Enhancement of a Civil Engineering Technology Curriculum by the Addition of a Minor in Engineering Management

Vernon W. Lewis, Jr. and Paul Kauffmann
Department of Engineering Technology
Old Dominion University
Norfolk, Virginia

Abstract

The Engineering Technology Program at Old Dominion University offers ABET accredited options in Civil, Electrical and Mechanical Engineering Technology. In recent years this offering has been expanded to include emphasis areas such as Surveying/Geomatics, Computer Engineering Technology and Nuclear Engineering Technology, under the umbrella of the three original programs. Old Dominion University requires students to meet their Upper Division General Education Requirements with a minor, a cluster (advanced study in a focus area) or a second major.

In assessing the needs of students for workplace success, the department Industrial Advisory Board, strongly suggested incorporation of course content in the areas of business and management. Within the College of Engineering and Technology, the Department of Engineering Management offers only graduate degrees, but supports other departments with courses at the undergraduate level. The Civil Engineering Technology program collaborated with the Engineering Management department to include courses in the curriculum that incorporate a minor in Engineering Management that addresses the concepts identified by the advisory group. This paper discusses the workplace need this direction addresses, the influence the change has made on the curriculum and the advantages following graduation that students experience.

Introduction

The Engineering Technology Program at Old Dominion University has programs in Civil, Electrical and Mechanical Engineering Technology. The Civil program includes emphasis areas in Design, Construction and Surveying. The total enrollment of the program is about 100 students. Students attend classes both on campus and through the TELETECHNET distance-learning program with the majority of the students in distance-learning. The paradigm for the delivery of these distance classes, particularly the laboratories has been the topic of numerous publications.[1,2,3]

The initiative discussed in this paper is the result of the convergence of three factors. First, the department faculty was considering how to better respond to the TAC of ABET program criteria (a-k) for technology programs. A theme of these eleven outcomes is that graduates not only must be technically proficient but also functional in a business context.[4]

The second factor involved input from advisory committees. The Engineering Technology program makes extensive use of its industrial advisory boards, especially the Civil Engineering Technology (CET) program. Input from these groups expressed an interest in improved business skills. For example, the surveying advisory board perceived a need for additional management skills in their new graduates, not all of which were Old Dominion University students.

Finally, in the same time period, the university revised its upper-division general education requirements and included the requirement for a minor, cluster (advanced study in a focus area), or second major that covered approximately twelve credit hours. This presented an opportunity to enhance the CET curriculum with the addition of course work in the business and management area. The next section discusses the surveying advisory board recommendation in more detail to provide context.

Issues with Business and Management

First, the licensing board for Surveyors assessed the disciplinary actions that the board was taking currently and noted that in many instances, the issues were indicative of a lack of training in the areas of business and management.

Several members of the licensing board were also members of the surveying advisory committee and saw in their own businesses that the students needed more business and management skills for advancement in many workplace situations. Over the course of their careers, many graduates develop an interest in advancing to management positions. Often this interest is not perceived prior to the completion of their education. It is not our purpose to anticipate universal career goals, but it is incumbent on the curriculum committee to include topics having widespread usefulness in a student's career.

In addition to the above, some employers require specific documentation of management training to be considered for promotion. This documentation could include additional coursework following graduation or could be met with the annotation of a minor in Engineering Management on the student's transcript. Specific instances of the requirement for documented management training have been noted by Old Dominion University Technology graduates.

Upper Division General Education Requirements

Old Dominion University recently made changes in its upper-division general education requirements. A curriculum trend in recent years has been toward reduced hours and at many universities the hours required for degree completion have been reduced to as low as 120 semester hours. The Technology Accreditation Commission of the Accreditation Board for Engineering and Technology requires a minimum of 124 hours for a Technology Program.

With this reduction of hours, many departments expressed an interest in eliminating some general education hours. The process of convincing the university curriculum committee to reduce these hours is itself worthy of a publication. In summary, the process was long and controversial, but the final result was that there was a limited reduction in the required general education requirements. One feature of the compromise was that each graduating student was required to complete the requirements for a minor, a cluster or a second major. A cluster is a course of study involving several courses of consistent focus, but not all in the same discipline. Often the clusters contain several options to assure that an adequate choice of courses is available.

The Engineering Management Minor

Courses from the business school could have been incorporated into the CET curriculum to address the suggestions of the advisory board. This would have required students to choose a minor in a related discipline. The result of this combination would have been additional reduction in the core CET course content. A natural choice to combine these two issues was a minor in the desired areas such as Engineering Management.[5] Fortunately the College of Engineering and Technology at Old Dominion University has a department of Engineering Management. The department does not have an undergraduate program, but supports the interests of other departments with undergraduate courses in Engineering Management and related topics. A twelve -credit hour minor was developed and the courses in this minor are listed below with a brief description:

ENMA 301 Engineering Management - An introduction to principles of management and organizational behavior as they apply to the engineering profession.

ENMA 302 Engineering Economics - Economic analysis of engineering alternatives. Valuation techniques, time value of money, cash flow analysis, cost estimation, taxes and depreciation, operations planning and control, project evaluation accounting and budget tools.

ENMA 401 Project Management - Foundations principles, methods and tools for effective design and management of projects in technology-based organizations

ENMA 420 Statistical Concepts in Engineering Management - Introduction to concepts and tools in probability and statistics with applications to engineering design, systems analysis, manufacturing and quality management problems.

or

ENMA 421 Decision Techniques in Engineering - A systematic approach to the formulation of problems, the generation and evaluation of alternatives, and the selection and implementation and evaluation of courses of action.

Each of these courses are three semester hours of credit, ENMA 421 is an available alternate to ENMA 420. The revised curriculum for the upper division courses of Civil Engineering Technology is described in the Figure 1 below. Note that ENMA 302 was already part of the curriculum and the three additional minor courses (where the remaining nine hours are contained: ENMA 301, ENMA 420, and ENMA 401) are listed at the top of the table.

Upper Division General Education and Departmental Requirements		
Old Dominion University courses		**Credit (Semester Hours)**
General Ed Cluster/Minor		3
General Ed Cluster/Minor		3
General Ed Cluster/Minor		3
CET 300	ET computing Laboratory	2
CET 301	Structural Analysis	3
CET 310	Fundamentals of Building Construction	3
CET 340	Soils and Foundations	3
CET 345	Materials Testing Laboratory	1
CET 360	Plans and Specifications	3
CET 400	Comp. Applic. To Structural Design	1
CET 410	Reinforced Concrete Design	3
CET 440	Contract Documents	3
CET 450	Structural Steel Design	3
CER 475W	Senior Design Project	3
CET ____	Approved CET Elective	3
CET ____	Approved CET Elective	3
CET ____	Approved CET Elective	3
CET ____	Approved CET Elective	3
MET 310	Dynamics	3
MET 330	Fluid Mechanics	3
MET 335	Fluid Mechanics Laboratory	1
ENMA 302	Engineering Economics	3

Figure 1: Upper Division CET Technical Content (2000-2002 Catalogue)

In the long term, our department assessment activities will integrate questions on the relative usefulness of various topics to career success. For instance, project management skills are constantly identified by business as critical skills for technology graduates. Future assessment activities will attempt to identify how well the course in the minor is preparing students for this workplace need.

Conclusion

In the current design and construction work place environment, it is essential that students have some background in business and management. Previous graduates without this background have experienced diminished career opportunities and have been sometimes limited to positions such as construction operations that do not require a background in cost, management or finance. In the current and future work place environment, the construction and civil engineering technology profession requires some mastery of these topics by all positions.

The addition of this minor has enhanced our program and its students in numerous ways as discussed above. A future area of attention is the implementation of coursework in areas concerned with people skills. The contemporary professional must possess these skills to be successful. An additional benefit to the student is the increased salary that may result from management training and the possibility of a wider range of employment opportunities.

Bibliography

1. Crossman, Gary R., "A CD-ROM Based Laboratory in Fluid Mechanics." *Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition.* (Albuquerque, NM, June 24-27, 2001).
2. Lewis, Vernon W. Jr., "Experiences with A Virtual Laboratory Class in Materials Testing For Civil Engineering Technology." *Proceedings of the 2000 American Society for Engineering Education Annual Conference & Exposition.* (St. Louis, MI, June 18-21, 2000).
3. Crossman, Gary R., "The Logistics of Teaching an Interactive Television Course to Remote Sites." *Proceedings of the 2000 American Society for Engineering Education Annual Conference & Exposition.* (St. Louis, MI, June 18-21, 2000).
4. TAC of ABET, "Criteria for Accrediting Engineering Technology Programs." Baltimore, MD, November 2000
5. Betit, Joseph, "Design for a Distance - Geomatics Program Delivery at a Distance Using Interactive Satellite and Internet Technologies." Presentation at *XVIII Surveying and Mapping Educator's Conference*, (Pennsylvania State University. July, 2001)

VERNON W. LEWIS, Jr.

Vernon W. Lewis, JR. P.E., Senior Lecturer, is Program Director of Civil Engineering Technology at Old Dominion University. He joined the faculty of Old Dominion University in January 1994. He has 30 years of professional experience in consulting, industry and forensic engineering and is registered in eight states. His areas of expertise include structural design, contract documents and materials testing

PAUL KAUFFMANN

Paul J. Kauffmann is Chair of the Department of Engineering Technology at Old Dominion University and previously was on the faculty of the Engineering Management Department. Prior to his academic career, he worked in industry where he held positions as Plant Manager and Engineering Director. Dr. Kauffmann received a BS degree in Electrical Engineering and MENG in Mechanical Engineering from Virginia Tech. He received his Ph.D. in Industrial Engineering from Penn State and is a registered Professional Engineer.