

2006-1406: DEVELOPMENT OF AN INTEGRATED CONSTRUCTION MANAGEMENT AND CIVIL ENGINEERING TECHNOLOGY CURRICULUM

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Development of an Integrated Construction Management and Civil Engineering Technology Curriculum

Introduction

The University of North Carolina at Charlotte's (UNC-Charlotte) Department of Engineering Technology currently offers three Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC of ABET) accredited baccalaureate degree programs; Civil Engineering Technology, Electrical Engineering Technology, and Mechanical Engineering Technology as well as a non-accredited Fire Safety Engineering Technology program. In an effort to strengthen enrollments and to enhance program offerings, the Civil Engineering Technology (CIET) program recently completed an examination of a wide range of potential curricula improvement options including the development of a new construction management program that will be closely integrated with the existing CIET program. This paper examines some of the lessons-learned by the CIET faculty from the academic program improvement and curriculum development effort.

Experience gained from the effort indicates that the development of a new academic program requires the following key elements:

- 1) Identification of the need,
- 2) Emergence of key faculty advocate,
- 3) Alignment with institutional mission and goals,
- 4) Consideration of accreditation options,
- 5) Development of curriculum
- 6) Addressing of administrative approval processes and,
- 7) Patience and perseverance.

Identification of the Need

The initial step in the planning process for any new academic program is the identification of the need for the program. In UNC-Charlotte's case the idea for a new construction-related program originated from CIET faculty as part of larger departmental curricula improvement discussions. At the time, all programs within the ET Department were upper division only, 2+2 type programs that only admitted students holding A.A.S. degrees. However, recent trends in program enrollments within the ET Department were either flat or declining while at the same time college and university wide enrollments were increasing significantly. In addition, trends within the community college system suggested that substantial improvements in enrollments using the existing 2+2 model were unlikely.

As a consequence, the ET Department undertook an effort to strengthen its enrollments by transforming its programs into traditional 4-year programs that could also admit freshman and internal change of majors. It was within this context of curriculum change and intense focus on improved enrollments that the possibility of adding a construction-related program to further bolster the CIET program was first raised. The idea was raised based on the observed level of

CIET student interest in construction-related employment opportunities and in consideration of the strong construction market within the Charlotte region.

However, to successfully proceed with the planning of a new academic program requires firm justification of the need for the program beyond anecdotal data as the new initiative will be competing against other on-campus initiatives for a limited pool of financial and faculty resources. In our case, we were able to provide economic data concerning the strength of the construction related job-market within the Charlotte region, letters of support from both alumni and industry, and an analysis demonstrating a lack of similar construction programs serving the immediate region. This data provided support to the faculty conjecture that such a construction-related program was needed and could be successful at UNC-Charlotte.

Emergence of Key Faculty Advocate

Even if the need for a new academic program has been firmly established, the emergence of a key faculty advocate for the proposed academic program is essential to moving the proposal forward. Our experience has shown that a substantial amount of administrative politicking is required in order to garner support from both faculty and university administrators. This requires that much of the background research and preliminary planning documentation be completed so that it can be presented to key personnel. This results in the skewed scenario where much of the planning work must be completed *before* formal approval to proceed with planning for the proposed academic program has been received.

Therefore, a key faculty advocate must emerge who is willing to commit the time and effort, beyond their normal duties, to collect the data, write the reports and to push the proposal forward. Without such support the idea, no matter how good, will languish and disappear within the university bureaucracy. Unfortunately, such new academic program development efforts are not likely to result in a substantial amount of tenure and promotion credit for the faculty, particularly at more research oriented universities. Therefore, the faculty advocate must be willing to assume some level of professional risk when undertaking the role.

Alignment with Institutional Mission and Goals

In order to garner institutional support for and ultimate approval of the proposed academic program, the proposal must be closely aligned with the overall mission and goals of the university. A proposal that lacks such alignment is not likely to be viewed favorably and, if approved, chances are the new program would ultimately become a “square peg in a round hole” and not receive the level of support needed or deserved. Fortunately, a construction-related program aligns nicely with the mission and goals of UNC-Charlotte.

An excerpt taken from the UNC-Charlotte mission statement states that “UNC Charlotte is prepared to focus interdisciplinary resources to address seven broad areas of concern to the Charlotte region: 1) Liberal Education; 2) Business and Finance; 3) Urban and Regional Development; 4) Children, Families, and Schools; 5) Health Care and Health Policy; 6) International Understanding and Involvement; and 7) Applied Sciences and Technologies.”¹ Therefore, a construction-related program aligns with the themes of Urban and Regional

Development and Applied Sciences and Technologies and the specific issues of “economic development, crime and violence, transportation, metropolitan infrastructure, urban planning, and the environment” outlined in the mission statement.

In addition, the proposed construction program aligns with the ET Department mission statement which indicates that our programs exist to serve business and industry in the region by supplying highly competent baccalaureate level technology graduates. In support of the mission statement, the ET Department’s 2005-2010 Strategic Plan identifies the following goals:

- GOAL #1: Establish the School of Engineering Technology.
- GOAL #2: Increase the quality, diversity, and number of students in Engineering Technology while maintaining and continuously improving quality educational experience.
- GOAL #3: Add new and expand existing programs in niche areas in Engineering Technology to serve the greater Charlotte region, the state of North Carolina and United States.
- GOAL #4: Provide adequate facilities to support expanding program offerings and facilitate applied research and outreach missions of School of Engineering Technology.
- GOAL #5: Participate in and contribute to Centers of Excellence.
- GOAL #6: Partner to Establish an Industrial Solutions Center.

As noted, Goal 3 of the strategic plan is to add new and/or expand existing programs in specific niche areas of Engineering Technology and, therefore, encompasses the construction program initiative. In addition, the proposed program also supports the increased enrollment targeted by Goal 2. Because of the proposed program’s strong justification and its alignment with institutional mission and goals, the construction program proposal received strong pre-approval support from all administrative levels including the Provost and Office of Academic Affairs.

Consideration of Accreditation Options

Once preliminary support for the proposed academic program has been obtained, the next step is to evaluate available accreditation options and requirements so that detailed curriculum development can begin. Accordingly, we identified three possible accreditation options for construction-related programs were identified: a TAC of ABET accredited Construction Engineering Technology (CNET) program, an American Council for Construction Education (ACCE) accredited program, or a National Association of Industrial Technology (NAIT) accredited program. An effort was then made to benchmark our existing CIET program against programs with the other types of accreditation so that an informed decision concerning the best available option could be made.

The resultant study identified 111 accredited construction-related baccalaureate programs within the United States.² Using available Internet sources, data concerning total undergraduate enrollment, total undergraduate degrees awarded, and the number of full-time faculty at each program was collected for the 2002-03 academic year. Results from the survey are summarized in Table 1.

Table 1

Variations in General Program Characteristics by Accreditation Type

Program Accreditation Type	Programs	Student Enrollment	Degrees Awarded	Faculty	Average Enrollment
ACCE	56	12,663	2,520	389	226
TAC of ABET (CIET)	27	2,065	436	99	76
TAC of ABET (CNET)	20	2,533	446	93	127
NAIT	8	995	166	46	124
TOTALS	111	18,256	3,568	627	164

Program size ranged from a low of 13 to a high of 594 students with the top ten programs having enrollments in excess of 375 students. The results suggested that ACCE accredited programs generate the largest enrollments followed by CNET and NAIT accredited programs with CIET accredited programs having the smallest enrollments. In fact, 19 out of the 20 top ranked programs, based on enrollments, were ACCE accredited programs with the other program being a CNET program. Based on the data obtained from this study and Industrial Advisory Board feedback, the decision was made to develop a construction management (CM) curriculum modeled on ACCE accreditation standards.

Development of Curriculum

Once the type of accreditation to seek had been established, the task of developing the actual curriculum could begin. A review of the ACCE accreditation criteria revealed that the following minimum curriculum content was required:³

- General Education: 15 semester hours
- Mathematics and Science: 15 semester hours
- Business and Management: 18 semester hours
- Construction Science: 20 semester hours*
- Construction: 20 semester hours*
- *Total of 50 semester hours in Construction Science & Construction is required
- Minimum Total Hours: 120 semester hours

It should be noted that ACCE accreditation standards also require specific topical content to be included within each of the categories. In construction science, required topics include design theory, design of construction systems, construction methods and materials, construction graphics, and construction surveying. Required construction topics include estimating, planning and scheduling, construction accounting and finance, construction law, safety, and project management. With these requirements as a guide, we developed our proposed construction management curriculum. The result was a curriculum that includes:

- General Education: 20 semester hours
- Mathematics and Science: 26 semester hours
- Business and Management: 18 semester hours
- Construction Science: 41 semester hours
- Construction: 23 semester hours
- Total Hours: 128 semester hours

As the research literature indicates that current models for delivering civil engineering and construction education have contributed to a lack of design and construction integration within the industry⁴, the proposed construction curriculum was closely integrated with the existing CIET program. In most educational models, design and construction are treated as separate topics and have even become separate degree programs. As a result, civil engineering students lack the ability to adequately assess the impact of their designs on the construction process. Conversely, construction students lack an appreciation of the engineering design process and its relevance in establishing construction means and methods. This lack of mutual understanding and appreciation of each others professions is compounded by insufficient opportunities to interact with students and faculty from other disciplines in a classroom setting.

Since the lack of design and construction integration has been shown to have a negative impact on the overall performance of civil infrastructure projects⁵, we attempted to develop an innovative integrated curriculum that shares a common lower division curriculum with the CIET program. This allows both CM and CIET students to share the same classroom and faculty during the first two years and to share several other upper division courses as well as an interdisciplinary capstone course. On average, students from both majors will share a total of 67% of their major specific courses.

Under the curriculum, students will not be required to select their preferred major until after their sophomore year. In addition, junior level transfer students with related A.A.S. degrees will also be able to matriculate into the four-year programs under the Department's existing 2+2 transfer arrangement. Such close integration also maximizes the use of faculty and facility resources.

Nationally, only three universities, Georgia Southern University, Southern Polytechnic State University, and Wentworth Institute of Technology currently house accredited CM and CIET programs on the same campus²; UNC-Charlotte will become the fourth. Of these institutions, UNC-Charlotte will be the only one whose programs share a significant number of common courses. Therefore, the program model represents a unique effort to integrate civil engineering technology and construction education and, by extension, improve overall project performance within the construction industry.

Addressing of Administrative Approval Processes

Every university has adopted formal approval processes for new academic programs and curriculums that must be satisfied before authorization to admit students into the new program is received. At UNC-Charlotte, the process includes three major components or reports. The first is a *Notification of Intent to Plan a New Baccalaureate, Master's, or C.A.S. Program* (Intent to Plan) which acts as the vehicle for obtaining preliminary concurrence from the university administration for the general concept so that unnecessary expenditure of time and effort is avoided if the proposed program is not viewed favorably.

Once the Intent to Plan has been approved, then a more detailed *Request for Authorization to Establish a New Degree Program* is prepared. This document is used to provide a more complete justification for the program, a more detailed description of the proposed curriculum and an analysis of expected budget and faculty requirements. This is the document that, when approved

by the university system, authorizes the establishment of the program and admittance of students into the degree program. The specific type and level of information required can be seen in the following obligatory outline for the report⁶:

- I. Description of the Program
- II. Justification for the Program
- III. Program Requirements and Curriculum
- IV. Faculty
- V. Library
- VI. Facilities and Equipment
- VII. Administration
- VIII. Accreditation
- IX. Supporting Fields
- X. Additional Information
- XI. Budget
- XII. Evaluation Plan
- XIII. Reporting Requirements

The report requires that other academic units that may be impacted by the proposal be consulted and their approval obtained. In the case of our proposal, that required obtaining approval from the Belk College of Business to incorporate the required business and management courses into our curriculum and from the College of Arts and Sciences for the math, science and general education courses. In addition, the library also had to be consulted to ascertain that adequate library materials were available to support the topical content of the proposed program.

The last document that is required is a *Course and Curriculum Proposal*. This proposal details the curriculum outline and associated catalog copy and course descriptions and requires approval from the faculty governance process. As a consequence, the proposal is reviewed by departmental, college and university faculty committees and ultimately requires the signature of the Department Chair, college Dean, and the Provost. Once approval has been received, then the program may begin to offer any new courses.

Patience and Perseverance

Our experience in navigating the construction program proposal through the myriad tasks and approvals described above has demonstrated that considerable patience and perseverance is required. In our case, it will have required almost four years to move the proposal forward from conception through to admittance of the first student. The process requires multiple approvals and documentation from all levels of administration. Unfortunately, not all of the reviewers share the level of enthusiasm and concern for the proposed academic program as do the initiators of the proposal. Therefore, the process is often one of “hurry up and wait” with frequent stops and starts as one anxiously waits for someone to complete their part so that the proposal can be moved up the ladder to the next approval level. Without ample patience, one would quickly become overly frustrated with the whole process.

Conclusion

In conclusion, our experience has shown that the development of a new academic program follows a formalized process that requires: 1) identification of the need, 2) emergence of key faculty advocate, 3) alignment with institutional mission and goals, 4) consideration of accreditation options, 5) development of curriculum, 6) addressing of administrative approval processes and, 7) patience and perseverance. This experience was gained through our efforts to plan, develop and establish a new construction management within the Department of Engineering Technology at UNC-Charlotte. However, our experience has also shown that a considerable amount of patience and perseverance is required in order to complete the process.

The resultant ACCE accreditation modeled curriculum has been closely integrated with the existing CIET program within the department. The curriculum will share a common lower division with the CIET program thereby allowing students to wait until the end of the sophomore year to declare their preferred major. In addition, the two programs will share approximately 67% of their major specific courses. It is believed that this will provide UNC-Charlotte with one of the only programs within the United States that integrates an ACCE accreditation based construction management program with a TAC of ABET accredited CIET program in this manner.

¹UNC-Charlotte Office of Academic Affairs, (Retrieved 1/17/2006). *UNC-Charlotte Institutional Plan 2004-2009*. URL <http://www.provost.uncc.edu/planning/lrp/institutional.pdf>

²Gehrig, G. B., (2005). *A Survey of the Status of Baccalaureate Degree Awarding Construction-Related Programs within the United States*. International Proceedings of the 41st Annual Conference of the Associated Schools of Construction, April 7-9, 2005, Cincinnati, Ohio.

³American Council for Construction Education. (Retrieved 1/17/2006). *Document 103 Standards and Criteria for Accreditation of Postsecondary Construction Degree Programs*. URL <http://www.acce-hq.org/PDF/form103.pdf>

⁴Fegusson, K. J., (1993). *Impact of Integration on Industrial Facility Quality*. Ph.D. Dissertation, Department of Civil Engineering, Stanford University.

⁵Gehrig, G. B., (2002). *A Decision Support System Framework to Improve Design-Construction Integration and Project Performance on Public Sector Underground Utility Projects*. Ph.D. Dissertation, Department of Civil Engineering, Colorado State University.

⁶UNC-Charlotte Office of Academic Affairs, (Retrieved 1/17/2006). Request for Authorization to Establish a New Degree Program. URL <http://www.provost.uncc.edu/planning/rte/Appendix%20C%20temp.doc>