MANDATORY CREDIT REDUCTION OF ENGINEERING TECHNOLOGY PROGRAMS - CAN QUALITY HIGH CREDIT PROGRAMS SURVIVE?

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The late 1980's and 1990's have proven to be very difficult times for engineering technology degree programs nationally. Not only have the numbers of enrolled students declined while employment opportunities have generally diminished, but the costs to support quality programs have continued to grow. The perceived reduction in interest for technology as a career choice has put added pressure on both institutions and program faculty to save and revitalize these programs. Business and industry have typically been strong and vocal supporters, thereby insuring a steady entry level pipeline of technician/technologist personnel, as well as allowing existing employees professional growth opportunities. State legislatures and system wide academic administrators however have created stringent financial criteria and developed full time equivalent (FTE) student-faculty algorithms to measure "program performance". Resulting economic decisions made by state officials have further impacted all engineering technology programs negatively.

Although the above noted trends are occurring nationally, this paper will deal generally with engineering technology associate degree programs within the state of Connecticut over the past ten years, and specifically with the Nuclear Engineering Technology Program at Three Rivers Community-Technical College in Norwich, CT.

In 1987, there were five Connecticut Technical colleges offering a combined total of 86 degree programs of which 23 were TAC of ABET accredited in 14 engineering technology fields. Technical program enrollment and graduate placement were high. The colleges were meeting the needs of their clients - students and industry - well. The trimester-based curricula were well supported by their regional industry advisory committees. The state legislature however decided that all degree programs at state-funded institutions should be semester-based in order to assure optimal credit transfer among institutions. In resulting legislative hearings, strong industry and student support for the existing trimester system fell on deaf ears; all programs were mandated to be semester-oriented by the start of the Fall 1989 semester.

Program faculty, working with their industrial advisory committees, transformed trimester programs into supposedly equivalent semester programs. However, there was the universal feeling that the resulting programs were of a lesser quality in both total technical content and breadth of technical education. The range of topics covered, electives available, and overall integration of technical material was negatively impacted. Reduced enrollments and decreased industrial support were evident as "new program" graduates entered the technical workplace.

Regional program enhancements over the next few years did minimally strengthen specific programs at individual colleges, but program FTE numbers continued a general decline. Alarmed by increased costs, reduced enrollment, and continued central administrative staff growth, the state then proposed the merger of the five technical college system into the existing twelve community college system. Again business and industry, as well as the student population, strongly opposed

this merger to create twelve community-technical colleges. Their fears of a "takeover" rather than a merger of the systems and neglect of the now "minority" technical programs were the oft repeated concerns cited at legislative hearings. With the heady fiscal days of the 1980's now gone, the state quickly mandated this merger in order to "save costs". (It should be noted that a state income tax was enacted during this same legislative period.)

The Fall 1992 semester dawned with the newly merged system in place. As expected the local administration of the five truly merged colleges, the new central office administration, and the new system wide governing board of trustees, had minimal technical membership. Technical programs were now competing with traditional community college programs for scarce fiscal and personnel resources. Algorithms were developed and applied to administer every facet of academics. If courses did not have 14 or more students they would not run, program budgets were based on FTE student populations not need, etc. The results were quick and predictable: numerous and diverse technical elective courses effectively disappeared; multiple course offerings at differing times were reduced to a single course section; the Dean of Technology position was eliminated; and necessary funding for laboratory maintenance/upgrade and professional development needs was sharply reduced. With fewer technology course/laboratory offerings and inconvenient/conflicting time slots, technical enrollment again decreased. Entry level technical employment had stabilized and even slightly increased as fewer graduates were being produced. With the effect of supply-and-demand for technology graduates now being realized, it appeared that those technology programs that had survived would now be able to grow and regain their earlier status and prestige.

With this background now documented, the recent, involuntary requirement for mandated credit reductions for engineering technology programs can be more fully appreciated.

The existing mix of technical and non-technical associate degree programs reveals two distinctly different academic communities. The typical community college non-technical degree program (ie, general studies, criminal justice, marketing, business, etc.) has high number student populations, low credit requirements, and weak graduate initial salary and employment histories. Typically, technical programs were exactly opposite. The nuclear engineering technology degree program, for example, in June 1996 had 12 graduates from the 78-credit curriculum with markedly more local job offers than graduates and an average starting annual base salary of $35,000.

With the sole exception of the nursing degree program at 68 credits, most all other community college-based associate degree programs exist at 60 credit. All technical associate degree programs are high credit, comprehensive programs averaging 78 credits. With continuing reduced public funding from the state legislature coupled to the algorithm-based management mentality of the central office bureaucracy, it was readily discernible that essentially all technology programs were a "financial burden" to operate. In reviewing options to reduce systems costs, central office management determined erroneously that TAC of ABET had a 68-credit upper limit for program accreditation. Even though this false statement was formally and correctively addressed by a TAC of ABET letter, the Chancellor for the merged 12 college system announced in December 1995 that ALL existing college associate degree programs must be reduced to 68 credits by June 1996. Similarly, no new associate degree programs would be considered for the colleges if they exceeded

68 credits. Since only the technical programs exceeded the new 68-credit threshold, this action was yet another major (and perhaps this time fatal) attack on technical education.

The curriculum for the nuclear program is shown as Table 1. The 78-credit program is actively reviewed each year by our 25-member Nuclear Advisory Committee (NAC) for meeting the advanced education and employment needs of our graduates. The NAC membership includes a vice president or higher from each and every nuclear business, currently 20, in Connecticut as well as the 5 department chairpersons from four year universities that our students typically attend for their baccalaureate degree. Their guidance and direction have optimized employment opportunities for our graduates and guaranteed acceptance as entering juniors in ABET-accredited BS programs. Their program involvement is substantial: recent program adjustments include requirements for the need for Chemistry I to upgrade from the Chemistry Principles; the need for a computer programming (Fortran, Pascal) course to upgrade from the Introduction to Computers (spreadsheet) course; and the establishment of a three credit nuclear co-op course.

Not only did this 68-credit goal have to be in place by June 1996, but the recommended reduction particulars had to be submitted by April and subsequently approved by the Chancellor. If programs failed to respond in a timely manner, the central office would create the required 68-credit program themselves.

The full NAC met with program faculty in December and after an extensive, thorough review of this proven academic program determined that no credit reductions could be effected without a substantial negative impact to the program and its graduates. The two stated goals of the program were: 1) provide a well educated technician for entry level employment into Connecticut's nuclear industry and business; and 2) create a well educated student for acceptance as a junior in regional baccalaureate-granting universities. The mandated 10-credit reduction would adversely impact both goals as well as possibly jeopardize TAC of ABET reaccreditation. All other technology programs at our college met with their respective industrial advisory committees and all independently arrived at the same conclusion - this mandated credit reduction was shortsighted and would harm their programs.

The NAC wrote a formal, forceful letter to the Chancellor documenting their concerns and requested that programs be considered on an individual basis for exemption from the credit reduction requirement. Not only was no remedial action considered by the Chancellor, but the NAC letter as well as correspondence from other programs was not even acknowledged.

Rather than have bureaucrats create a 68-credit curriculum for the nuclear program, department faculty and NAC members developed a working list of possible techniques to achieve this 10-credit program reduction. A description of each technique, with accompanying strengths and weaknesses, is listed below.

A) Utilize Tech-Prep Credit Exemptions

To strengthen the numbers of high and vo-tech school graduates entering technical degree programs, a tech-prep program has been established and strongly promoted for several years. It

permits selected students to take pre-approved, college-equivalent courses that will be accepted for college credit if the student then enters a recognized college technology degree program. Typically, a student could receive up to 13 credits of tech-prep credit for high school coursework in humanities, math, physics, and chemistry. As our college and the nuclear program have had a long and positive tech-prep involvement, 10 of the credits typically awarded for tech-prep program credit, English Composition, Physics Mechanics, and Precalculus, were identified for the mandated reduction. These three courses, at 3, 4, and 3 credits respectively, would be removed from the published degree curriculum. All three courses were pre-requisites for subsequent required degree coursework, Technical Writing, Physics Heat Light and Sound, and Calculus 1 respectively. Although not required in the official curriculum, the three basic courses would still have to be mastered by non tech-prep students in order to meet pre-requisite requirements for later courses. Also, as these three courses are standard to virtually all technology programs, they could be universally removed to standardize all technology programs' credit reductions to the 68-credit level. The resulting 68-credit program would then still effectively remain the proven and desired 78-credit program.

While there are a lot of very positive aspects to this reduction choice, the main one being that the old program survives in a different format, there is concern that the newly published curriculum falsely advertises the program's academic criteria. Potential new students would be drawn into a perceived 68-credit program, not realizing that they are required in fact to satisfy 78-academic credits. Similarly, the formal removal of the three listed courses from the curriculum would reduce the number of published humanities, basic science, and math credits. While the course material would be covered through either tech-prep or not-for-credit pre-requisite coverage, as it is not officially required in the published curriculum, it can then not be counted toward meeting published TAC of ABET humanities, basic science, and math credit requirement minimums. Thus, TAC of ABET reaccreditation is jeopardized, even though the program has not actually altered its true educational coverage.

Upon consideration of all factors, this approach was abandoned.

B) Eliminate Four Technical/Socio-Humanistic/Open Electives

During the final two semesters of the program, there are four electives - two socio-humanistic, one technical, and one open - required. These electives are chosen to match the student's career goals. Those students going on to baccalaureate programs will typically take Differential Equations, Chemistry II, Sociology, Introduction to Literature, etc., to better facilitate their transfer as entering juniors. Similarly, those students seeking immediate employment will opt for Nondestructive Testing, Economics, Advanced Technical Writing, Statistics, etc., to make themselves more "attractive" to potential employers. This diversity in elective selection has had a noticeable impact in the rounding off the total education experience. It is a major strength of the program as it does enhance the graduate's employment opportunities or permits the graduate to enroll in baccalaureate programs as entering juniors. This program strength has been repeatedly documented through both graduate and employer surveys.

Elimination of these electives would definitely insure that students continuing their education would not continue as juniors at baccalaureate degree granting institutions. Students would also not meet certain entry level academic standards for specific commercial nuclear power operations positions. In general, the program would be markedly downgraded in meeting the documented needs of its clients - the graduate and the nuclear industry of the state.

Upon consideration of all these factors, this approach was also abandoned.

C) Elimination of Required Non-Nuclear Technical Courses

When the nuclear program was being developed, one major consideration was the development of a well rounded technical graduate, one who could readily adapt to a changing technical workplace environment. Unlike some technical programs which only offer technical coursework within its own discipline, the nuclear program specifically requires non-nuclear technical coursework to meet degree requirements. Such coursework includes Fluid Mechanics, Thermodynamics, Heat Transfer, Electricity, AC/DC Machinery, etc. Completion of this coursework strengthens the student's understanding of upper level nuclear courses and integrates the total technical education experience.

Elimination of these technical courses would weaken the overall nuclear program education. Graduates would not only have a lesser education, but would be unprepared for entry level nuclear operations employment positions and could not be accepted as entering juniors in baccalaureate programs.

Again, once all these factors were considered, this approach was also abandoned.

D) Elimination of Upper Level Nuclear Coursework

The nuclear program requires 25 credits of specific nuclear course/laboratory offerings. This diverse and integrated technical education insures the graduate will meet numerous entry level technician education standards within the commercial nuclear power industry, the main employer of program graduates. It also insures that the graduate will readily be accepted as an entering junior in nuclear baccalaureate programs as defined in various articulation agreements. Lower level coursework could not be removed, as this forms the pre-requisite base for the upper level work. The upper level course and laboratory offerings can not be removed as they enable the student to meet workplace entry standards. Not only do these technical courses meet entry level standards, but are key recognized components of professional growth toward more responsible positions, such as reactor operator. All nuclear coursework is essential if the student is to successfully complete the Reactor Simulator course, which is the defined capstone course for the degree. This one course with laboratory enables students to successfully integrate their entire education into the demonstrative understanding and physical operation of a nuclear power plant and its numerous subsystems.

Upon consideration of all factors, this approach was also abandoned.

With four credit reduction techniques thoroughly reviewed and rejected, the NAC concluded a 10- credit reduction could not be achieved without imposing a significant negative impact on the

existing, well accepted, award winning program. The two governing program goals would be violated - graduates would not meet entry level academic employment standards nor would they be able to continue their education as entering juniors in baccalaureate programs. This program degradation could not be accepted, as it devalued a technical program clearly needed and supported by business, industry, and the general population.

A second stronger letter was prepared by the NAC to reiterate their concerns to the Chancellor and again request an exemption from this credit reduction requirement. A definitive response has not been received as of this report preparation, but a one year extension for all technology programs to implement the credit reduction mandate has been granted. An altered curriculum at the 68-credit level for the nuclear engineering technology program is now required for implementation for the Fall 1998 semester, thereby giving the program and its advisory committee a one year period to resolve this important issue. It should be noted that the nuclear program is the only such program in the northeast and supplies technicians to the entire nuclear-dependent New England region. A separate associate's degree program in Health Physics Technology was developed and forwarded to the central office for adoption two years ago. It also would be the only program of its kind in the northeast. Its separate industrial advisory committee unanimously endorsed this program as there is a distinct need for this educated technician workforce in New England; but no action has ever been taken since this program would require a 72-credit curriculum, which again exceeds the mandated 68 credit maximum.

In summary, the engineering technology degree programs have been developed, offered, and refined as necessary by competent industrial advisory committees and cognizant faculty to meet the needs of business, industry, and the general public. These technology programs are necessarily more costly and require more academic credit than typical community college-based programs due to their complexity and the sophistication of the technical workplace that the graduate will enter. College system wide management must recognize the importance of technology programs in the economic health of the state and educational goals of its residents. This management must also understand and support the advice and guidance role of known and knowledgeable technical experts, the industrial advisory committees, to insure that the technical programs offered do meet the needs of the state. They must utilize the committees' expertise in recognizing program credit levels and curriculum distribution. If this important guidance is disregarded, the resulting technical programs created by management will not meet the needs of business and industry, the programs will decline and die, and industry will relocate to a more educationally friendly environment. Perhaps this entire action would not have been necessary had a justifiable reason been issued to reduce program credits in general or a specific valid reason to achieve a 68-credit maximum level. Should this 68-credit mandate remain unchanged for the Fall 1998 semester period, it is predicted that over half of the existing programs will be abandoned as graduates will not meet minimum entry level employment educational standards and employers will no longer support these programs.

TABLE 1
NUCLEAR ENGINEERING TECHNOLOGY
CURRICULUM-TAC/ABET ACCREDITED

COURSE TITLES	LEC	LB	CRD
SEMESTER I			
English Composition	3	0	3
Pre-Calculus	3	0	3
Physics Mechanics	3	0	3
Physics Mechanics Lab	0	2	1
Chemistry I	3	0	3
Chemistry Principles Lab	0	2	1
Intro. to Prog./Pascal (or Fortran/Basic)	3	0	3
Intro. to Prog./Pascal (or Fortran/Basic) Lab	0	2	1
Introduction to Nuclear Systems	3	0	3
TOTAL:	18	6	21
SEMESTER II			
Technical Writing	3	0	3
Oral Communications	3	0	3
Calculus I	3	0	3
Physics - Heat, Light, Sound	3	0	3
Physics - Heat, Light, Sound/Lab	0	2	1
Radiation, Health Safety	2	0	2
Radiation, Health Safety Lab	0	2	1
Atomic and Reactor Physics	4	0	4
Nuclear Chemistry	1	0	1
TOTAL:	19	4	21
SEMESTER III			
Literature, History, or Economics	3	0	3
Calculus II	3	0	3
Reactor Theory	4	0	4
Electricity and AC/DC Machinery	3	0	3
Electricity and AC/DC Machinery Lab	0	2	1
Fluid Mechanics-Thermodynamics	4	0	4
Nuclear Materials Science	2	0	2
Nuclear Materials Science Lab	0	2	1
TOTAL:	19	4	21
SEMESTER IV			
Psychology, Sociology, or Political Science	3	0	3
Open Elective	2	0	2
Nuclear Instruments and Control	2	0	2
Nuclear Instruments and Control Lab	0	2	1
Heat Transfer	2	0	2
Thermal Sciences Lab	0	2	1
Nuclear Simulator	1	0	1
Nuclear Simulator Lab	0	2	1
Nuclear Topics	2	0	2
TOTAL:	12	6	15
GRAND TOTAL:	68	20	78

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Professor James R. Sherrard has been the Chairman of the Nuclear Engineering Technology Department at Three Rivers Community-Technical College for ten years. His B.S. was in General Engineering from the U.S. Coast Guard Academy. He has received advanced degrees in Nuclear Engineering, Nuclear Science, Naval Architecture, Mechanical Engineering, and Naval Engineering from MIT, University of Connecticut, and The Catholic University of America. He is a registered Professional Engineer and retired U.S.C.G. officer.