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Electrical Engineering, Engineering Technology, & Electrical and Computer Engineering Technology - Department of Engineering & Technology, Western Carolina University

To achieve the expected learning goals of the QEP, WCU has identified a set of core skills and behaviors (outcomes) that are central to a student's development as an integrated, intentional learner. These core expectations include the ability to: *Solve complex problems and to Communicate effectively and responsibly*. The Accreditation Board for Engineering and Technology (ABET) requires that all institutions seeking to accredit an engineering program must demonstrate that an assessment plan is in place and that results of the plan are used to affect continuous improvement in the particular program. To that end, ABET has issued program outcomes, referred to as a-k. There are similarities among the QEP Learning Goals and Outcomes and the EAC of ABET a-k Program Outcomes. As part of the Program Assessment Plan for ABET, performance criteria and program outcomes are assessed at specified time intervals, all to demonstrate that ABET criteria a-k are met. The QEP Core Expectations, as related to ABET criteria, relied on the assessment process for the necessary data to assess the extent to which these expectations are met.

QEP Core Expectations	ABET Program Outcomes from a-k
<i>Communicate effectively and responsibly.</i>	d. an ability to function effectively on teams. g. an ability to communicate effectively.
<i>Solve complex problems.</i>	c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. e. an ability to identify, formulate, and solve engineering problems. k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Specific performance criteria were assessed under each ABET program outcome. For all the Department of Engineering and Technology's programs, a full two-semester multidisciplinary senior capstone project sequence has been established and geared toward complex problem solving by way of industry and government funded projects. The capstone project is a multidisciplinary team activity (2-4 students) requiring a rigorous application of knowledge to solve complex problems and the dissemination of those processes in several formats. Presentation methods included several venues from formal presentations in front of students, faculty, and industry partners; poster sessions; undergraduate exposition venues at WCU; and publishing a scholarly paper at the National Conference on Undergraduate Research.

In four years, forty-five (45) projects have been initiated. In order to frame and demonstrate the complexity and varied nature of the addressed problems, several are highlighted as follows: (1) *LED Lighting System to Assist Prostate Cancer Treatment*. Brachy therapy treats cancerous prostate tissue by implanting radioactive seeds into the prostate. A student team developed a disposable light-emitting diode (LED) lighting system and software to connect a physician treatment plan to seed implantation. A second team improved the design by making the system wireless and battery powered. A third team designed and developed an automatic pneumatic seed loading instrument and the device was patented. (2) *Total Knee Replacement Rehabilitation Device*. The project sought to develop a device for home use to assist the patient in achieving full range of motion following a total knee replacement operation. The knee device was subsequently submitted for a patent. (3) *Wake Forest Mannequin*. The purpose of this project was to design and build a prototype mannequin with appropriate mass, geometry, tissue stiffness, and joint stiffness properties to be used for weight shifting and patient transfer simulations. (4) *Medical Tool & Technologies*. The project sought to design, build, and test a head tracking system for use in proton radiation therapy for cancer treatment. (5) *U.S. Coast Guard*: The purpose of this project was to design and build a replacement structure and apparatus for the HU25 jet engines for display models to be placed at several bases. (6) *FLS Energy*: The purpose of the project was to design, build, and test a solar apparatus producing water temperatures at the mid-level (350 degrees F) for use in industrial processes and food production.

Assessment data were collected 2011-2012 from a variety of sources, including the Final Project Gate Review 6, which is conducted by faculty and industry/government mentors using several grading rubrics incorporating both QEP and ABET performance indicators – student outcomes; the Comprehensive Assessment of Team Member Effectiveness tool (CATME); the students' personal project logbook (intellectual property management), which

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included meeting minutes, action items from meetings, design sketches and other project information; and the final project documentation package, which includes all work documenting the designing, building, and testing of the new product or system. Assessment and evaluation of the capstone course sequence learning objectives have resulted in the following attainment levels ($n = 51$): For the QEP expectation, *Communicate effectively and responsibly*, 31.4% of the students scored *excellent*, 47.1% scored *satisfactory*, 17.6% scored *marginal*, and 3.9% scored *unsatisfactory*; for the QEP expectation, *Solve complex problems*, 13.7% of the students scored *excellent*, 66.7% scored *satisfactory*, 15.7% scored *marginal*, and 3.9% scored *unsatisfactory*.