess of \$6.5 billion to North Carolina’s bustling agribusiness sector⁹.

Contract Research Organizations (CRO’s) are another example of a spin-off industry. They are a vital part of the regulatory process and the success of many bio-manufacturing companies in North Carolina. As more and more products are developed within the state, the expertise provided by CRO's will be needed to effectively bring those products to market. The success of new companies and products often depends on the availability of these CRO’s to reduce the amount of time, cost and effort that would normally be a tremendous undertaking for a company to do on its own. For example, consider the extensive effort and resources needed by a company

to effectively manage the clinical trials of new pharmaceutical products to obtain the product approval needed for sale.

The North Carolina Community College System (NCCCS) began the BioNetwork initiative in 2002 and had been in a constant state of growth. The number of students in this program has been increasing over the years with 511 students in 2002-2003 year, 722 students the next year and in 2004-2005 there was a grand total of 874 students enrolled in one the biotechnology related AAS programs. At Pitt Community College this current year, there are 45 students in the program and 10 are going to continue their education at ECU through the new concentration in bioprocess manufacturing.

Students can enter into the biotechnology education from one of 44 community colleges in the state through a 1+1 program that involves completing the first year of courses that are mostly general education and science courses. After the first year, the student attends one of the 14 community colleges that offer AAS degree programs in some form of biotechnology. These degrees include Biotechnology, Chemical Technology, Bioprocess Technology, Clinical Trials, Nanotechnology, Chemical Process Technology, Laboratory Technology, Agriculture Biotechnology and Industrial Pharmaceutical Technology. For instance, a student could attend Craven Community College in New Bern, North Carolina for their first year and then transfer to Pitt Community College (AAS Biotechnology) for their second year (see Figure 1). Pitt Community College is a hub for the biotechnology area.

The BioNetwork also consists of six centers of excellence located throughout the seven economic development regions in the state to facilitate this training and education. However, each Center's focus is not regionalized, but focused on a key aspect of biotechnology. This helps to create a true statewide initiative rather than simply a regional training situation. The six centers of excellence are:

- BioNetwork Bioprocessing Center, located in the Northeastern/Eastern region.
- BioNetwork BioAg Center, located in the Southeastern region.
- BioNetwork BioBusiness Center, located in the Western region.
- BioNetwork Biopharmaceutical Center, located in the Piedmont Triad region.
- BioNetwork BioEd Center, located in the Charlotte region.
- The Capstone Center, located in the Research Triangle region.

Each center has its own core of faculty expertise comprised of former bio-manufacturing industrial practitioners and executives who specialize in areas that support their mission and objectives of the center. Working together as a true network, the centers can call upon each other to assist in solving problems and developing the appropriate training as needed for newly recruited companies and expanding industries within the state. This base of industry experience makes the network a value-added resource for the entire state when called upon by community colleges and universities to educate and train the workforce for this dynamic industry.

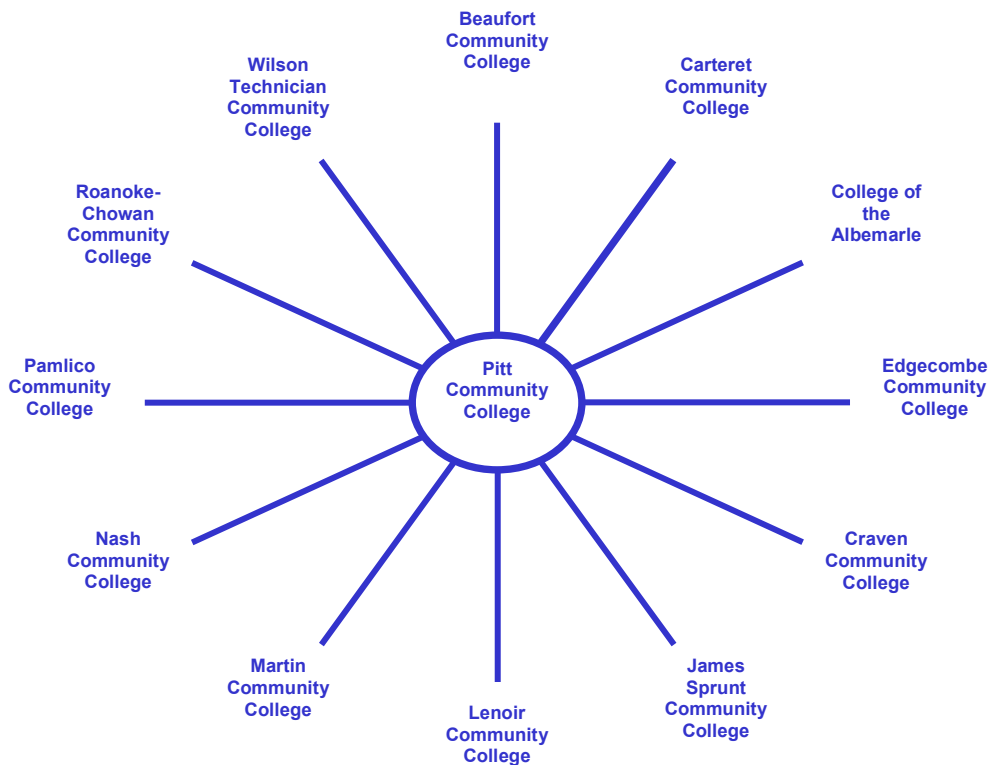


Figure 1. Community Colleges Participating in the 1+1 Program with Pitt Community College.

A majority of workers in the pharmaceutical and bio-manufacturing industries have only an Associate in Applied Science Degree⁸ or less; however, there is a need for quality workers from the levels of technicians up to Ph.D. level scientists⁷. The BioNetwork created many collaborative opportunities to develop the workforce in North Carolina, but lacked a formal pathway to continue education for students in a four-year institution. To develop this element, a team from the BioNetwork approached the Department of Technology Systems at East Carolina University about collaborating to develop a new concentration to meet the needs of these students. ECU’s Department of Technology Systems and the Division of Continuing Studies have led in this area by creating an Associate in Applied Science (AAS) degree which supports the baccalaureate degree completion for community college.

BS Degree Completion Issues

The institutions comprising the North Carolina Community College System (NCCCS) offer a wide range of Associate in Applied Science (AAS) programs in technology driven fields. Together, these programs represent a major element of the state’s workforce development capability. A significant issue in developing the potential of students in these programs is that there is a general lack of coordination and communication on how the AAS degrees leads to completion of a baccalaureate degree. The top students in these AAS programs do not have a

clear pathway to continue their career development to include a baccalaureate degree and studies beyond this level. The number and variety of these AAS programs, the different approaches taken by each college, and the individual nature of each student have combined to produce a situation that limits opportunities for these programs. This, in turn, limits the market appeal for these programs and a reduction in recruitment and student numbers. The net result is reduction in work force capability that, among other things, is detrimental to the North Carolina economy.

An approach is needed to alleviate this road block. Distance education has been used to meet these needs by offering courses online. Online education gives the student the flexibility to take the course at a time and place that is convenient to their lifestyle. The Division of Continuing Education at ECU has been a leader in this area: “East Carolina University has been a leader in distance education in North Carolina for more than fifty years. ECU recognized the potential of online learning early and was among the first schools in the nation to develop and offer a degree completely over the Internet. Since then, the university has created more than 50 degree and certificate programs in health, education, technology and other areas”¹. As a result of this vision, East Carolina University’s distance education enrollment far surpasses the other 15 universities in the University of North Carolina System⁶. A recent report described the financial impact of this major program by indicating that of the \$14 million in allocation by the UNC system to state higher education institutions for distance education this year, ECU received \$11 million of it for the university’s 4000 distance education students. The Department of Technology Systems has helped East Carolina University lead the way with over 710 distance education students in 2005. The Department of Technology Systems offers five graduate programs fully online and also one undergraduate degree and continues to develop more online courses to meet the needs of the students and workforce development.

The collaboration in North Carolina between industry, community colleges and the university to provide the educational and workforce development for the biotechnology industry mirrors the goals set by President Bush’s High Growth Training Initiative⁷. The United States Department of Labor Employment and Training Administration stated “Partnerships are the foundation of this initiative ... Industry representatives define workforce solutions ... Community colleges and other education providers assist in developing courses and curricula to build skills and train workers”¹⁰.

Bioprocess Manufacturing Curriculum Development and Planning

The bioprocess manufacturing concentration contains 42 hours of technical content (see Table 1). Of these 14 courses, five courses are common among all concentrations in the Bachelor of Science in Industrial Technology degree and include topics such as quality, technical writing and industrial safety. This concentration also utilizes other technical courses from the Manufacturing and Industrial Distribution concentrations.

Bioprocess Manufacturing Concentration Technical Coursework

However, there are five new courses that were developed specifically for the bioprocess manufacturing concentrations:

- Microbiology for Industrial Processing
- Engineering for Food Safety and Sanitation
- Separation Techniques for Industrial Processing
- Waste Treatment Techniques for Industrial Processing
- Quality in Regulatory Environment

The new courses developed for the bioprocess manufacturing concentration build upon the educational knowledge developed at the community colleges. The Microbiology for Industrial Processing course covers microbiological and cell growth techniques utilized by the bioprocessing, chemical, food, or other industries. The Engineering for Food Safety and Sanitation discusses different techniques for the sanitary design of food plants and food plant equipment. Numerous separation techniques utilized by the bioprocessing industry are covered in the Separation Techniques for Industrial Processing course. The Waste Treatment Techniques for Industrial Processing course gives the students knowledge with waste treatment processes utilized by the bioprocessing, chemical, and food industries. In the Quality in Regulatory Environment course, the students learn about current Good Manufacturing Practices (cGMP) and other quality processes utilized by the bioprocessing and chemical industries.

Table. 1 Technical Coursework.

Technical Coursework
ITEC 3290 Technical Writing
ITEC 3300 Technology Project Management
ITEC 3800 Cost and Capital Analysis
ITEC 4293 Industrial Supervision
ITEC 3200 Introduction to SPC
ITEC 3292 Industrial Safety
ITEC 4300 Quality Assurance
ITEC 4150 Microbiology for Industrial Processing
ITEC 4250 Engineering for Food Safety and Sanitation
ITEC 4350 Separation Techniques for Industrial Processes
ITEC 4450 Waste Treatment Techniques for Industrial Processing
ITEC 4550 Regulatory Environment Quality in Industrial Processing
Approved Technical Elective
Approved Technical Elective

The Department of Technology Systems worked with representatives from the BioNetwork to develop these upper level courses that will build upon the knowledge that they will gain from their associate degree. These courses and the other technical courses are offered fully online. The department is also arranging an information session with all the community colleges in North Carolina. This session will discuss the degree and educational pathway for community college students and an advisory board will be developed. This advisory board will include industrial representatives, economic developers, community college representatives, chemistry and biology representatives and students. The advisory board will be utilized to guide the concentration and all changes and modifications to it and the specific courses.

Summary

Collaboration and cooperation are the key ingredients for the success of this workforce development initiative. Bio-manufacturing is an emerging and growing area of manufacturing. To maintain a competitive position for this industry segment, North Carolina implemented the BioNetwork initiative which connected community colleges across the state to provide the specialized training, curricula and equipment needed to develop a world-class workforce in the unique and emerging area of bio-manufacturing. East Carolina University and the North Carolina Community College System partnered to create an educational pathway for these community college students through the Bachelor of Science Degree in Industrial Technology with a concentration in Bioprocess Manufacturing. This degree will be delivered through the ECU distance education network which will meet the needs of working professionals in this industry. The partnership between East Carolina University and North Carolina Community College System provided a seamless transition for the students that finish with their Associates of Applied Science degree to continue their education at East Carolina University from wherever they reside.

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