Industry Certification Program in Quality Control

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Abstract

Engineering Technology curriculum generally provides wide spread knowledge in problem solving, management of resources, and process planning. Quality Control is a key skill required by Engineering Technologists, who work in project-driven manufacturing companies. An Industry Advisory Council for a university in Louisiana expressed the need for quality control trained graduates, and worked with Engineering Technology faculty to develop a post-baccalaureate certificate program focused on quality control.

This paper discusses the development of a post-baccalaureate industry certificate program in quality control. It starts by identifying the need for quality control knowledge and skills. After that it discusses the key components for quality control body of knowledge. These components led to identifying relevant course topics to include: Statistical Analysis, Economics, and Quality. These topics were used to evaluate university curricula to identify what existing courses can be used to deliver the required knowledge and skills. Furthermore, the developed certificate is offered both face-to-face and online, hence the paper discusses adaptations of content to facilitate delivery in these different environments. The paper concludes by providing directions for future development of the certificate.

Introduction and Background

The National Academy of Engineers forecasts that engineers and technologists will continue to operate in a rapidly changing innovation environment[1]. This is compounded by globalization of economies, diversity of social and business groups, multidisciplinary research trends, and cultural and political forces. Engineering systems are of increasing complexity in energy, environment, food, product development, and communications[1]. Hence, it is imperative to introduce engineering and technology practices in undergraduate education, where students can experience the iterative process of designing, analyzing, building and testing. There is a growing importance for engineering practice, but the engineering profession seems to be held in low regard compared to other professions and industry tends to view engineers and technologists as disposable commodities[2].

Engineering Technology prepares graduates with knowledge skills and technical problem solving abilities necessary to success in a wide range of engineering technology disciplines[3]. The specific ABET ETAC student outcomes for Engineering Technology are[4]:
   a. An ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities
   b. An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies
   c. An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes
   d. An ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives

e. An ability to function effectively as a member or leader on a technical team
f. An ability to identify, analyze, and solve broadly-defined engineering technology problems
g. An ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature
h. An understanding of the need for and an ability to engage in self-directed continuing professional development
i. An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity
j. A knowledge of the impact of engineering technology solutions in a societal and global context
k. A commitment to quality, timeliness, and continuous improvement

The field of manufacturing is wide, and engineering technologists must understand the processes and materials involved in the creation of a useful product[5]. The emergence of non-traditional education providers (such as online and hybrid) poses challenges for US higher education institutions. To remain competitive, US universities should re-adapt the way education is delivered, and develop curricula that meets the core competencies required in the market place[6]. At a time when local, state, and national resources for education are becoming increasingly scarce, expectations for institutional accountability and student performance are becoming more demanding. There is a need for more educational innovations that have a significant impact on student learning and performance[7].

An industrial advisory council approached an engineering technology department at a University in Louisiana with a need to develop a new program tailored to working professionals. This program was named a Post- Baccalaureate Certificate in Quality Control, which focuses on effective decision-making in technical, manufacturing, and service providing industries. According to long term projections for industrial production managers, the need for quality controllers in industrial organization is around 2170/year until 2022. In the Louisiana Workforce Commission's Five-Star Jobs listing, there are approximately 300+ advertisements for supervisors, inspectors, controller, and industrial technician advertisements[8] (accessed on 11/11/2016). With this new certificate program, it is expected that students with baccalaureate degrees will fill a number of quality control related skilled personnel positions, controller and other supervisory positions in technical, manufacturing, and service providing industries.

This research takes a pragmatic approach to develop a post-baccalaureate certificate. The paper proceeds by discussing the method used to carry out the research. After that it provides a summary of the results. The paper concludes by a discussion of the key findings and provide directions for future development of the certificate.

Method

This paper uses a case-study approach. Based on needs identified by a manufacturer managers' council, a faculty team of the Engineering Technology department worked with members of their industry advisory committee to develop a new certificate program on quality control. The team researched similar programs available nationwide, studied the body of knowledge provided by the American Society of Quality, and reviewed the university documentation and catalog information (including course descriptions and dependencies, course syllabi, course competencies, and course assignments). The team identified the knowledge areas required by a holder of the new certificate. After that a new program proposal was submitted and approved by the institute's governing body.

Results and Discussion

The selected Engineering Technology program has both major and support courses to prepare graduates for technical and supervisory careers in a variety of industries. The program combines technical knowledge with communications skills and teamwork to provide the flexibility needed in today's rapidly changing marketplace. The selected program educational objectives are:
- Demonstrate technical proficiency in the field
- Apply quantitative reasoning and critical thinking in solving technical problems
- Effectively communicate technical knowledge, ideas, and proposals to others, including upper management
- Lead project teams in successful completion of projects
- Have strong organizational and management skills

Several institutions nationwide provide certification programs in quality control. Table 1 provides examples of such programs offered by University of California- San Diego[9], University of Central Florida[10], and Collin College[11]. These certificates have audiences ranging from general manufacturing or healthcare to specific industries such as pharmaceutical and biological companies. They are available at the associate, undergraduate, and graduate levels. Some institutions provide only a set of required courses, while others include a choice among a set elective courses. The courses associated with the certificates are offered face-to-face, online, or in a hybrid format.

Table 1. Examples of Quality Control Certificate Programs

Program Name	Quality Assurance and Quality Control	Quality Assurance	Quality Control Technologies
University	UC San Diego	University of Central Florida	Collin College
Required Courses	Required • Introduction to QA/QC for Drugs and Biologics • Advanced QA/QC for Drugs and Biologics • Good Manufacturing Practices • Regulatory Compliance for Drugs and Biologics	Required (9 hours) • Engineering Statistics • Reliability Engineering • Quality Design and Control Elective (3 hours) • Total Quality Management • Quality Management	Required • Introduction to Quality Control • Manufacturing Quality Control • From Quality Control to Quality Improvement • Total Quality Management
Number of Hours	11	12	12
Course Availability	Online/Face to Face	Online/Face to Face	Face to Face
Target Audience	Pharmaceutical and biologic industry	General: Manufacturing, healthcare, etc.	General: Manufacturing, healthcare, etc.
Level	Undergraduate	Graduate	Community College

The Post-Baccalaureate Certificate in Quality Control is an 18-hour program, which will be delivered online and face to face. *The number of hours for the certificate program was determined by the requirements established by the institute's governing body.* The certificate will fulfill workforce needs which have grown as Louisiana has attracted many technical, manufacturing, and service providing industries over the past five years. The following is a listing of the required and elective courses required for the certificate program.

Required Courses (12 credit hours)
- **Mathematics of Statistics (3 credit hours)**. Statistics as a scientific tool; frequency distributions, tabular and graphical representation of data; measures of central tendency; normal curve; correlation; sampling; probability curve fitting; limitations of theory. **Or Basic Business Statistics (3 credit hours)**. A basic statistical foundation is developed; emphasis is then placed upon practical business applications including hypothesis testing, ANOVA, contingency table analysis, and introductory regression analysis; material is related directly to business applications.
- **Quality Control (3 credit hours)**. Methods and procedures employed in industrial quality control, theories of measurement, error, prediction, sampling, tests of significance and models.
- **Engineering Economics (3 credit hours)**. Principles and applications of economic analysis presented through engineering-oriented examples. Introduction and definitions of economic factors, analysis methods for evaluating alternative choices, and decision making tools for real-world situations.
- **Elements of Occupational Supervision (3 credit hours)**. Preparation, training, and problems of the supervisor.

Electives: (Take 2 electives, 6 credits hours)
- **Technical Project Management (3 credit hours)**. Project evaluation and selection; project planning, organizing, managing and controlling. Software tools and techniques for work breakdown structure; project networks; scheduling; critical path method; program evaluation and review technique; project crashing for small/large project of commercial/academic or nonprofit organizations.
- **Production and Inventory Control (3 credit hours)**. Planning and control of production; operation analysis; routing, scheduling, dispatching; production charts and boards; inventory control; accumulation of material requirements; use of critical path techniques.
- **Intermediate Business Statistics (3 credit hours)**. Time series, index numbers, analysis of variances, chi square, non-parametric tests applied to business and economic problems.
- **Business Law I (3 credit hours)**. The study of the legal environment of Business, with an emphasis on the development of law, an overview of the court system, legal concepts underlying business crimes and torts, contracts, employer-employee relationships, commercial paper, and property rights, ethics.
- **Database Systems (3 credit hours)**. Study of the design, implementation, and management of database systems in a business environment. Topics include data modeling, normalization and the utilization of a relational database management system to develop an integrated database application. A certification examination will be

required as a part of the course assignment. The student does not have to pass the certification exam to pass the course.

- **Organization and Management (3 credit hours)**. Management processes and ethics, with focus on the management of people in organizations, their behavior, motivation, and interactions with management structure.

Several of the identified courses are already offered both online and face-to-face by the university. Online course shells were developed for the courses that were only previously offered face-to-face. These course shells include assignments, online quizzes, and exams pursuant to the university's online policies.

The developed certificate program represents a way to address demands established by the market place. The future developments pertaining to the certificate include addition to university catalog and creation of recruiting materials. Proposals for additional certificate programs are in preparation for Project Management, Automation and Robotics, and Business Analytics.

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9. Quality Assurance and Control Certificate- UC San Diego. [Available online: http://extension.ucsd.edu/programs/index.cfm?vAction=certDetail&vCertificateID=76]

10. Quality Assurance Graduate Program- University of Central Florida. [Available online: http://www.graduatecatalog.ucf.edu/programs/Program.aspx?ID=1260]

11. Quality Control Technologies Certificate- Collin College. [Available online: https://www.collin.edu/ce/certificates/quality_control_technologies.html]