Distance Learning in Engineering Technology at Western Carolina University: Celebrating Success and Looking Toward the Future

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Abstract – Distance education for engineering technology programs continues to face challenges in providing quality instruction equitable to resident on-campus programs. Western Carolina University has sought to insure the delivery of quality instruction by taking the baccalaureate engineering technology program on-site to regional community colleges. This paper will provide a brief historical overview of the evolution and delivery of technology based programs at Western Carolina University. Program curricula will be presented along with a description of articulation approaches with regional community colleges. Challenges encountered and opportunities for the future will be discussed.

Keywords: Distance education, distance learning, Engineering Technology curriculum, future directions.

BRIEF HISTORY

Growth as an Institution

Founded in 1889, Western Carolina University first served the Western North Carolina region as a semi-public high school. In 1905, the institution became Cullowhee Normal and Industrial School, whose stated purpose was to train teachers for the North Carolina public schools, and prepare workers for careers in industry [1]. During its normal years, the school grew to the equivalence of a junior college. In 1929, the institution was elevated to the baccalaureate level and renamed Western Carolina Teachers College. The addition of graduate degrees led to a further change in name in 1953 to Western Carolina College, and in 1967, the institution was granted full university status [2].

During the mid-1960's, growth in the manufacturing sector of the region created a need for technical and management skills to bridge an expanding gap. In 1965, new and expanded shop and laboratory space, and the creation of a B.S. in Industrial Technology enabled the institution to enhance course offerings to educate potential engineers, managers, supervisors, and technicians for employment in the region. A new facility was completed in 1971 that included state-of the art classrooms and labs in Graphic Arts, Drafting, Electricity/Electronics, Construction, Metals/Welding, Machine Shop, and Environmental Safety [3].

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Growth in Engineering Technology

Based on steady growth in manufacturing, coupled with the rise in high tech applications, the university established a Manufacturing Engineering Technology (MET) curriculum in 1977. The MET curriculum sought and was granted ABET accreditation shortly thereafter. In response to the need for more electronics personnel in the WNC region, a B.S. degree in Electronics Engineering Technology was approved in 1988. The Department of Industrial Engineering and Technology served the region well for over 20 years, until it was renamed the Department of Engineering Technology. Graduates with BS degrees in Industrial Technology, Manufacturing Engineering Technology, Electronics Engineering Technology, and Industrial Distribution were actively recruited and employed by regional industry. However, in recent years, these traditionally strong programs began to experience problems of low enrollment, resource dispersion, and less relevance to industry needs due to a downturn in the manufacturing sector of the economy. This trend resulted in part, from global economic factors, outsourcing of manufacturing and high tech jobs, and niche competition [4].

In 2002, as a result of regular program assessment, faculty in the Department of Engineering Technology at WCU began to detect a downward trend in enrollment. Faculty and administrators made the decision to develop a new program that would offer traditional core engineering technology courses coupled with courses that broaden the scope of the curriculum through a product development systems approach. The new curriculum would no longer specifically target traditional manufacturing markets, but would focus upon preparing students to respond to the rapidly changing industrial scene. The BS in Engineering Technology is currently preparing students for employment in the rapidly changing manufacturing and public service sector in Western North Carolina.

Development of Distance Programs

In the mid-70's, it became apparent that not all students who needed technical degrees were being served. With the end of the Viet Nam war, many veterans were returning to the workforce under prepared. Many had earned educational assistance through the GI Bill. Western Carolina University responded to these non-traditional students with the development of the "in-service" program, a curriculum designed to award the BS in Industrial Technology degree on weekends. That led to the first "distance" program in Manufacturing Engineering Technology in the Morganton/Hickory area of North Carolina in the early 80's. That program, along with Electronics Engineering Technology was offered in Asheville, NC soon thereafter.

CURRENT STATUS

Rationale for Distance Learning

Western North Carolina has been particularly hard-hit by layoffs due to the increased globalization of furniture, textiles, heavy metals and other traditional manufacturing. Industry in Western North Carolina has had to undergo significant changes due to those global economic factors and the subsequent loss of thousands of manufacturing jobs between the years of 1999 and today [5]. In April of 2002, North Carolina had the third highest unemployment rate in the country and 50,500 fewer people were employed in manufacturing than in 2000 due to plant closings and layoffs, a problem reported as "near crises proportion [5]." In 2002, the total employment in North Carolina decreased by 91,100 jobs [6]. Many counties in Western North Carolina had not experienced such dire economic conditions since the Great Depression [7]. Job loss has continued and the current unemployment rate for the 25 counties in Western North Carolina ranges from 3.67% to 9.0%. The average for the region is 4.8% [8].

The current economic crises, coupled with the university's long-standing commitment to industry in Western North Carolina, led the university's chancellor, Dr. John Bardo, to establish a campus-wide mandate for engagement with regional business and industry. Engagement activities should focus on sustaining regional businesses and boosting entrepreneurial startups through innovative and creative projects that develop intellectual capital and technology transfer [9, 10, 11]. Additionally, current research suggests that creative and innovative engagement projects be coupled with student learning to strengthen the competencies of ET graduates [12].

The main vehicle for extending the university's offerings to Western North Carolina's unskilled or underskilled workforce is through the current distance learning curriculum in Engineering Technology. After the development of the new on-campus Engineering Technology curriculum in 2002, a new distance curriculum also emerged.

Western Carolina University had built a strong reputation for service to the region's workforce by offering a traditional face-to-face, site-based curriculum since the inception of off-campus offerings in the early 1980's.

Program Components

The current off-site program in Engineering Technology enables place-bound (non-traditional) individuals employed in business, industry and government-related occupations to pursue their four-year degree through part-time evening study. The program combines the benefits of the established on-site Engineering Technology curriculum, with the convenience of locations near the students' homes. Instructional delivery is primarily through live face-to-face classes supplemented by online components and interactive video. The intent of the degree program is to provide an appropriate educational experience that will qualify graduates for career advancement. Western Carolina currently has three off-campus locations for its Engineering Technology distance program including Asheville, Spindale, and Hickory/Morganton. Incedentally, these locations have been particularly hard-hit by the recent economic downturn.

Applicants to the off-site Engineering Technology program must have an Associate's degree in Pre-Engineering or an Associate of Applied Science in an Engineering Technology. The student must complete a total of 124 semester hours of study, including the university's 42 hour liberal study component, math and science program requirements, and 45 hours of upper and lower level engineering technology classes. Specific curriculum requirements are:

Liberal Studies Requirements **42 hours**

May be taken at a local community college

C1: ENGL I	3 hours
C1: ENGL II	3 hours
C2: MATH	3 hours
C3: Oral Communication	3 hours
C4: Wellness	3 hours
C5: Science	3 hours
C5: Science	3 hours
P1: Social Science	3 hours
P1: Social Science	3 hours
P3: History	3 hours
P4: Humanities	3 hours
P5: Fine Arts	3 hours
P6: World Cultures	3 hours
First Year Seminar	3 hours

Upper Level Requirement (one perspective must be 300-400 level)

Program Requirements **19 hours**

Trigonometry
Statistics
Calculus
Physics
Chemistry

Transferred Lower Level Engineering Courses **18 hours**

Must include Engineering Graphics and Engineering Materials

Transferred Upper Level Engineering Courses **12 hours**

Must include Statics/Strength of Materials and CAD/ 3-D Modeling

WCU Engineering Technology Courses **33 hours**

Must complete 11 classes of the following:

ECET 301	Electrical Systems	3 hours

ENGL 305	Technical Writing	3 hours
ET 331	Quality Systems	3 hours
ET 335	Safety Systems	3 hours
ET 349	Rapid Tooling and Prototyping	3 hours
ET 351	Engineering Analysis	3 hours
ET 362	Engineering Logistics	3 hours
ET 410	Advanced 3D Computer Modeling & RP	3 hours
ET 420	Polymer Technology	3 hours
ET 425	Metrology & Reverse Engineering	3 hours
ET 436	Engineering Economic Analysis	3 hours
ET 441	Power Transmission Systems	3 hours
ET 449	Advanced Rapid Tooling and Prototyping	3 hours
ET 461	Engineering Project Management	3 hours
ET 472	Integrated Control Systems	3 hours
ET 478	Integrated Systems Project	3 hours
Total		**124 hours**

The primary focus of the Engineering Technology curriculum is on engineered systems with a secondary focus on product development. The revised program should fit the new ABET program criteria by offering a strong core based on traditional ET courses coupled with a broad exposure to technology. The BS degree in Engineering Technology follows the program criteria for accrediting by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET) in the Manufacturing Engineering Technology field. As specified, the program consists of coursework that ensures that graduates have proficiency in materials, prototyping and modeling. The program is currently accredited under the old MET criteria and will be considered for reaccreditation in 2008 [ABET, 13].

THE ROLE OF COMMUNITY COLLEGES

The role of local community colleges is critical to the success of the off campus Engineering Technology curriculum at Western Carolina University. Applicants to the off-site Engineering Technology program **must** have an Associate of Arts or Associate of Science degree in Pre-Engineering or an Associate of Applied Science in an Engineering Technology. Additionally, the student will be given credit for 18 hours of lower level (100-level) engineering technology courses and 12 hours of upper level (200-level) engineering technology courses that were taken as a component of their 2-year engineering technology degree. All of the Liberal Studies requirements (with the exception of the upper-level requirement) may be taken through the community college system. In addition, all of the Program Requirements can be taken at the community college as well. The option to take courses locally provides a "win-win" opportunity for both students and the local community college. Students benefit by remaining employed and taking courses at times that best fit their schedules. Community colleges benefit from increased enrollment, which in turn, results in increased funding from the state.

There is an alternative to satisfying the 42-hour Liberal Studies requirement at the university. The University of North Carolina System (which includes Western Carolina University) and the North Carolina Community College System have agreed upon a "Comprehensive Articulation Agreement" that greatly improves transfer between community colleges and member institutions of the UNC system. The agreement is based upon legislation passed in the 1995 session of the North Carolina General Assembly through House Bill 739 and Senate Bill 1161 [14]. Through this agreement, students from any community college in North Carolina can satisfy the General Education requirements for any public university in North Carolina. Students who choose this route must satisfy the following components:

English Composition	6 hours
Humanities/Fine/Arts	9-12 hours

Social/Behavioral Sciences	12 hours
Natural Science/Mathematics	14-20 hours
Total	**44 hours**

In addition to all of the 58 community colleges in North Carolina, a number of North Carolina's Independent Colleges and Universities have signed similar agreements.

SUCCESSES, OPPORTUNITIES AND CHALLENGES

Recent success of the current curriculum indicates that students are taking advantage of the opportunities that are being provided through the off-campus Engineering Technology curriculum. In 2004, there were approximately 48 students enrolled in off-campus Engineering Technology locations. Today, there are 97 students enrolled off-campus. The program has seen particularly strong growth in the Hickory metro area. One reason for growth in that area is a strong partnership with Catawba Valley Community College and Western Piedmont Community College. WCU and these two colleges have formed transfer agreements, exchanged information, and established good relationships between the faculty and administration.

In 2005, another step was taken to form strong partnerships with the community colleges in Western North Carolina. An Articulation Conference was held on the campus of Western Carolina University to strengthen relationships among the partner institutions. At the first conference, seven community colleges were represented with 30 faculty members in attendance. In 2007, the third annual conference was held, with twelve colleges represented and 45 faculty members in attendance. At these conferences, community college instructors were provided an opportunity to review the curriculum and tour the facility. Transfer agreements between the community colleges and the university were also drafted at this time.

Successes and Further Opportunities

The off-campus Engineering Technology program continues to be successful and students continue to take advantage of offerings at distance locations. The potential for new students remains high in all areas of Western North Carolina. Success of the current program also hinges upon articulation and transfer of the student's 2-year degree. This articulation leads to a minimum of courses that need to be taken at the more expensive university. Students can take classes at the community college for $42 per hour as opposed to $81.29 per hour at the university. Potentially, a student would only need to take 33 hours of the more expensive classes through the university.

There has been a great deal of satisfaction in graduates of the program. Focus groups and advisory committee feedback indicate that graduates are promoted into engineering and/or engineering management positions as soon as they complete their degree. Current students also indicate a high degree of satisfaction in the quality of the instructors and the program as a whole. A common reason given for satisfaction is the traditional face-to-face delivery of Western's curriculum. At present, WCU is the only university in North Carolina to deliver Engineering Technology at a distance using live professors.

Challenges

While Western Carolina University has assisted many non-traditional students in the region, there have also been challenges. One of the major challenges to overcome has been to maintain alignment of the off-campus curriculum with the on-campus curriculum. Considerable progress has been made in offering all of the courses needed for graduation off-campus, but challenges still remain. The availability of tenured or tenure-track professor who are willing to teach off-campus is a continued concern. While most are willing to teach at a distance location (sometimes a 230-mile round trip), on-campus schedules often prevent it. There is also a very limited pool of personnel available for adjunct positions due to lack of experience and a relevant MS degree.

Another major concern is the availability of adequate facilities for laboratory courses taught at a distance. Newly formed partnerships with local industry and community colleges have improved the situation, but it is still necessary to require students to drive to campus for occasional Saturday sessions to complete laboratory requirements in some

courses. With fuel prices escalating (currently exceeding $3.00 per gallon), students will continue to have problems meeting the laboratory requirement.

The outlook for continued expansion of the Engineering Technology appears strong. While growth is indicative of success, it does present challenges. Classroom usage at the distance locations is often at or above capacity. Additionally, student service issues are more difficult to resolve due to the large number of students. The program director has 90-plus students to advise and communicate with on a regular basis. The addition of a faculty associate who could assist with recruiting, advisement, and transcript evaluation would greatly enhance the program.

It is imperative that the challenges that remain need to be converted into opportunities for improvement. One particular challenge involves the changing needs of the off-campus student. While the on-campus and off-campus curricula are similar, the needs of the on-campus and off-campus population are totally different. On-campus students, at an average age of 20, have very limited technical knowledge and skills. Typically, off-campus students average 35 years of age, possess a 2-year degree in an engineering technology, and have been working in industry for an extended time. The needs of the two groups of students are quite different, and in the future, the two programs should change to meet their needs.

FUTURE DIRECTION

In order for the success of the off-campus Engineering Technology to continue, adequate resources must be committed to sustain and further grow the program. One of the major factors for its success is the personal interaction between advisors/faculty and the students. The face-to-face delivery of instruction by tenured WCU faculty ensures a constant link to the main campus. Students believe they are getting the same quality instruction as their on-campus counterparts. Advisors regularly schedule visits to their classrooms and maintain regular office hours at each location. In the future, consideration must be given to extend current faculty resources by possible development of online delivery. Some experimentation with web-based interactive video has been successful. Additional courses in the future will be pursued.

The major challenges described should drive the future direction for the Engineering Technology distance curriculum. The differences in need for the off-campus student versus the on-campus student may indeed require program changes. While the on-campus and off-campus curricula are similar, the students and their needs are much different. Resident students have very limited technical knowledge and skills, while the distance students posses work experience and skills that are highly technical. The difference in need may necessitate an alternate emphasis for the distance program.

SUMMARY AND CONCLUSION

As a part of its mission, Western Carolina University has served the western region of North Carolina since its inception in 1889. In response to significant changes in Western North Carolina's economy on recent years, Western's commitment to industry and its workforce has never been stronger. The off-campus Engineering Technology program has doubled its enrollment in the last three years, indicating success, but also creating certain challenges.

Successes include a high-quality, face-to-face, curriculum taught by highly qualified tenured/tenure-track professors. Western's commitment to engagement with the region is admirable, and faculty /administrators are to be commended for their contributions toward building a strong distance program. Continued success of the program is also attributed to excellent community college partners who are committed to the success of their graduates. Another factor in the success of the off-campus program is its low cost and high value.

Today's successes provide tomorrow's challenges. In order for the off-campus program to continue to thrive, steps must be taken to ensure that challenges do not become inhibiting problems. Adequate faculty resources will allow the distance program to provide quality instruction to those who need it. In addition, adequate classroom and laboratory facilities will provide safe, high quality instruction to the deserving place-bound students who cannot

commute to campus. Finally, proper program evaluation and assessment will provide information that will serve as impetus for change, if change is truly warranted.

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