# Web-Based Evaluation Process for an Electrical and Computer Engineering Department

by

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An Abstract of a Dissertation Submitted to Nova Southeastern University
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National and regional accrediting agencies require educational institutions to provide evidence that indicate the fulfillment of program objectives and generate results for improvement of curriculum. The Accreditation Board for Engineering and Technology (ABET) requires programs to develop and implement an evaluation process for assessing learning outcomes, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program.

Accrediting agencies require a structured plan to measure and evaluate learning outcomes and objectives, as defined by a program. They do not stipulate the methods to be used in the development of assessment and evaluation processes. However, they require that institutions demonstrate the andragogy used to achieve objectives as well as evidence of assessment and plans for continuous improvement.

The study developed an evaluation model that included seven surveys for measuring the achievement of program objectives and learning outcomes, methods for scoring the results of these surveys, and techniques for presenting and comparing the measurements obtained. Committees were formed to represent industry, professional organizations and societies, science department, masters program, local conference leaders, faculty, and IEEE student branch. The committees assessed the evaluation model.

Web-based technologies were employed to deliver the surveys to students, faculty, alumni, and industry. These browser-based instruments were password protected to provide security to constituents. The university online survey system provided a database for storing data to be assessed over several semesters or terms of assessment for comparing results and determining trends.

## Acknowledgements

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And gladly would he learn and gladly teach.
*The Canterbury Tales: General Prologue - The Clerk*
Geoffrey Chaucer (1380s)

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# Chapter 1

# Introduction

## Engineering Accreditation

The Commission on Colleges of the Southern Association of Colleges and Schools (SACS) accredits Christian Brothers University (CBU). In addition, the individual engineering programs of chemical, civil, electrical, and mechanical are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). Prior to the changes prescribed by ABET in 2000 and SACS in 2001, preparation for an accreditation visit consisted of compiling a self-study report the year before the visitation. The achievement of learning outcomes and program objectives and continuous improvement are now a part of the accreditation process for ABET and SACS (ABET, 2004; SACS, 2005). Faculty members must now understand and be concerned with the accreditation process on an ongoing basis and not just the year prior to an accreditation visit.

Before the 2001/2002 ABET certification visit, the ECE department developed a set of learning outcomes for each ECE course and shared this information with other engineering departments and the school of science. However, for the most part, individual ECE faculty members performed the task necessary to fulfill accreditation criteria for each ECE course, with the efforts of all coordinated by the chair of the ECE department (EED, 2003). In doing so, the ECE program satisfied ABET's Engineering Criteria of 2000 (EC2000).

Since the adoption of new accreditation criteria began in 2000, many undergraduate programs have not experienced the programmatic guidelines of continuous evaluation processes based on open-ended learning outcomes prescribed by EC2000 and SACS' Principles of Accreditation. Schools of engineering have difficulty in providing an evaluation process to meet these new accreditation guidelines in that engineering programs give little attention to providing instruction to faculty members for measuring the achievement of learning outcomes and program objectives prescribed by accrediting agencies (Felder & Brent, 2003). Engineering faculty are inclined to formulate outcomes and objectives based on existing curriculum that has been developed based on content-driven courses unrelated to their constituency: students, alumni, industry, and employers.

To meet accreditation standards, programs must demonstrate that they have implemented evaluation processes that measure the achievement of outcomes and objectives based on input from constituents (Felder & Brent, 2003). Without a clear understanding of accreditation requirements and a framework for developing and implementing learning outcomes and program objectives, faculty are limited to content-driven objectives. Course content can no longer be the sole consideration in curriculum development, in that EC2000 and SACS' Principles of Accreditation require that programs measure the achievement of specified learning outcomes and educational objectives (Fink, 2003).

Accrediting agencies require programs to continuously evaluate and publish the needs of constituents and maintain educational objectives that are consistent with these needs. Programs with dissimilar constituents may have different objectives in that ABET and SACS do not question a program's objectives as long as the program demonstrates that the objectives meet the needs of constituents. ABET accredited engineering programs when not all performance criteria were achieved on their first accreditation visit under EC2000 (Felder & Brent, 2003). In ABET's first visit to a program following EC2000, a plan for a continuous evaluation process sufficed.

**Problem Statement**

Engineering programs have recognized the need for a procedure to measure the achievements of students and to demonstrate value-added knowledge necessary to the practice of engineering. The year prior to an accreditation visit, engineering programs gather data necessary to meet the accreditation criteria for a certification visit by ABET (EED, 2003). Felder and Brent (2003) identified the need for engineering programs to develop measurable outcomes, data collection methods, assessment procedures, evaluation standards, and processes for program improvements in order to comply with the accreditation criteria. Computer technologies afford the means to develop Web-based assessment and evaluation processes identified by Felder and Brent. Computer technology is used to assist undergraduate programs in achieving program objectives and learning outcomes, determining students' progress, and providing mechanisms that make available feedback for continuous program improvement (Hoare, Besterfield-Sacre, Shuman, Shields, Gerchak, Eartman, & Johnson, 2002).

Institutions use Web-based assessment instruments to verify that program objectives and learning outcomes are met. The Illinois Online Network provides a range of Web-based services for on-line instruction that include instructional design, instructional strategies, and methods for assisting students in obtaining skills needed to participate in on-line instruction. The Pitt On-line Student Survey System ($OS^3$) uses Web-based instruments to gather student self-assessments from seven engineering schools (Hoare et al., 2002). According to Hoare et al., there is a need for a reporting system that allows administrators to adapt the results of these surveys to their specific learning outcomes and defined program objectives. Whereas these on-line services deliver instructional materials and report achievement, the study measured the level to which a program meets its program objectives, reviewed the products of these measurements, and provided results for improving the program.

While meeting accreditation requirements may seem straightforward and routine, a paradigm shift is occurring in undergraduate education due to revised accreditation requirements. National and regional accrediting agencies require educational institutions to provide evidence that indicates the fulfillment of program objectives and generates results for improvement of curriculum (ABET, 2004; Abramson, 2002; SACS, 2005). Although ABET has required a plan for continuous program improvement, many engineering programs do not provide feedback in a manner that is of assistance in improving programs (Besterfield-Sacre, Schuman, Wolfe, Scalise, Larpkiattaworn, Muogboh, Budny, Miller, & Olds, 2002; Felder & Brent, 2003). *The problem identified for the study is* that undergraduate engineering programs have failed to generate evaluation processes that comply with accreditation requirements.

**Goal**

*The goal of the study was* to develop and implement an evaluation process for meeting accreditation requirements: assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process was encapsulated in a model that contained a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvement.

The model provided a continuous course of actions that considered the needs of constituents: faculty, students, employers, industry, and alumni. The acquiring of input from constituents, assessing of achievement of students and graduates, and formulation of results based on these assessments provided the rationale for a formative study to improve an undergraduate program as evaluation processes are developed (Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths, & Wittrock, 2001). As a final point, the evaluation processes provided a systematic comparison of current measurements and past results.

**Relevance and Significance**

Christian Brothers University (CBU) in Memphis, Tennessee, is one of 17 colleges or universities that form the Institute of the Brothers of Christian Schools. The schools that are a part of the CBU community are located in 86 countries with a faculty and staff of over 90,000 and serve one million students from grade school to Ph.D. CBU offers degrees in arts, business, engineering, and sciences with an enrollment of 1800 undergraduate students and 600 graduate students in education, business, and engineering management. A Web-based evaluation process enhanced the ability to share information between the program and administrators.

The U.S. Department of Education (DE) and Council for Higher Education Accreditation (CHEA) recognizes ABET, a coalition of 31 professional engineering and technical societies, as the sole accreditation agency for engineering programs (Carnevale, 2000; Phillips, Peterson, & Aberle, 2000). State licensing boards for engineers require a degree from an institution with an ABET approved program; and accreditation of a school is required for students to receive federal funds in the form of grants, loans, and assistantships. Parents and potential students are assured that a program has met minimum standards when it is ABET accredited. Accreditation criteria, therefore, are a guiding force in engineering education.

In the 2001-2002 assessment report, ABET (2003) found 38% of the 294 evaluated programs weak, that is the programs were found to lack the potential to assure compliance until the next review. McVearry (2002) stated that the majority of the problems experienced in meeting ABET accreditation dealt with program objectives, learning outcomes, and assessment.

Besterfield-Sacre et al. (2002) identified studies indicating that almost 50% of students entering engineering schools did not graduate in engineering, with a majority leaving in the first year. CBU's retention rate is consistent with these results. The University of Pittsburgh used predictive systems based on ABET's accreditation criteria for continuous program development and improved retention from 72% in 1996 to 88% in 2001. Based upon these results, the engineering retention problem can be addressed by improvements in assessment and evaluation processes that readily provide information to faculty for continuous improvement of engineering programs.

The study is timely because in the first visit to CBU in 2003 under EC2000 guidelines, ABET permitted programs to continue with only a plan for continuous improvement (Felder & Brent, 2003). In the second visit of the six-year accreditation cycle in 2009, programs must demonstrate that they have implemented evaluation processes that contain all elements of ABET's accreditation criteria including methods for continuous improvement. In addition, SACS adopted new Principles of Accreditation in 2001 (SACS, 2005), and this study will assist the ECE department in meeting SACS' criteria.

**Barriers and Issues**

The Office of Institutional Research and Effectiveness (OIRE) at CBU and Soundarajan (2002) suggested that evaluation strategies contain:

1. A plan that is a product of input from constituents
2. A plan that is continuous rather than periodic
3. Involvement of several faculty members
4. Multiple methods of measurement for decision-making

Faculty must obtain input from constituents, generate meaningful results from this input, and prepare learning outcomes and program objectives based on this information (Soundarajan, 2002). Soundarajan suggested the use of a wide range of assessment strategies to evaluate programs and provide feedback for improvements. An Undergraduate Studies Committee might formulate a set of program objectives and circulate them electronically to the faculty for comment. The committee would then revise the objectives based on faculty feedback. Input from constituents could be obtained online for analyzing and distribution to curriculum committees. A Web site developed by Ellis, Zurita, and Ventura (2005) and WebCT (http://webct.cbu.edu/webct/public/home.pl) provided access to the surveys and results for committees and constituents involved in the evaluation processes.

Computing and networking technologies have afforded educational institutions the ability to send, receive, and store vast amounts of information anywhere at anytime (Abbey, 2000; Littman, 2002). These technological advances are not changes in the level of competency but a fundamental change in the methodology of instruction, assessment, and evaluation. The rate of acceptance and incorporation of technological advances into the accreditation process relies on the level of knowledge of the faculty and the planning process of educational decision makers (Abramson, 2004). This change in methodology requires a framework for evaluation and assessment that is radically different from the traditional curriculum framework of content-based evaluation processes. An effective Web-based evaluation process provided the faculty and administrators the information necessary to enable systematic improvements in engineering programs in order to comply with accreditation criteria, if accepted, by students, faculty, and alumni.

One fundamental change in program development was the formation of faculty teams to formulate course requirements (Zabudsky, 2000). Historically, faculty have generated goals and learning outcomes, measured student progress, and reported the instructional results for each course taught. Often different sets of goals and measurements of learning outcomes for a particular course are generated resulting in inconsistencies in results for that course. An agreed upon set of goals, learning outcomes, assessment processes, and performance evaluations by ECE faculty teams can provide uniformity to the program (Soundarajan, 2002). Web-based technologies can facilitate the process by providing a framework for an evaluation process that is readily available to the faculty.

The University of Alabama's ECE department (http://ece.eng.ua.edu/undergraduate_programs/abet_and_assessment.asp) developed a two-loop model for program evaluation, and Arizona State University's Mechanical and Aerospace Engineering Department (http://ceaspub.eas.asu.edu/mae-ec2000/PDF_documents/standard_processes/sp00.pdf) developed a model for program evaluation that employs three loops. While these models use the concepts contained in the Two Loops of EC2000 process as recommended by ABET (2004) for program evaluation, this work focused on methods for measuring the level to which program objectives are fulfilled and developed strategies for expanding the existing evaluation processes. A systematic framework was used to present results of the evaluation processes to the faculty and administrators. A model for curriculum design developed by Diamond (1998) was used to formulate the evaluation processes.

**Research Questions**

Four research questions guided this study to enhance evaluation processes in undergraduate programs:

1. Who are the constituents of the program?

2. What information must be gathered from the constituents in order to satisfy accreditation requirements?

3. What performances are expected of graduates as a result of their educational experiences?

4. What evaluation processes may be used to measure the achievement of program objectives required by constituents of undergraduate programs?

**Limitations**

The following is an acknowledgement of the limitations to the scope and applicability of the study:

1. The relatively small ECE department at CBU provided the basis for the study. Generalization of results to other programs may be limited.
2. The constituents were recruited from a community associated with a small private university that emphasizes small class sizes and Christian values. Generalizations to other universities may be limited to similar communities and constituencies.
3. The study was limited by the willingness of constituents to respond truthfully and thoroughly when completing the survey instruments.

**Delimitations**

The following is an acknowledgement of the delimitations to the scope and applicability of the study:

1. Participants used a Web-based instrument to participate in the study. Provisions for paper-and-pencil surveys/questionnaires were not provided.
2. The study was restricted to the ECE program rather than all programs in the engineering department. Generalizations to other engineering departments at CBU may be of limited value.
3. Participants were allowed to take part in the study without supervision. It was possible for individuals other than CBU constituents to access the surveys if given information by participants. In addition, it was possible for participants to submit multiple responses.
4. The constituents in the study were limited to students, faculty, alumni, and employers.
5. Alumni and employers were aware that the surveys were being conducted at CBU.

**Definition of Terms**

An explanation of how the following terms are used in this document will help the reader. Terms are listed in alphabetical order and each is supported by the literature. Acronyms are established within the definitions.

*Accreditation Board for Engineering and Technology, Inc. (ABET).* The sole accreditation agency for engineering education in the United States (ABET, 2003; Carnevale, 2000). It consists of a coalition of 31 professional engineering and technical societies and accredits some 2500 engineering programs in over 500 schools in the United States.

*Assessment.* A process defined by ABET (2002, 2004) for measuring the achievement of learning outcomes. ABET specifies that all engineering programs measure the achievement of at least 11 specified learning outcomes.

*Commission on Colleges of the Southern Association of Colleges and Schools (SACS).* The mission of SACS is the improvement in education through accreditation of colleges and schools. Member colleges of SACS set accreditation standards, and these standards are subject to peer review and represent the cooperative judgment of member colleges. SACS accredits over 12,000 schools in 11 states (SACS, 2005).

*Constituency.* Students, faculty, administrators, alumni, employers of graduates, industry, government, and the citizens that are stakeholders in the ECE program (http://www.abet.org/documents/eac/csucasestudy.doc and http://ece.eng.ua.edu/undergraduate_programs/abet_and_assessment.asp).

*Electrical and Computer Engineering (ECE) Advisory Board.* A committee comprised of alumni, employers of graduates of CBU and industry leaders who provide constituent input for improving the program (http://www.cbu.edu/engineering/eceadv.html). The faculty provide program objectives to the board for evaluation and comment.

*ECE Curriculum Committee.* A committee comprised of members from professional societies, faculty, student branches of professional societies, and faculty from other science and engineering management departments (Soundarajan, 2002). The committee provides input for improvement in the evaluation processes.

*Engineering Criteria of 2000 (EC2000).* A publication by ABET that formulates the program requirements necessary to maintain accreditation (http://www.abet.org/ec2000.html).

*Evaluation.* A process defined by ABET (2002, 2004) for examining results obtained from measuring learning outcomes and program objectives. The results of this process should enable faculty to improve programs.

*Formative Evaluation.* A process for implementing program changes while gathering information to improve a program is taking place (Anderson et al, 2001). Program modification may take place while appraising the results from measuring the achievement of program objectives. A process of improving a program based on evidence collected while measuring the achievement of learning outcomes and program objectives (Gardiner, 2002).

*Objectives.* A term defined by ABET (2002, 2004) as statements of the knowledge that learners are expected to have achieved that are needed in the first few years in the practice of engineering. ABET requires that engineering programs specify program objectives that are consistent with its constituents.

*Office of Institutional Research and Effectiveness (OIRE).* An administrative department at CBU responsible for compiling, disseminating, and analyzing data and information for the entire university (http://www3.cbu.edu/Academics/Faculty/appendix_c9.htm). The OIRE reports to the Academic Vice President and works with the individual departments of the university in applying the Institutional Effectiveness Criteria established by SACS and ABET.

*Outcomes.* A term defined by ABET (2002, 2004) as statements of the knowledge that learners will have acquired by graduation. ABET requires that engineering programs specify learning outcomes that are consistent with its constituents.

*Performance Criteria.* Measurable statements that appraise learning outcomes and program objectives (ABET, 2002, 2004). ABET requires proof of the attainment of specific learning outcomes and achievement in the workplace independent of students' success in taking exams and passing courses.

*Principles of Accreditation*. A publication by SACS that formulates the institutional requirements necessary to maintain accreditation (http://www.sacscoc.org/principles.asp).

*Rubric.* A set of guidelines for grading and assessing constituents' values, attitudes, level of confidence, and perceptions (Wiggins, 1998). A scale of values assigned to work or measures to evaluate quality or achievement (Wiggins & McTighe, 2005).

*Summative Evaluation.* A process for implementing program changes after the gathering of information to improve a program (Anderson et al, 2001). Program modification may take place after appraising the results from measuring the achievement of objectives. A process in which the implementation of program improvements occurs at the completion of measuring the achievement of learning outcomes and program objectives (Gardiner, 2002).

**Summary**

Accreditation criteria require a process that integrates constituents into the evaluation process. The evaluation process developed provides a systematic framework using Web-based technologies for measuring program objectives and presenting evaluation results to the faculty and administrators.

Professional judgment is the basis for an evaluation process in engineering education, in that ABET is a coalition of professional engineering and technical societies. ABET requires programs to meet the requirements for the practice of engineering, and the evaluation process determines whether a program meets accreditation criteria (Prados, Peterson, & Lattuca, 2005). Likewise, accreditation is a process for determining if a program meets standards of educational quality. Accreditation assures students, industry, and the public that graduates of an accredited curriculum have achieved a minimum level of proficiency in a program.

# Chapter 2

# Review of Literature

## Overview of Engineering Accreditation

For over 70 years, accrediting agencies have provided guidelines to educational institutions to assist in the preparation of engineering graduates to meet the demands of engineering practice (Boykin, 2005). By the 1980s, accreditation criteria had become progressively more prescriptive, preventing the development of program enhancements needed to meet the varying needs of the profession (Besterfield-Sacre, Shuman, Wolfe, Atman, McGourty, Miller, Olds, & Rogers, 2000). To meet the requirements of the profession and industry, ABET, a coalition of 31 professional engineering and technical societies, revised accreditation criteria to emphasize learning outcomes, program objectives, and continuous quality improvement rather than dogmatic criteria.

Prados et al. (2005) described the early evolution of engineering accreditation and professional licensing,

> Many of today's accreditation issues have their roots in the historical development of engineering education in the United States, which evolved in the nineteenth century from two stems: the formal mathematical-scientific, school-based system developed in France, as exemplified in the École Polytechnique, and the apprenticeship system prevalent in England. …By the early 1900s, these two approaches had been blended into a somewhat uncomfortable compromise at most institutions. …Intertwined with accreditation is the legal regulation of engineering practice. Beginning in 1907 with the passage of a Wyoming law, states began to regulate such practice through systems of licensure administered by state boards of registration. …Engineers offering their services to the public are required by law to be licensed in the state(s) in which they practice.

> Registration laws normally provide certain exemptions for engineers working for industry and government. …Until the early twentieth century, few, if any, efforts were made to standardize or regulate programs of engineering education. …By 1920, the number of state boards had increased to ten, seven of which joined to form the Council of State Boards of Engineering Examiners to encourage uniform laws and licensing standards among its member boards (http://www.ncees.org/introduction/about_ncees/history.php). The Council has undergone several name changes since that time and is now known as the National Council of Examiners for Engineering and Surveying (NCEES), representing fifty-five boards of registration… In 1907, the Society for the Promotion of Engineering Education (now the American Society for Engineering Education—ASEE) invited four professional societies to join in a Joint Committee on Engineering Education to make recommendations regarding engineering curricula. (p. 166)

In the 1920s and 1930s, several engineering societies met and formed the Engineers Council for Professional Development (ECPD) (http://www.abet.org/history.shtml). The purposes of ECPD were to supply information for engineering students, develop plans for professional development, appraise engineering curricula, and provide the means by which individuals could achieve recognition of engineering proficiency. In 1980, ECPD became the Accreditation Board for Engineering and Technology (ABET) to reflect its focus on accreditation to the public.

In 1997, after a decade of development, ABET adopted Engineering Criteria 2000 (EC2000) that focuses on learning outcomes rather than course content. EC2000 criteria require engineering programs to evaluate the educational performance of students and the performance of graduates in the workplace. In addition, the criteria require that undergraduate programs develop curriculum based on constituent input.

Accreditation criteria require undergraduate programs to develop curriculum based on constituent input and has required a revamping of evaluation processes (Fink, 2003). Accrediting agencies allow a great deal of leeway in formulating educational objectives and learning outcomes, as the intent is to be less authoritative in program development. Faculty are responsible for formulating processes that meet student, graduate, industry, and institutional needs for undergraduate programs.

ABET requires engineering programs to demonstrate that knowledge has been acquired and applied in appropriate environments. The National Research Council (NCR) (2003) recommends that educators use a scientific approach to program assessment and program evaluation. Educators benefit by following an established educational model during the program assessment and evaluation processes. The challenge for educators is to develop an evaluation process that employs ever-changing technology in an efficient and systematic manner (Brawner, Anderson, Zorowski, & Serow, 2001; McNeil & Robin, 2002).

**Literature Search**

The review of the literature introduces the principles and status of the assessment and evaluation processes found in undergraduate engineering education. It focuses on the evaluation processes used in undergraduate education and the principles that promote quality improvement in the evaluation process and student achievement. First, the learning theory associated with engineering education is reviewed. Second, the accreditation criteria for programs are examined to provide a guide to assessment and evaluation processes, particularly for those not familiar with accreditation criteria. The next section reviews assessment and evaluation processes used to satisfy accreditation criteria and highlights faculty, students, alumni, and industry as the key components of quality evaluation processes. Finally, an examination of relevant examples of evaluation processes found in undergraduate education is presented to provide a benchmark for reliable practices for implementing quality evaluation processes.

*Learning Theory*

Technology-enriched educational programs require faculty to have an understanding of learning theory that is applicable to the curriculum. Developing a model that incorporates established learning theory provides a sound educational basis for an evaluation process.

Learning theory is the foundation on which to develop Web-based technologies for engineering curriculum and is characterized by two wide-ranging theories: (1) Objectivism, based on elaboration and information processing theory, wherein learning is the transfer of knowledge from the teacher to the student utilizing well-organized instructional material and step-by-step instruction in increasing order of complexity (Jackson & Dwyer, 1995; Parker, 1993); (2) Constructivism, based on Vygotsky's learning theory, wherein learning includes activity, perspective, collaboration, opinion, and reflection (Artemeva, Logie, & St-Martin, 1999; Khan & Brown, 2000; Perrenet, 2000).

Engineering activities often entail extensive collaboration in a team setting with a great deal of interaction with team members, clients, and management (Crowley, Dolle, Litchfield, & Price, 2001). Vygotsky (Bork, 2000; Mahn, 1999; Wood & Wood, 1996) developed learning theories relevant to engineering activities and education, as well as the development of managerial skills. Mahn (1999) describes Vygotsky's theory of development as the interaction of the individual and social forces, which lead to learning and the evolution of higher mental functions. This evolution is a qualitative transformation and not a continuous progression of knowledge by learners (Genalo, Schmidt, & Schiltz, 2004).

Wood and Wood (1996) demonstrated the effectiveness of instruction in enhancing learning outcomes utilizing the general concept of *Vygotsky's Zone of Proximal Development*. *Vygotsky's Zone of Proximal Development* is the difference between the level of existing development (knowledge) of a learner and the potential of greater development (knowledge) that comes about in interaction (collaboration) with skilled participants in a learning process. Wood and Wood use Vygotsky's learning theory to demonstrate scaffolding and tutoring strategies, in that scaffolding and tutoring serve as structures between a learner's existing knowledge and successful learning outcomes. Vygotsky's work examines three principles: the mind is understood by examining how it changes; higher mental functions originate in collaborative activity; and higher mental functions are facilitated by tools and signs.

Other learning theories related to engineering curriculum are elaboration theory (Jackson & Dwyer, 1995), social learning theory (Ryckman, 1997), information-processing theory (Parker, 1993), and conditions of learning theory (Becker, 1986). Jackson and Dwyer utilized the elaboration theory, extension of the theories of Ausubel (advance organizers) and Bruner (spiral curriculum) (Mahn, 1999; Miller, 1983), to sequence sets of instructions in ever-increasing order of complexity in order to optimize learning outcomes. Social learning, based on Albert Bandura's social-cognitive theory, emphasizes the interaction of cognitive, behavioral, and environmental influences and the important role these experiences play in the development and modification of behavior, resulting in successful learning outcomes. Parker describes information-processing theory as containing relationships between stimuli, visual registers, auditory registers, haptic registers, short-term memory, long-term memory, processing of information, and information retrieval time. Becker expresses Gagne's *conditions of learning theory* as a structural analysis of knowledge in ways that assist cognitive instruction and that there are eight types of learning: signal learning, stimulus-response learning, chaining, verbal association, discrimination learning, concept learning, rule learning, and problem solving. Artemeva et al. (1999) interpreted situated learning as a social process in which learners first observe a function or activity and then learn through dialogue and social activity.

Additional learning theories related to engineering curriculum are situated learning theory (Artemeva et al., 1999), dual coding theory (Stolte, 1996), and theory of andragogy (Cullen, 1999). Situated learning, as a general theory of knowledge acquisition, is well suited to technology-based disciplines that require problem-solving skills. Stolte states that according to the dual coding theory, a person's cognitive system consists of two subsystems: one verbal for language and one nonverbal for visual, auditory, and tactile. Cullen describes Malcolm Knowles' theory of andragogy on self-directed learning as learning situations in which learners take the responsibility for learning activities: in determining learning needs, in formulating learning objectives, in locating resources, in developing a learning plan, and in assessing the extent to which the objectives are met.

The learning theories discussed are not mutually exclusive and include learning theories that are applicable to evaluation processes. In addition, the theory of andragogy defines the characteristics beneficial to online learners and provides a structure for continuing education for learners in that engineering professionals need life-long learning skills (Cullen, 1999; Miller, 2000).

The implications of the EC2000 guidelines are that educators may develop curriculum and assessment tools based on program objectives and learning outcomes (Besterfield-Sarce et al, 2000).

According to Besterfield-Sacre,

> The integration of these three key elements (cognitive, attitudinal, and behavioral) provides a comprehensive approach to defining a specific learning outcome. Further, true learning outcomes are a demonstration that knowledge does not exist apart from application. In fact, the two are tightly coupled. The attitudinal element indicates that the individual not only is capable of doing "engineering work" but also embodies values of the profession. (p. 101)

ABET does not stipulate the methods used in the development and evaluation process. However, ABET demands that institutions demonstrate the andragogy used to achieve learning objectives as well as evidence of evaluation. A clear understanding of the learning theory on which evaluation processes are based is an important part of the accreditation process.

*ABET's General Criteria*

*Criterion 1: Students.* Institutions must assess student performance, advise students on curriculum and career choices, and measure students' progress in achieving program outcomes. Institutions must ensure that all students meet program requirements.

*Criterion 2: Program Educational Objectives.* Engineering programs must provide (a) educational objectives that are consistent with the institutional mission statement, (b) an evaluation process based on the needs of constituents and that periodically determines if program objectives are achieved, (c) a curriculum that prepares students for the achievement of learning outcomes, (d) a curriculum that promotes the accomplishments of graduates in the practice of engineering that are consistent with program objectives, and (e) an ongoing evaluation process to determine if objectives are obtained and improve the program.

*Criterion 3: Program Outcomes and Assessment.* Engineering programs must demonstrate that students have acquired the ability to:

a) apply knowledge of mathematics, science, and engineering
b) design and conduct experiments, as well as to analyze and interpret data
c) 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
d) function on multidisciplinary teams
e) identify, formulate, and solve engineering problems
f) recognize the importance of professional and ethical responsibility
g) communicate effectively
h) appreciate the broad education necessary to comprehend the impact of engineering solutions in a global, economic, environmental, and societal context
i) recognize the need for, and an ability to engage in life-long learning
j) employ contemporary issues in engineering problems
k) use the techniques, skills, and modern engineering tools necessary for engineering practice

*Criterion 4: Professional Component.* The professional elements of the curriculum must include one year of mathematics and basic sciences that includes experimental experiences and one and one-half years of engineering topics with design that develops systems to meet desired requirements. The curriculum must contain a general educational component that complements program objectives and that prepares students for engineering practice through a capstone design experience based on the knowledge acquired in earlier course work.

*Criterion 5: Faculty.* Faculty must be of sufficient number and have the competencies to cover the curriculum. Faculty must be of adequate levels to accommodate student-faculty interactions, student coinciding, service activities, professional development, and faculty-industry interactions. The faculty competencies must contain a diversity of backgrounds, engineering experiences, teaching experiences, program development skills, participation in professional societies, and licensure as Professional Engineers.

*Criterion 6: Facilities.* The institution must provide adequate classrooms, laboratories, and equipment to accomplish the program objectives. Facilities must be available to support faculty-student interaction and provide the capacity for students to employ modern technology.

*Criterion 7: Institutional Support and Financial Resources.* Institution must provide financial resources, leadership, and staff to assure the quality and stability of the program. Sufficient resources must be available to acquire, retain, and train well-qualified faculty.

The ECE department has adopted the program outcomes of Criterion 3 and the following program objectives to describe the competencies required of graduates in the practice of engineering (http://www.cbu.edu/engineering/eceobj.html):

> The educational objectives of the ECE program are to prepare students to enter and continue the practice of engineering and/or to continue their education by study in graduate or professional schools. Graduates will demonstrate:
> 1. The ability to apply mathematics, engineering sciences, computational methods, and natural sciences to ECE engineering problems.
> 2. Entry-level competency of discipline-specific principles and practices within the following major areas of electrical engineering: communications, continuous/discrete systems, electronics, controls, and power systems. This knowledge base includes the development of analytical and experimental skills.
> 3. The ability to synthesize principles and techniques from engineering, mathematics, and natural/social sciences to develop and evaluate alternative design solutions to electrical engineering problems with specific constraints.
> 4. Professional responsibility and a sensibility to a broad range of societal concerns, such as ethical, environmental, economic, regulatory, and global issues.
> 5. Successful contribution to a team, effective communication, and an awareness of the necessity for personal and professional growth.

*Evaluation Process Requirements*

Accrediting agencies require programs to consider the identified requirements of its constituencies and to focus on open-ended learning outcomes (Fink, 2003; National Research Council, 2003). According to Parker and Alam (2004), constituents consist of faculty, students, alumni, and industrial partners. ABET requires learning outcomes and program objectives to be based on input from constituents.

Prior to the 2000-2001 school year, programs were evaluated based on the design content of the curriculum and not on program objectives and learning outcomes. Accrediting agencies allow flexibility in program content, but they require programs to define outcomes and objectives and demonstrate that students and graduates meet program standards. To meet the requirements for accreditation, faculty must demonstrate compliance with established program objectives that provide an educational process consistent with the mission of the college or university and the needs of its constituencies.

Historically, engineering programs have met the challenge of ever-changing technology that drives program objectives (Denton, Doran, & McKinney, 2002). With the encouragement of industry, accrediting agencies require institutions to measure knowledge and skills based on learning outcomes and program objectives and demonstrate continuous program improvement (Brawner et al., 2001). Whereas ABET requires the measurement of learning outcomes and program objectives, Denton et al. stated that engineering faculty are not trained in educational processes, such as developing and measuring learning outcomes as part of an evaluation process.

ABET (2003) requires that engineering programs assess the quality and performance of the students and graduates. Institutions must evaluate, provide guidance, and monitor students to demonstrate compliance with program objectives. In addition, engineering programs must demonstrate compliance with published learning outcomes and objectives and provide evidence of an educational process consistent with these learning outcomes and objectives (Besterfield-Sacre et al, 2002; Safoutin & Atman, 2000). Moreover, engineering programs must provide an ongoing assessment plan to ensure the achievement of the objectives of the curriculum and a process that enables the continuing evaluation to improve the effectiveness of the curriculum.

The University of Pittsburgh developed surveys for measuring the attitudes and perceptions of students and alumni of engineering programs (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf). The surveys reflected the mature outlook that students gain in advancing through the educational programs. Diamond (1998) provided surveys to alumni to assess attitudes and skills acquired in educational programs. The *Teaching Goals Inventory* formulated by Angelo and Cross (1993) allows instructors to self-assess their perceptions of their classroom activities and instructional goals. The adaptation of these surveys to measure the achievement of program objectives and the integration of these surveys into an evaluation process provided information on the perceptions and attitudes of students, alumni, and faculty toward engineering programs.

Institutions can develop and implement Web-based assessment and evaluation processes that minimize the time required by faculty to assess students' progress, make use of existing computer skills of faculty, and employ existing computer networks and resources (Gaud, 1999). A meaningful development of Web-based processes that will enrich a program is due in part to the interdisciplinary cooperation of engineers, cognitive physiologists, and educationists (Craig, Gholson, Ventura, Graesser, & the Tutoring Research Group, 2000). Hoare et al. (2002) stated that Web-based assessment and evaluation processes facilitate measurements of performance criteria and level of achievement of program objectives.

*Model for an Evaluation Process*

Anderson et al. (2001) formulated a formative evaluation process that provides a mechanism for measuring information about learning as learning is taking place. Fink (2003) reported that a formative evaluation process is an integrated progression of instructional endeavors that include program objectives, learning outcomes, learning activities, instructional resources, assessments, and program modifications. The employment of formative evaluation processes generates models that provide feedback for continuous improvement and support participation from all members of the faculty.

Diamond (1998) developed a model for program development that affords faculty a systematic course of action for modifying the programs to improve the quality of learning during the evaluation process. The use of a systematic model for an evaluation process employing Web-based technologies to integrate instructional activities in formative and summative evaluation processes provide faculty with the means to improve the quality of learning in engineering programs as students learn (Hoare et al., 2002; Anderson et al., 2001).

Denton et al. (2002) stated that the development of standards that are acceptable to faculty allows for the establishment of a systematic approach to evaluation processes. Once standards for measuring the skills of students and alumni are adopted, then new faculty, or faculty that are weak in educational techniques needed for evaluation processes, can identify these standards and experience a smoother transition to outcome-based evaluation processes.

Hoare et al. (2002) stated that an effective Web-based evaluative process enables the efficient use of faculty, facilities, and equipment associated with determining students' progress. While educational institutions provide many technology-based systems to assist in instruction, course management, and program evaluations, few exist that provide toolsets suitable for Web-based evaluation processes that are associated with outcome-based assessment processes (McGourty, 2002b). An outcome-based assessment requires embedded methods of measurement that allow customization by multiple instructors with individualized course content.

Pimmel (2003) discussed the lack of tested instructional material that conforms to the requirement of EC2000 and developed short modules for teaching and measuring skills. These modules measured the students' perception of 15 skills in the four categories of ethical-societal skills, communication skills, professional skills, and technical skills. In the context of engineering problem solving, Pimmel measured students' confidence in their ability to perform tasks associated with:

1. global and societal impact
2. ethical interpretation
3. current issues
4. graphical communication
5. oral communication
6. written communication
7. time management
8. teaming
9. lifelong learning
10. project management
11. problem solving

12. modeling

13. experimental methods

14. design

15. computational methods

The study measured these 15 skills based on existing program-required objectives using surveys and questionnaires to be described in Chapter 3.

Accrediting agencies require evaluation processes to measure outcomes in a comprehensive and secure manner and provide results to faculty and program administrators. Web-based technology can provide the measures and results required to fulfill the assessment and evaluation processes provided the technology meets faculty expectations and the faculty possess or acquire the expertise to use the technology (Abramson, 2004).

**Contribution to the Field of Engineering**

The use of outcome-based evaluation processes that provides feedback for program improvements required an expansion in the methods used in the measuring of learning outcomes and program objectives, and the evaluation of these measurements in order to improve the program (McGourty, 2002b). Web-based technology provided the flexibility necessary for measurements that may be lacking in traditional paper-and-pencil methods and provided the customization of embedded processes for the measurement of the achievement of learning outcomes. Engineering programs need outcome-based evaluation processes that include methods for measuring the obtainment of program objectives, tabulating results for comparison over several semesters, and providing feedback for program improvements.

Faculty are ultimately responsible for the evaluation of a program. Faculty benefit by gaining the ability to integrate the results of surveys on program objectives obtained from constituents into an evaluation process and from a model that enables them to demonstrate that students have met program objectives. In addition, the study identified and employed Web-based technologies to assist undergraduate programs in determining program effectiveness and provided mechanisms to deliver feedback for program improvement.

**Summary**

A review of the literature produced the underlying theory and techniques necessary to develop a model for a Web-based evaluation process. Web-based procedures for measuring the obtainment of program objectives have proven to be effective. However, the specifics of employment of these procedures in an evaluation process that provides feedback for quality improvement had not been adequately developed before the study was conducted.

Models to provide guidelines for evaluation processes that include students and alumni have been developed and used to improve programs. The literature supported the use of cyclical models that provide feedback for quality improvement to programs (Baldrige National Quality Program, 2002). Although these models have proven to be successful in a variety of programs, the literature did not provide the specifics of using these models in a Web-based environment with input from a variety of constituents and employing an assessment by peer constituents.

# Chapter 3

# Methodology

## Research Methods

The investigation employed instruments and procedures using Web-based technologies to enhance evaluation processes used in an undergraduate engineering program. The following actions were implemented for the study: (a) establish an ECE Curriculum Committee, (b) expand the responsibilities of the ECE Advisory Board, (c) develop Web-based instruments to measure the achievement of program objectives of graduates and learning outcomes of students, and (d) provide a model that integrates input from constituents, assessment committees, and results formulated from the results of measuring achievement of students and graduates into an evaluation process.

In order to provide a Web-based evaluation process, the study employed WebCT (2004) and the CBU Online Survey System (Ellis et al., 2005) as interfaces for customized instruments to acquire input from constituents and provide results. Employers and alumni assessed the CBU Online Survey system via a browser to provide information for the study, in that the institutional license for WebCT only allows students presently enrolled at CBU to access the WebCT survey tools. Students used WebCT and the CBU Online Survey System, and instructors used the CBU Online Survey System.

Access was password dependent or URL specific, providing administrators management tools for evaluation and progress tracking. WebCT and the CBU Online Survey System provided quantitative results to the ECE Curriculum Committee and ECE Advisory Board (Basogain, Olabe, & Olabe, 2001; Galvin, 2000).

**Procedures**

The following procedures were implemented:

1. Employed surveys/questionnaires to measure the achievement of program objectives using Web-based technologies
2. Established an ECE Curriculum Committee that contains members from local engineering organizations, the student chapter of IEEE, and faculty
3. Expanded the responsibilities of the ECE Advisory Board to include the examination and validation of the evaluation processes
4. Provided instruments to measure the achievement of program objectives
5. Provided results of surveys/questionnaires to the ECE Advisory Board and ECE Curriculum Committee that enabled them to validate the survey instruments and the model for evaluation

The ECE Curriculum Committee was formed and included:

1. A member of the executive board of the Memphis Chapter of IEEE
2. A member of the executive board of the Memphis Chapter of the Tennessee Society of Professional Engineers (TSPE)
3. A member of the Organizing Committee of the Memphis Area Engineering and Sciences Conference

4. Chair of the IEEE Student Chapter at CBU
5. ECE faculty
6. Dean of Engineering
7. Chair of the Master of Engineering Management
8. A faculty member from the School of Sciences

*Participants*

All ECE students at CBU were invited to participate in the study. Courses offered in the fall semester of 2005 were employed to allow all ECE students to participate. Students were encouraged to participate in the surveys during the classes. Participants for the study consisted of students, faculty, alumni, employers of graduates, and industry who are stakeholders in the ECE program at CBU and as described in Table 1.

Table 1. Participants and Composition

| **Participants** | **Composition** |
|---|---|
| ECE Freshman Class | ME 121 – Solids Modeling |
| ECE Sophomore Class | ECE 250 – Digital Design |
| ECE Junior Class | ECE 331 – Electronics I |
| ECE Senior Class | ECE 409 – Senior Project |
| Graduates | The OIRE provided a list of graduates |
| Employers or potential employers of ECE graduates | The OIRE provided a list employers or potential employers of ECE graduates |
| Faculty | The faculty of the ECE department |

All subjects were 18 years of age or older. The current student body at CBU is 57% female and 43% male; however, the ratio for engineering is approximately 15% female and 85% male.

The author provided the following requests for participation: *Request for Participation by Students– CBU Online Survey* (Appendix A), *Request for Participation by Students – WebCT* (Appendix B), *Request for Participation by Alumni* (Appendix C), *Request for Participation by Industry* (Appendix D), and *Request for Participation by Faculty* (Appendix E). The requests for participation provided participants with instructions for gaining access to the online instruments.

*Surveys and Questionnaires*

To collect information, the author provided a series of surveys or questionnaires for each group of stakeholders. All surveys were available in a password protected or URL specific Web site (http://www.cbu.edu/engineering/survey/) or in an ECE course that uses a password protected WebCT account (http://webct.cbu.edu/webct/public/home.pl). The URL had the form http://www.cbu.edu/survey/tracking.PHP?survey*XX,* where *XX* is a number between 1 and 99 that specifies a specific survey. Students accessed WebCT via their individual CBU e-mail password. In the CBU Online Survey System site and the WebCT course sites, only the aggregate results of a survey were available to the investigator. Individual information was not recorded, nor any information pertaining to the participant's computer. The seven surveys shown in Table 2 provided the measures for the study.

Table 2. Surveys/Questionnaire

| **Surveys/Questionnaire** | **Participants** |
|---|---|
| Freshman Engineering Attitudes Survey (Appendix F) | Freshman ECE students |
| Sophomore Engineering Learning and Curriculum Evaluation Survey (Appendix G) | Sophomore ECE students |
| Junior Engineering Learning and Curriculum Evaluation Survey (Appendix H) | Junior ECE students |
| Senior Survey (Appendix I) | Senior ECE students |
| ECE Alumni Survey (Appendix J) | ECE graduates from May 2000 to May 2005 |
| Industry Survey (Appendix K) | Employers or potential employers of ECE graduates |
| Instructional Goals Questionnaire (Appendix L) | ECE faculty |

No identifying individual information of the participants was recorded in these instruments. The surveys/questionnaire were representative of instruments the participants would expect to encounter in an educational setting. However, the individual groups of students, faculty, alumni, and employers were identified via an instrument specific password or explicit URL. Again, only the aggregate results of these instruments were available to the investigator from the CBU Online Survey system and the WebCT survey system.

All ECE students were asked to participate in the surveys. Students completed one of the first four surveys based on their credit hour standings. Students accessed the surveys via WebCT or the CBU Online Survey System. ECE alumni who graduated in

May 2000 or thereafter completed the ECE Alumni Survey; employers and potential employers completed the Industry Survey; and ECE faculty completed the Instructional Goals questionnaire, all via the CBU Online Survey System.

Figure 1 is an example of the Freshman Engineering Attitudes Survey (first four questions) using the CBU Online Survey System and is representative of all of the surveys in the CBU Online Survey System. The CBU Online Survey System was available to all faculty members.

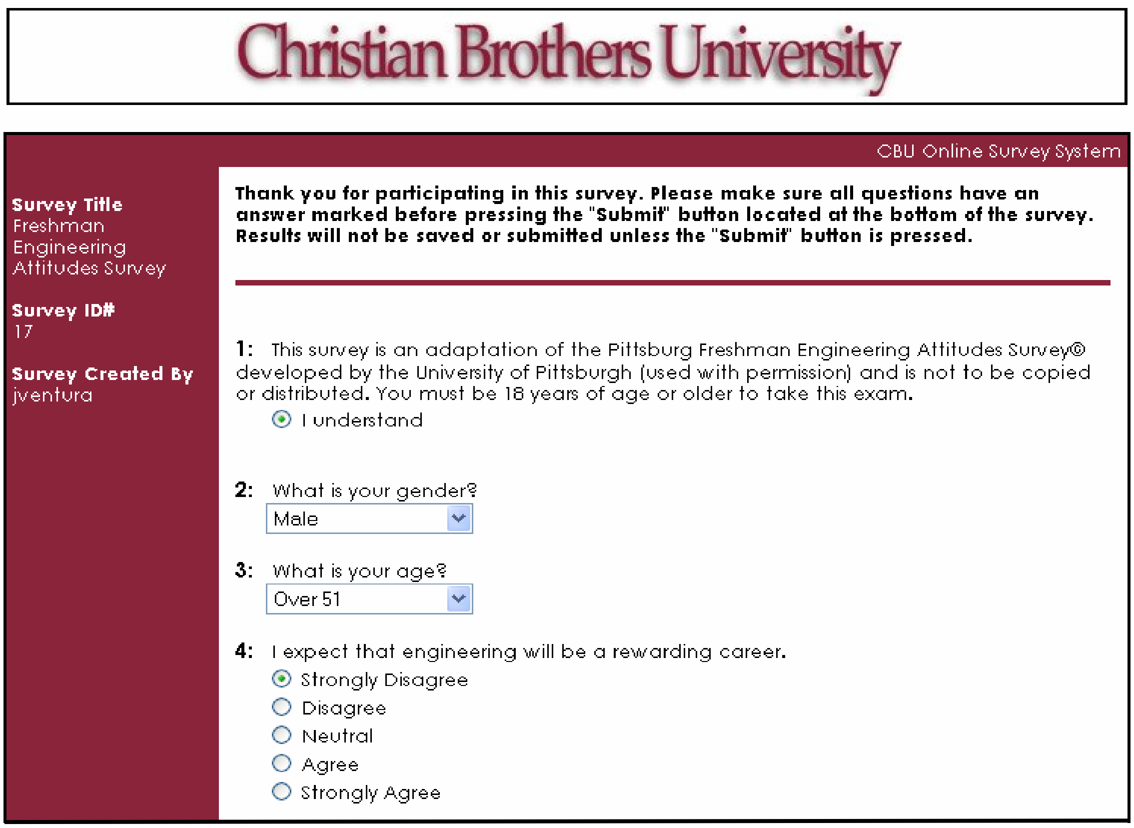



**Figure 1.** Example of the Freshman Engineering Attitudes Survey (first four questions)

Each student and faculty member was given a Request for Participation form by the author. The author provided a survey specific password or survey specific URL to the participants. The alumni and employers were sent a Request for Participation form and a survey specific URL by the author via e-mail.

Figure 2 is an example of the Senior Survey (first four questions) using WebCT. WebCT was available to all faculty members and was linked to the CBU database for student and faculty passwords.

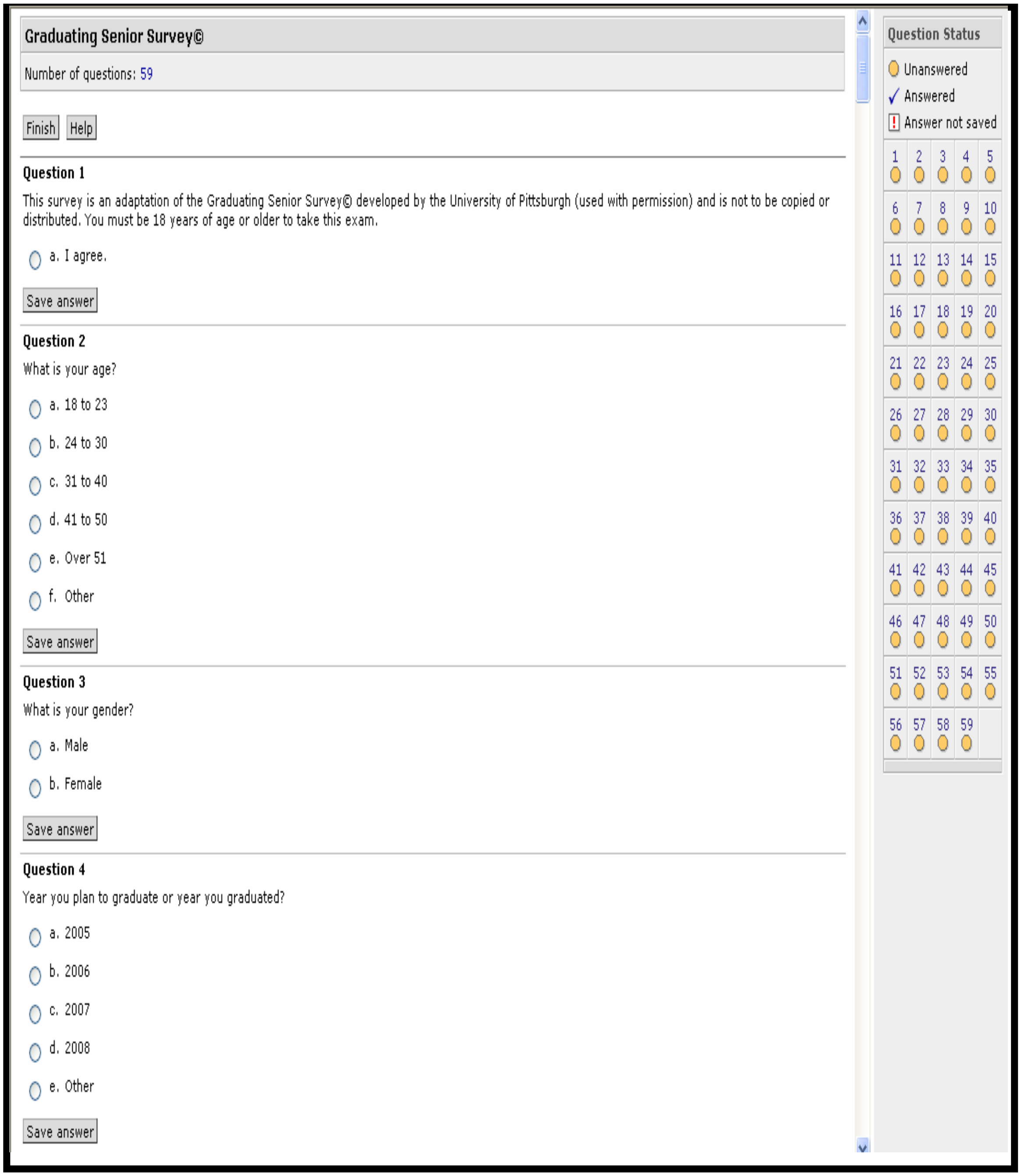



**Figure 2.** Example of the Senior Survey (first four questions)

**Formats for Presenting Results**

Responses were assigned the numerical ratings (categories) shown in Tables 3 and 4. These rating scales were employed to determine the mean for the quantitative questions in the surveys and in the scoring schemes of Tables 5 and 6.

Table 3. Rating scale (category) for measures used in surveys except Industry Survey

| **Category** | **Measure** | | | | | |
|---|---|---|---|---|---|---|
| 1 | Strongly Disagree | Strongly Not Confident | Poor | Not at All | None | Not Applicable |
| 2 | Disagree | Not Confident | Fair | Very Little | Very Little | Unimportant |
| 3 | Neutral | Neutral | Good | Some | Some | Important |
| 4 | Agree | Confident | Very good | A Lot | A Lot | Very Important |
| 5 | Strongly Agree | Strongly Confident | Excellent | A Great Deal | A Great Deal | Essential |

Table 4. Rating scale (category) for measures used for Industry Survey

| **Category** | **Measure** |
|---|---|
| 1 | Low |
| 2 | Medium |
| 3 | High |
| 4 | Very High |

Tables 5 and 6 display adaptations of the grading format used at the University of Pittsburgh's School of Engineering for Freshman Engineering Attitudes Survey, Sophomore Engineering Learning and Curriculum Evaluation Survey, Junior Engineering Learning and Curriculum Evaluation Survey, Senior Survey, ECE Alumni Survey, and Industry Survey (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf).

Table 5. Grading Criteria for ABET Learning Outcomes except Industry Survey

| **Grade** | **Criteria** |
|---|---|
| A+ | >= 75% of responses in categories 5 and 4; > = 50% rated as 5 |
| A | >= 75% of responses in categories 5 and 4; > = 37.5% rated as 5 |
| A– | >= 75% of responses in categories 5 and 4; < 37.5% rated as 5 |
| B+ | 50 to < 75% in categories 5 and 4; >= 37.5% rated as 5 |
| B | 50 to < 75% in categories 5 and 4; >= 25% rated as 5 |
| B– | 50 to < 75% in categories 5 and 4; < 25% rated as 5 |
| C+ | Highest frequency of ratings for category 3 but < =50% in category 3 or number of (4 + 5) and (1 + 2) <= 50%; number of (4+5) > number of (1+2) |
| C | 50 to < 75% in category 3 or number of (4 + 5) and (1 + 2) <= 50%; number of (1+2) = number of (4+5) |
| C– | Highest frequency of ratings for category 3 but <= 50% in category 3 or number of (4 + 5) and (1 + 2) <= 50%; number of (1+2) > number of (4+5) |
| D+ | < 75% to >= 50% in categories 1 and 2; < 25% are in category 1 |
| D | < 75% to >= 50% in categories 1 and 2; >= 25% to < 37.5% are in category 1 |
| D– | < 75% to >= 50% in categories 1 and 2; >= 37.5% are in category 1 |
| F | >= 75% are in categories 1 and 2 |

Note. From “University of Pittsburgh School of Engineering Student Assessment System,” by M. Besterfield-Sacre, L. Shuman, R. Hoare and H. Wolfe, July 7, 2005 (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf). University of Pittsburgh©. Adapted with permission of the authors (Appendix M).

Table 6. Grading Criteria for ABET Learning Outcomes for Industry Survey

| Grade | Criteria |
|---|---|
| A+ | >= 80% of responses in categories 3 and 4; > = 50% rated as 3 |
| A | >= 80% of responses in categories 3 and 4; > = 37.5% rated as 4 |
| A– | >= 80% of responses in categories 3 and 4; < 37.5% rated as 4 |
| B+ | 60 to < 80% in categories 3 and 4; >= 37.5% rated as 4 |
| B | 60 to < 80% in categories 3 and 4; >= 25% rated as 4 |
| B– | 60 to < 80% in categories 3 and 4; < 25% rated as 4 |
| C+ | Highest frequency of ratings for category 2 and 3 but < =60% in category 2 and 3; number of (3+4) > number of (1+2) |
| C | 60 to < 80% in category 2 and 3 |
| C– | Highest frequency of ratings for category 2 and 3 but < =60% in category 2 and 3; number of (1+2) > number of (3+4) |
| D+ | < 90% to >= 70% in categories 1 and 2; < 25% are in category 1 |
| D | < 90% to >= 70% in categories 1 and 2; >= 25% to < 37.5% are in category 1 |
| D– | < 90% to >= 70% in categories 1 and 2; >= 37.5% are in category 1 |
| F | >= 90% are in categories 1 and 2 |

Note. From "University of Pittsburgh School of Engineering Student Assessment System," by M. Besterfield-Sacre, L. Shuman, R. Hoare and H. Wolfe, July 7, 2005 (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf). University of Pittsburgh©. Adapted with permission of the authors (Appendix M).

Employing the results obtained from the Freshman Engineering Attitudes Survey, Sophomore Engineering Learning and Curriculum Evaluation Survey, Junior Engineering Learning and Curriculum Evaluation Survey, Senior Survey, ECE Alumni Survey, and Industry Survey, the investigator applied the grading criteria of Tables 3 and 4 to the results of the surveys for each of the learning outcomes of Criterion 3 as found on page

23. Table 7 is an example of the format used for the application of the grading criteria to the survey responses for Criteria 3b – An ability to design and conduct experiments, as well as to analyze and interpret data.

Table 7. Grading Criteria 3b – An ability to design and conduct experiments, as well as to analyze and interpret data

| Survey Question | Constituent | Grade |
|---|---|---|
| Designing and conducting an experiment to obtain measurements or gain additional knowledge about a process | Freshman | |
| Designing an experiment to obtain measurements or gain additional knowledge about a process | Sophomore | |
| Designing an experiment to obtain measurements or gain additional knowledge about a process | Junior | |
| Designing an experiment to obtain measurements or gain additional knowledge about a process | Senior | |
| Designing an experiment to obtain measurements or gain additional knowledge about a process | Alum Then | |
| My ability to design and conduct an experiment to obtain measurements or gain additional knowledge | Alum Now | |
| Rate the ability to design a device or process to satisfy a set of specifications | Industry | |
| Rate the ability to design a device or process to satisfy a set of specifications | Industry Non-CBU Graduate | |
| Rate the ability to design a device or process to satisfy a set of specifications | Industry CBU Graduate | |
| Analyzing and interpreting a set of data to find underlying meaning(s) | Freshman | |
| Analyzing a set of data to find underlying meaning(s) | Sophomore | |

| Survey Question | Constituent | Grade |
|---|---|---|
| Analyzing a set of data to find underlying meaning(s) | Junior | |
| Analyzing a set of data to find underlying meaning(s) | Senior | |
| Analyzing a set of data to find underlying meaning(s) | Alum Then | |
| My ability to analyze and interpret a set of data to find underlying meaning | Alum Now | |
| Rate the ability to analyze and interpret data | Industry | |

Note. From "University of Pittsburgh School of Engineering Student Assessment System," by M. Besterfield-Sacre, L. Shuman, R. Hoare and H. Wolfe, July 7, 2005 (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf). University of Pittsburgh©. Adapted with permission of the authors (Appendix M).

Tables 8 and 9 were employed to display the results of the Instructional Goals Questionnaire (Teaching Goals Inventory) developed by Angelo and Cross (1993), and adapted by Diamond (1998). These tables provided a self-evaluation process for the faculty to determine the perceived instructional goals for courses.

Table 8. Assessment of Importance of Goals

| Cluster Number and Name | | Goals Included in Cluster (Item #) | Total Number of *Essential* Goals in Each Cluster (Six Faculty) | Cluster Ranked for 1st to 6th by Number of *Essential* Goals |
|---|---|---|---|---|
| I | Higher-Order Thinking Skills | 3-10 | | |
| II | Basic Academic Success Skills | 11-19 | | |
| III | Discipline-Specific Knowledge and Skills | 20-27 | | |
| IV | Liberal Arts and Academic Values | 28-37 | | |

| Cluster Number and Name | Goals Included in Cluster (Item #) | Total Number of *Essential* Goals in Each Cluster (Six Faculty) | Cluster Ranked for 1st to 6th by Number of *Essential* Goals |
|---|---|---|---|
| V Work and Career Preparation | 38-45 | | |
| VI Personal Development | 46-54 | | |

How many of the 52 goals were rated as *essential*?

Note. From "Classroom Assessment Techniques," by T. A. Angelo and K. P. Cross, 1993. Copyright 1993 by Jossey-Bass – John Wiley & Sons, Inc. Also, from "Designing and Assessing Courses and Curricula" by R. M. Diamond, 1998. Adapted with permission of Jossey-Bass Inc. – John Wiley & Sons, Inc. (Appendix N and O).

Table 9. Cluster Assessment

| Cluster Number and Name | Goals Included | Sum of Ratings Given to Goals in That Cluster | Divide Sum of Ratings by This Number | Cluster Scores | Cluster Ranked for 1st to 6th by Scores |
|---|---|---|---|---|---|
| I Higher-Order Thinking Skills | 2-10 | | | | |
| II Basic Academic Success Skills | 11-19 | | | | |
| III Discipline-Specific Knowledge and Skills | 20-27 | | | | |
| IV Liberal Arts and Academic Values | 28-37 | | | | |
| V Work and Career Preparation | 38-45 | | | | |
| VI Personal Development | 46-54 | | | | |

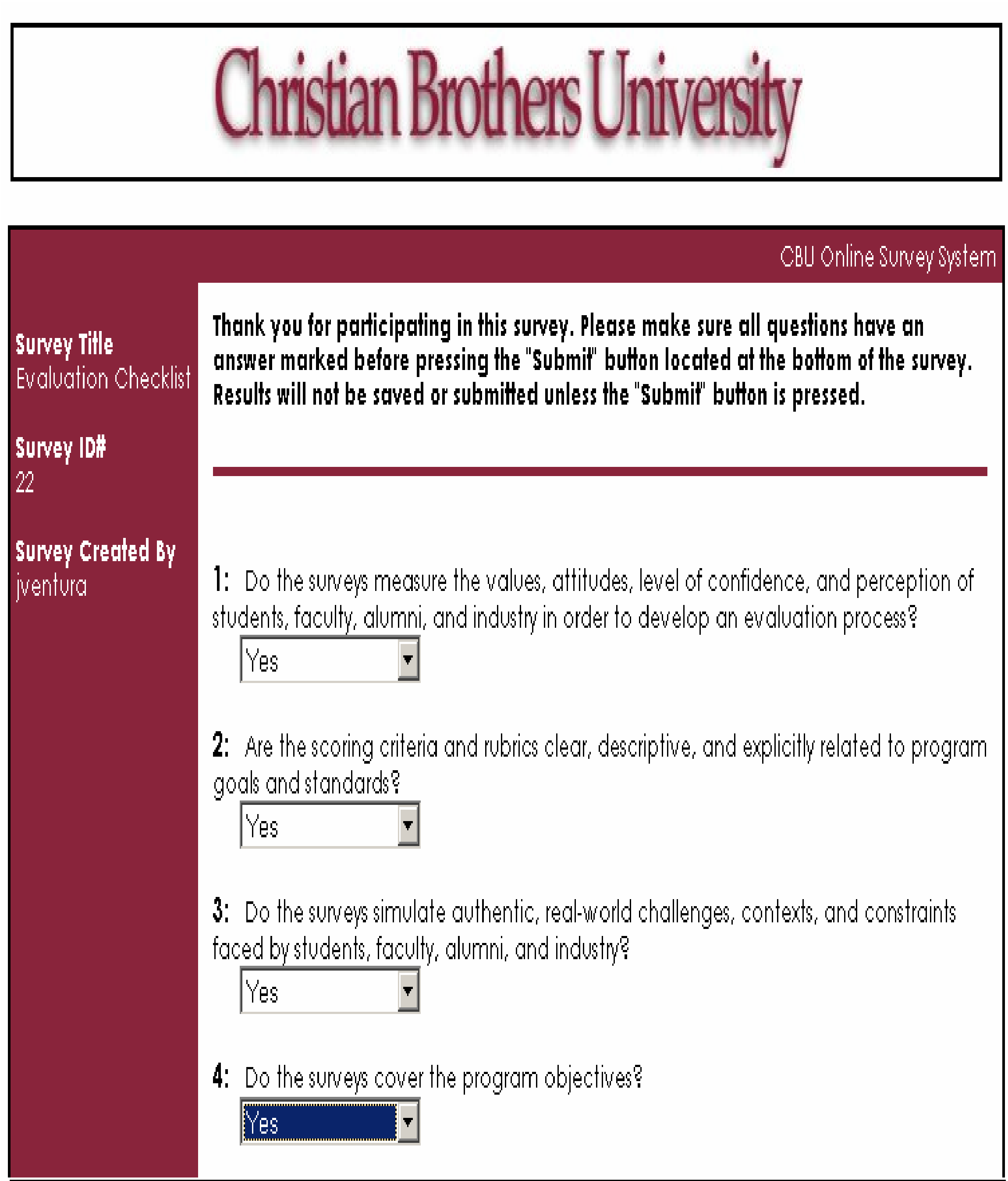
Note. From "Classroom Assessment Techniques," by T. A. Angelo and K. P. Cross, 1993. Copyright 1993 by Jossey-Bass – John Wiley & Sons, Inc. Also, from "Designing and Assessing Courses and Curricula" by R. M. Diamond, 1998. Adapted with permission of Jossey-Bass Inc. – John Wiley & Sons, Inc. (Appendix N and O).

After the ECE Curriculum Committee was formed (Appendix P), the ECE Advisory Board (Appendix Q) and ECE Curriculum Committee were given the Model for an Evaluation Process for an Electrical and Computer Engineering Department (Appendixes R) and asked to complete the Evaluation Checklist for the ECE Advisory Board and ECE Curriculum Committee (Appendix S). The checklist was adapted from the Assessment Design Rating Checklist for Peer Review developed by Wiggins (1996, 1998) (Adapted with permission of publishers –Appendixes N and T). The Model for an Evaluation Process for an Electrical Engineering Department contained (Appendixes R):

1. A brief introduction of why engineering programs need an evaluation process
2. Educational Objectives (Program Objectives) of the ECE Department
3. Criterion 3: Program Outcomes and Assessment
4. Problem statement
5. Goal of the study
6. Model for evaluation
7. Procedures employed for the study
8. List of surveys and participants
9. Grading criteria
10. Composite of survey results applied to learning outcomes of Criterion 3
11. Evaluation of Instructional Goals Questionnaire

Based on the information provided by the 11 items listed in the Model for an Evaluation Process for an Electrical Engineering Department, the ECE Advisory

Board and ECE Curriculum completed the Evaluation Checklist (Appendix S). The evaluation checklist was available to all committee members via the survey system. Figure 3 is the evaluation checklist (first four questions) as displayed by the survey system.



Christian Brothers University

CBU Online Survey System

**Survey Title**
Evaluation Checklist

**Survey ID#**
22

**Survey Created By**
jventura

**Thank you for participating in this survey. Please make sure all questions have an answer marked before pressing the "Submit" button located at the bottom of the survey. Results will not be saved or submitted unless the "Submit" button is pressed.**

**1:** Do the surveys measure the values, attitudes, level of confidence, and perception of students, faculty, alumni, and industry in order to develop an evaluation process?
Yes

**2:** Are the scoring criteria and rubrics clear, descriptive, and explicitly related to program goals and standards?
Yes

**3:** Do the surveys simulate authentic, real-world challenges, contexts, and constraints faced by students, faculty, alumni, and industry?
Yes

**4:** Do the surveys cover the program objectives?
Yes

**Figure 3.** Evaluation Checklist (first four questions)

**Resources and Requirements**

To meet the goal of developing a model for implementing an evaluation process using these procedures, the following steps were required of the ECE Advisory Board and ECE Curriculum Committee:

- Determine the constituents need for the evaluation process.
- Validate instruments that contain the expectations of constituents, especially graduates and employers.
- Assess the quality and performance of the evaluation process.
- Assess the methods used for gathering information in a Web-based environment.

The ECE Advisory Board and ECE Curriculum Committee evaluated and validated the program evaluation processes by providing affirmative responses to the Evaluation Checklist. These committees reviewed input from constituents and methods used by the investigator in executing the evaluation processes as demonstrated in Figure 4: ECE Advisory Board validates program objectives and evaluation process, ECE Curriculum Committee validates survey instruments and evaluation process, and ECE Curriculum Committee examines and validates learning outcomes. These reviews provided the basis for validating the model for an evaluation process.

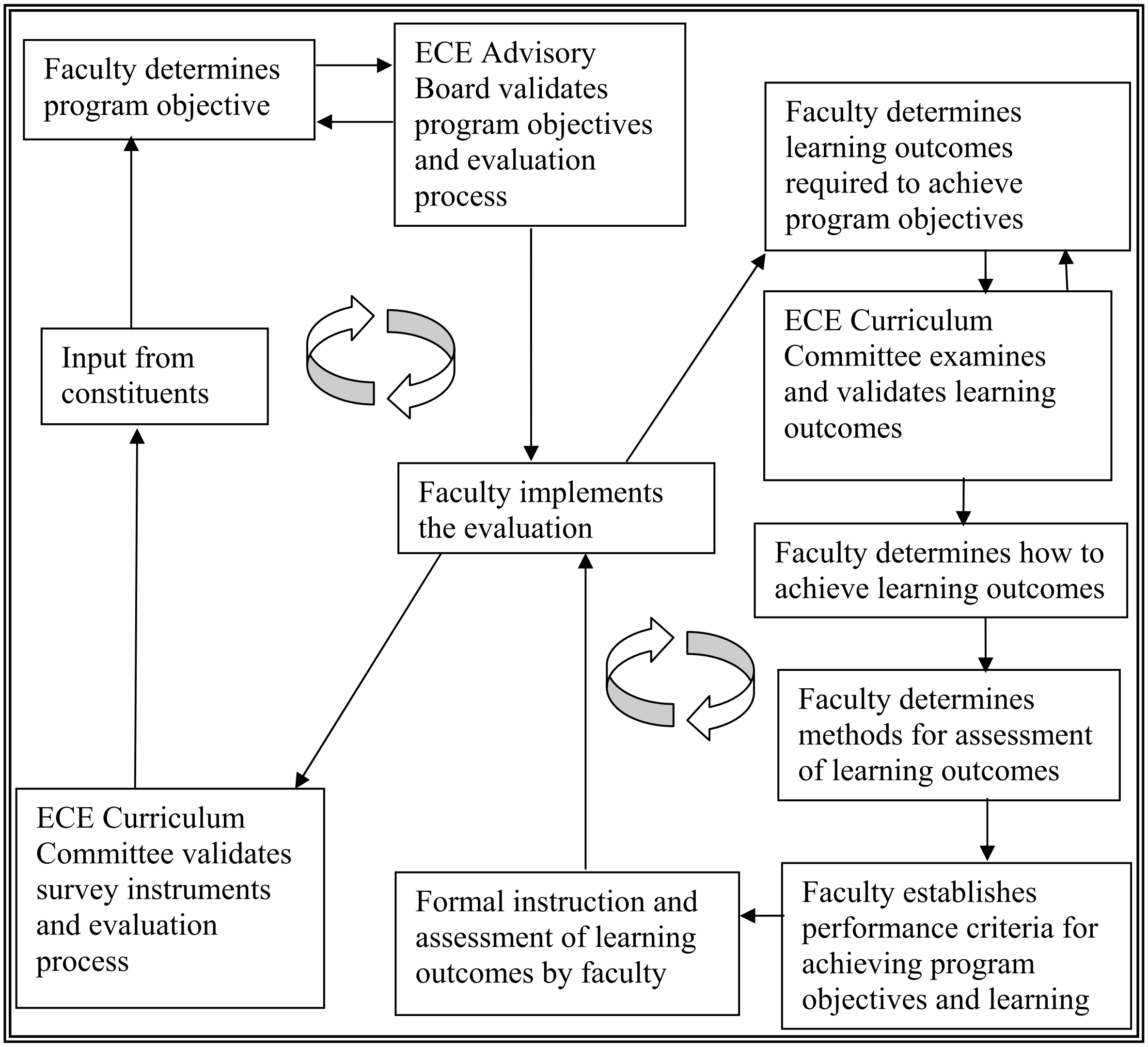



**Figure 4.** Model for Evaluation Processes (Adaptation of the *Two Loops of EC-2000* – Copyright 2002 by ABET. Used with permission)

CBU provided the Web-based technologies and faculty resources necessary to expand the existing assessment and evaluation processes into a Web-enhanced assessment and evaluation process that offered faculty the means to obtain assessment results and improve the program. Permission to conduct the study was obtained from Dr. Fred Terry, Department Chairman Electrical and Computer Engineering and Dr. Eric Welch, Dean of Engineering (Appendix U). All data collection from students took place in the ECE Department. Permission was obtained to conduct the study from the IRB of Nova Southeastern University (Appendix V) and the IRB of CBU (Appendix W).

The ECE faculty (Appendix X) agreed to participate in the study, and they gave the author their consent to recruit ECE students from their classes during class meetings. The author was the Web site administrator for the study; access was browser-based; and participants accessed the Web sites from CBU, home, and work.

## Milestones

The milestones shown in Table 10 corresponded with the goals and approach outlined in the study. The model developed by Diamond (1998) allowed for concurrent tasks permitting the completion of all tasks in two months.

Table 10. Milestones, Tasks, and Duration

| Milestone | Task Required | Duration |
|---|---|---|
| Web-based instruments for measuring program objectives | Find and/or adapt Web-based instruments for program evaluation: establish program objectives, exit interviews, surveys, review graduate acceptance, job placement, and appraise internship program | 6 weeks |
| Modification of framework of evaluation processes | Expand responsibilities of ECE Advisory Board to review the evaluation processes and establish an ECE Curriculum Committee to appraise the evaluation processes | 4 weeks |
| Establish a framework using Web-based technologies for evaluation processes | Find and/or adapt instruments for WebCT for course evaluation and Web-based instruments for measuring program objectives | 6 weeks |

| Milestone | Task Required | Duration |
|---|---|---|
| Measurement processes and results | Provide constituents with instruments that measure the level of achievement of program objectives and present results to faculty, ECE Advisory Board and ECE Curriculum Committee | 6 weeks |
| Feedback from ECE Advisory Board and ECE Curriculum Committee | Validation of survey instrument and model for evaluation from ECE Advisory Board and ECE Curriculum Committee | 2 weeks |

**Reliability and Validity**

The Freshman Engineering Attitudes Survey, Sophomore Engineering Learning and Curriculum Evaluation Survey, Junior Engineering Learning and Curriculum Evaluation Survey, Senior Survey, and ECE Alumni Survey were adaptations of surveys developed at the University of Pittsburgh (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf) in the 1990s (Adapted with permission of the authors – Appendix M) and were used along with the Engineering Education Alumni Questionnaire© in obtaining re-accreditation in 1999 at the University of Pittsburgh. The Instructional Goals survey was an adaptation of the Teaching Goals Inventory© developed by Angelo and Cross (1993) (Adapted with permission of the publisher – Appendix N). The Industry Survey was a combination of the Engineering Education Alumni Questionnaire© developed at the University of Pittsburgh and the Alumni Survey© developed by Diamond (1998) (Adapted with permission of the publisher – Appendix O).

According to the University of Pittsburgh, over 20 schools have used the instruments they developed and all surveys/questionnaires, have been tested for reliability and validity. The Teaching Goals Inventory© developed by Angelo and Cross (1993) was later adopted by Diamond (1998). The ECE Advisory Board and ECE Curriculum Committee assessed the surveys/questionnaire as to their value to the ECE program.

**Summary**

The model *Process for the Development of Educational Programs*, developed by Diamond (1998, 2002), has been employed in a wide range of educational programs and courses and was used as a guide for developing an evaluation process to meet accreditation criteria. The model, like the cyclical *Two Loops of EC2000* (ABET, 2004), contains two phases: (1) Program Selection and Design and (2) Production, Implementation, and Evaluation. The model allows flexibility in sequencing the assessment and evaluation processes rather than a linear progression of operations. A cyclical evaluation process that includes the validation of objectives, determination of outcomes necessary to meet objectives, establishment of performance criteria, evaluating and revising of objectives, and repeating the process controlled the work flow of the first cycle. Input from students, alumni, and employers, determination of program objectives, validation of objectives, evaluating and revising of objectives, and repeating the process controlled the work flow of the second cycle.

The study expanded an existing engineering evaluation process and generated a framework for evaluating an engineering program that contains a combination of Diamond's model and ABET's *Two Loops of EC2000* as shown in Figure 4. This framework provided the model for an evaluation process that contains procedures that are conducive to modifications to an existing evaluation process. Diamond suggested a work flow of approximately four months when developing curriculum. In that the study is an expansion of an existing program, the work flow for this study was approximately two months.

An evaluation process must be based on the needs of constituents, measure the achievement of learning outcomes, and assess the accomplishment of graduates. The School of Engineering Curriculum Committee (Appendix Y) determined the program's constituents. The determination of constituents for the study provided the answer to the first research question, "Who are the constituents of the program?"

Surveys adapted from studies at the University of Pittsburgh (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf), the Teaching Goals Inventory© by Angelo and Cross (1993), and alumni surveys developed by Diamond (1998) provided the basis for formulating the surveys to collect the data necessary to meet accreditation criteria. The determination of the program objectives and learning outcomes by the committees provided the information needed in the surveys and answered the second research question, "What information must be gathered from the constituents in order to satisfy accreditation requirements?"

A Web-based assessment system provided the means to obtain information from students and alumni to provide data for measuring performance criteria and tracking progress (Brawner et al., 2001; Hoare et al., 2002). The study expanded and modified the ECE program's evaluation process while implementing a Web-based assessment process to provide departmental commonality in complying with accreditation criteria and enabled systematic evaluation processes that collect and evaluate data against a standard on a regular basis. The systematic collection of data provided results that answer the third research question, "What performances are expected of graduates as a result of their educational experiences?"

While learning outcomes for each ECE course have been established, many of the existing paper-and-pencil assessment processes are not uniformly applied across the curriculum.  The methods for measuring outcomes was an expansion of existing paper-and-pencil techniques to Web-based measuring systems.  To bring continuity to the program, Web-based instruments measured constituents' perceptions and the level to which a program meets its objective and provided results that answer the fourth research question, "What evaluation processes may be used to measure the achievement of program objectives required by constituents of undergraduate programs?"

In summary, the study focused on the development of a unifying framework for course and program development that demonstrated the achievement of program objectives by constituents.  It incorporated the Web-based results of a systematic evaluation process into a program, enabled the comparing of results, and provided feedback for continuous improvement (Denton et al., 2002; McGourty, 2002b; Pimmel, 2003).

# Chapter 4

# Results

## Introduction

The Web-based survey system provided an efficient and orderly manner for the investigator to gather and assess data in order to develop a model for an evaluation process that meets accreditation requirements. In this chapter the results of measured perceptions and attitudes of students, alumni, industry and faculty, which influence the development and improvement of program objectives and learning outcomes, were examined and analyzed.

The analysis focused on the program objectives required by ABET's Criterion 2 and the 13 learning outcomes of Criterion 3. The ECE Advisory and the ECE curriculum Committee determined that the learning outcomes in Criterion 3 paralleled the program objectives of the ECE program at CBU.

In November of 2005, the School of Engineering Curriculum Committee (Appendix Y) identified the stakeholders for the engineering program as students, employers, parents of current students, alumni, donors, faculty, and staff. They later identified students, alumni, employers, and faculty as the necessary stakeholders for evaluation processes needed to meet accreditation standards at CBU.

**Surveys**

Seven surveys that address learning outcomes and program objectives were developed in the study. The surveys were based on results of research described in the literature. The following sections describe the adaptation of these surveys and the stakeholders that participated in the studies.

*Student Surveys*

The four student surveys were adapted from research performed at the University of Pittsburgh since the 1990s (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf). They were based on Bloom's general taxonomy (Bloom, 1984; Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956; Huitt, 2004) and Krathwohl's taxonomy (Huitt, 2001) of the affective domain, and they measured the students' competencies associated with learning outcomes. The surveys measured the students' attitudes and perceptions of engineering. In addition, the surveys measured the level of comfort toward engineering principles and confidence in problem solving that students gain as they progress through a program.

*Alumni Survey*

The alumni survey was adapted from surveys developed at the University of Pittsburgh and rates graduates' confidence in their engineering ability at the time of graduation and while in the workplace. They are asked to rate the cultural experiences they found in the classroom, laboratory, and workplace, and their ability to perform in the workplace based on these experiences.

*Industry Survey*

The industry survey was an adaptation of the alumni survey described above and the alumni surveys developed by Diamond (1998) and rated the ability of graduates to perform in the workplace. Industry was asked to identify the skills required of graduates in the workplace. In addition, they were asked to rate the skill level of graduates of the program and graduates of other engineering programs.

*Faculty Survey*

The faculty survey is an adaptation of the *Teaching Goals Inventory* developed by Angelo and Cross (1993) and provided the basis for measuring the faculty's perceptions of their instructional goals and the course objectives. Faculty were asked to self-assess their instructional activities and rate their perception of course objectives.

**Grades**

The University of Pittsburgh developed a rating scale and grading system that was adapted for this study (Tables 3-6 on pages 40-42) for demonstrating the distribution of responses from student and alumni surveys. Algorithms were developed to provide a grading system for the surveys used in this study based on the University of Pittsburgh's methodology. The grading measures provided the means to compare results from the seven surveys and the means to compare results of surveys over several semesters or terms.

**Data Analysis**

The surveys, as adapted from past studies, measured the values, attitudes, level of confidence, and perception of students, faculty, alumni, and industry. In October of 2005, the CBU Online Survey System and WebCT were used to deliver survey instruments to students, alumni, industry, and faculty. All students in the program were requested to participate in the study. The program had 10 freshmen (nine participated), 15 sophomores (nine participated), eight juniors (all participated), and 13 seniors (11 participated). Requests for participation were sent to 20 committee members (16 participated in meetings and eight participated in the online surveys), 35 graduates (21 participated) and to 20 industries that potentially employ ECE graduates (15 participated). Six faculty members participated in the instructional goals survey.

Although all the survey questions were related to the program, only those questions directly associated to Criterion 3 are considered. Statements such as "I had enough information when I chose my major." or "I prefer studying alone." are outside the scope of this investigation, but were collected for future work on improving the program.

The survey system exported the data into a spreadsheet and calculated the mean based on the measures of Tables 3 and 4 (page 40) that contained the rating scale for the surveys. Data provided by the WebCT survey system were manually placed in a spreadsheet for calculations. The measures described in Tables 3 and 4 and the grading scheme (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf) provided in Tables 5 and 6 (pages 41-42) were employed using data obtained from the student surveys, alumni survey, and industry survey to formulate tables for each of the 11 learning outcomes of Criterion 3 as shown in Table 11 for Criterion 3a. The numbers in parentheses indicate the questions for each survey, and the data is grouped according to constituents. The tables containing the grades for each of the 11 learning outcomes of Criterion 3 were presented to the ECE Advisory Board and ECE Curriculum Committee (Appendix R) for their review, and Table 11 is an example of the 11 tables. The numbers in the parentheses are the questions in the respective surveys of the constituents.

Table 11. Grading Criteria 3a – An ability to apply knowledge of mathematics, science, and engineering

| **Question** | **Constituent** | **Grade** |
|---|---|---|
| Confidence in my ability to use my knowledge of mathematics to solve relevant engineering problems. (55) | Freshman | C+ |
| Confidence in my ability to use my knowledge of chemistry to solve relevant engineering problems. (56) | Freshman | D |
| Confidence in my ability to use my knowledge of physics to solve relevant engineering problems. (57) | Freshman | D+ |
| Confidence in my ability to use my knowledge of engineering to solve relevant engineering problems. (58) | Freshman | C– |
| Confidence in my ability to use mathematical concepts to solve engineering problems. (47) | Sophomore | B– |
| Confidence in my ability to use chemistry concepts to solve engineering problems. (48) | Sophomore | C– |
| Confidence in my ability to use physics concepts to solve engineering problems. (49) | Sophomore | C+ |
| Confidence in my ability to use engineering concepts to solve relevant engineering problems. (50) | Sophomore | C |
| Confidence in my ability to use mathematical concepts to solve engineering problems. (56) | Junior | C– |
| Confidence in my ability to use chemistry concepts to solve engineering problems. (57) | Junior | C– |

| Question | Constituent | Grade |
| --- | --- | --- |
| Confidence in my ability to use physics concepts to solve engineering problems. (58) | Junior | B– |
| Confidence in my ability to use engineering concepts to solve relevant engineering problems. (59) | Junior | C+ |
| Confidence in my ability to use my knowledge of mathematics to solve relevant engineering problems. (5) | Senior | A |
| Confidence in my ability to use my knowledge of chemistry to solve relevant engineering problems. (6) | Senior | D+ |
| Confidence in my ability to use my knowledge of physics to solve relevant engineering problems. (7) | Senior | B– |
| Confidence in my ability to use my knowledge of engineering to solve relevant engineering problems. (8) | Senior | B– |
| At the time of graduation, describe your knowledge and ability in basic science (physics, chemistry, etc) and math. (15) | Alum Then | B– |
| Based on your experience since graduation, describe your knowledge and ability in basic science (physics, chemistry, etc) and math. (16) | Alum Now | B– |
| Rate the importance of basic mathematics at the company. (10) | Industry | A |
| Rate the mathematical ability of ECE graduates of CBU. (11) | Industry CBU Graduate | A |
| Rate the mathematical ability of other than CBU graduates. (12) | Industry Non-CBU Graduate | B– |

Note. From "University of Pittsburgh School of Engineering Student Assessment System," by M. Besterfield-Sacre, L. Shuman, R. Hoare and H. Wolfe, July 7, 2005 (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf). University of Pittsburgh©. Adapted with permission of the authors (Appendix M).

Figure 5 is a pie chart output of the CBU Online Survey System. The survey system provided pie charts for all quantitative questions and calculated the mean, the number of participants, and the percentage of participants that chose a measure.

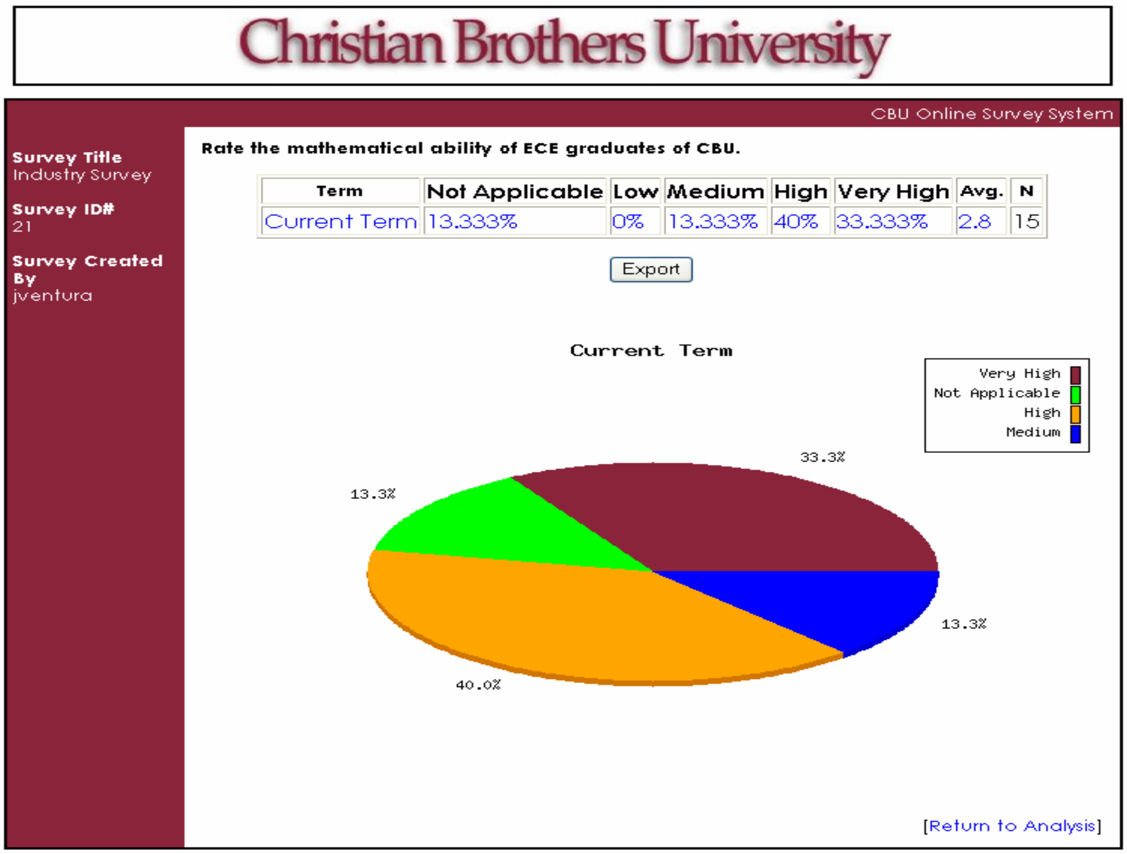



**Figure 5.** Industry Survey: Rate the mathematical ability of ECE graduates of CBU

The categories for each set of questions associated with a learning outcome for a survey were used with Tables 5 and 6 (pages 41-42) to provide the grades in Table 12. For example, the resulting freshman grade of C– for Criterion 3a was based on questions 55, 56, 57, and 58 of the Freshman Engineering Attitudes Survey as shown in Table 11. *Freshman*, *Sophomore*, *Junior*, and *Senior* represent the composite results from the student surveys. The results shown in *Alumni at graduation* represent the competencies of alumni at the time of graduation, and *Alumni now* represent the competencies of alumni now. The results of *Industry Rating* represent the values industry placed on these outcomes, and *Industry (CBU Graduate)* is the ratings industry placed on graduates of CBU in their employ.

Table 12. Scoring for Criterion 3

| **Criterion 3 –Demonstrate the ability to** | **Freshman** | **Sophomore** | **Junior** | **Senior** | **Alumni at graduation** | **Alumni now** | **Industry Rating** | **Industry (CBU Graduate)** |
|---|---|---|---|---|---|---|---|---|
| a) apply knowledge of mathematics, science, and engineering | C– | C+ | C+ | B– | B– | B– | A | A |
| b) design and conduct experiments, as well as to analyze and interpret data | C+ | C+ | C | B– | C+ | B– | A | A– |
| c) 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 | C– | C | C | B– | C– | B– | B | C |
| d) function on multidisciplinary teams | B– | C | B | B– | C+ | B | A– | B– |
| e) identify, formulate, and solve engineering problems | C– | C– | C– | B– | C | B | B+ | B– |
| f) recognize the importance of professional and ethical responsibility | C+ | C+ | B– | A– | C | B– | A+ | A– |
| g) communicate effectively | C+ | C– | C+ | C+ | C+ | B– | B– | C |

| Criterion 3 –Demonstrate the ability to | Freshman | Sophomore | Junior | Senior | Alumni at graduation | Alumni now | Industry Rating | Industry (CBU Graduate) |
|---|---|---|---|---|---|---|---|---|
| h) appreciate the broad education necessary to comprehend the impact of engineering solutions in a global, economic, environmental, and societal context | C+ | C+ | C– | C | C+ | B– | B+ | B |
| i) recognize the need for, and an ability to engage in life-long learning | C+ | B | B | B– | C+ | B+ | A– | C |
| j) employ contemporary issues in engineering problems | C– | B | C | B– | C– | B– | C | B– |
| k) use the techniques, skills, and modern engineering tools necessary for engineering practice | B– | C+ | C | C+ | C+ | B– | B | A |

The methods described in Tables 8 and 9 (pages 44-45) were used to formulate results based on the instructional goals chosen by the faculty. Information from the Instructional Goals Questionnaire was used to generate Tables 13 and 14, as developed by Angelo and Cross (1993) and used by Diamond (1998). Tables 13 and 14 are based on a composite score of six instructors rather than individual instructors.

Table 13. Ranking by Essential Goals and Cluster

| Cluster Number and Name | | Goals Included in Cluster (Item #) | Total Number of *Essential* Goals in Each Cluster (Six Faculty) | Cluster Ranked for 1st to 6th by Number of *Essential* Goals |
|---|---|---|---|---|
| I | Higher-Order Thinking Skills | 3-10 | 12 | 1 |
| II | Basic Academic Success Skills | 11-19 | 3 | 4 |
| III | Discipline-Specific Knowledge and Skills | 20-27 | 9 | 2 |
| IV | Liberal Arts and Academic Values | 28-37 | 2 | 5 |
| V | Work and Career Preparation | 38-45 | 1 | 6 |
| VI | Personal Development | 46-54 | 7 | 3 |

How many of the 52 goals were rated as *essential*? 34
(Average 5.66 for six faculty members)

Note. From "Classroom Assessment Techniques," by T. A. Angelo and K. P. Cross, 1993. Copyright 1993 by Jossey-Bass – John Wiley & Sons, Inc. Also, from "Designing and Assessing Courses and Curricula" by R. M. Diamond, 1998. Adapted with permission of Jossey-Bass Inc. – John Wiley & Sons, Inc. (Appendix N and O).

Table 14. Ranking by and Cluster Scores

| Cluster Number and Name | | Goals Included | Sum of Ratings Given to Goals in That Cluster (Six Faculty) | Divide Sum of Ratings by This Number | Cluster Scores | Cluster Ranked for 1st to 6th by Scores |
|---|---|---|---|---|---|---|
| I | Higher-Order Thinking Skills | 2-10 | 181 | 48 | 3.77 | 1 |

| Cluster Number and Name | | Goals Included | Sum of Ratings Given to Goals in That Cluster (Six Faculty) | Divide Sum of Ratings by This Number | Cluster Scores | Cluster Ranked for 1st to 6th by Scores |
|---|---|---|---|---|---|---|
| II | Basic Academic Success Skills | 11-19 | 170 | 54 | 3.15 | 3 |
| III | Discipline-specific Knowledge and Skills | 20-27 | 166 | 8 | 3.45 | 2 |
| IV | Liberal Arts and Academic Values | 28-37 | 168 | 60 | 2.80 | 6 |
| V | Work and Career Preparation | 38-45 | 151 | 48 | 3.14 | 4 |
| VI | Personal Development | 46-54 | 166 | 54 | 3.07 | 5 |

Note. From "Classroom Assessment Techniques," by T. A. Angelo and K. P. Cross, 1993. Copyright 1993 by Jossey-Bass – John Wiley & Sons, Inc. Also, from "Designing and Assessing Courses and Curricula" by R. M. Diamond, 1998. Adapted with permission of Jossey-Bass Inc. – John Wiley & Sons, Inc. (Appendix N and O).

Table 15 contains the responses obtained from the Instructional Goals Inventory as to the role of the faculty. The primary role is compared to the Cluster Rankings of Table 14.

Table 15. Primary Role Compared to Cluster Rank

| Primary Role as Stated by Instructor | Number of Faculty | Cluster | Rank from Table 14 |
|---|---|---|---|
| a) Teaching students facts and principles of the subject matter | 1 | Discipline-specific Knowledge and Skills | 2 |

| Primary Role as Stated by Instructor | Number of Faculty | Cluster | Rank from Table 14 |
|---|---|---|---|
| b) Providing a role model for students | 1 | Personal Development | 5 |
| c) Helping students develop higher-order thinking skills | 1 | Higher-Order Thinking Skills | 1 |
| d) Preparing students for jobs/careers | 2 | Work and Career Preparation | 4 |
| e) Fostering student development and personal growth | 0 | Liberal Arts and Academic Values | 6 |
| f) Helping students develop basic learning skills | 1 | Basic Academic Success Skills | 3 |

Table 16 relates the results of questions from the Instructional Goals Questionnaire to Criterion 3. The numbers shown in columns 2 thru 7 correspond to questions on the Instructional Goals Survey by clusters chosen by the faculty to be essential that relate to Criterion 3. The last column is the percentage of total number of essential goals chosen for a specific learning outcome.

Table 16. Percentage of Essential Goals Chosen by Faculty Compared to Criterion 3

| **Criterion 3 –Demonstrate the ability to** | **Higher-Order Thinking Skills** | **Academic Success Skills** | **Discipline Specific Knowledge and Skills** | **Liberal Arts and Academic Values** | **Work and Career Preparation** | **Personal Development** | **% of Essential Goals (54)** |
|---|---|---|---|---|---|---|---|
| a) apply knowledge of mathematics, science, and engineering | 3 | 19 | | | | | 14 |
| b) design and conduct experiments, as well as to analyze and interpret data | 5 | | | | | | 9 |
| c) 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 | 4, 6, & 9 | | 21 | | | | 19 |
| d) function on multidisciplinary teams | | | | | 38 | | 3 |
| e) identify, formulate, and solve engineering problems | 7 | | | | | | 6 |
| f) recognize the importance of professional and ethical responsibility | | | | 37 | 41 | 52 | 6 |
| g) communicate effectively | | | | | 39 | | 0 |
| h) appreciate the broad education necessary to comprehend the impact of engineering solutions in a global, economic, environmental, and societal context | 8 & 10 | | 23 & 27 | 34 & 36 | | | 6 |
| i) recognize the need for, and an ability to engage in life-long learning | | | 24 & 25 | 32 | 44 | | 3 |

| Criterion 3 –Demonstrate the ability to | Higher-Order Thinking Skills | Academic Success Skills | Discipline Specific Knowledge and Skills | Liberal Arts and Academic Values | Work and Career | Personal Development | % of Essential Goals (54) |
|---|---|---|---|---|---|---|---|
| j) employ contemporary issues in engineering problems | | | | 30 & 35 | | | 0 |
| k) use the techniques, skills, and modern engineering tools necessary for engineering problems | | | 22 | | | | 6 |
| Other | | | | | | | 28 |

Although the study was not constructed as an experiment, a statistical analysis of the Industry Survey results was conducted. An analysis of variance (ANOVA) was calculated between the responses in the Industry Survey for differences in *industry* requirements, graduates of *CBU*'s perceived competencies, and graduates of *other* institutions' perceived competencies. There was a significant difference between *industry* and *other* ($t = 2.04$, $p < 0.05$) and *CBU* and *other* ($t = 2.05$, $p < 0.05$). There was no difference between *industry* and *CBU* ($p > 0.05$).

**Findings**

The following list contains the evaluation checklist (Appendix S) provided to the committees in December 2005, committee member comments (as stated), and discussion:

**1. The surveys measured the values, attitudes, level of confidence, and perception of students, faculty, alumni, and industry.**

*Committee Comment:* I think it was a good idea to measure the freshmen, sophomores, juniors, and seniors as they progress throughout each academic year.

*Discussion:* The committees validated the surveys for compliance with the program objectives and the measures employed by the surveys to achieve the objectives by using the learning outcome of Criterion 3. The survey system generated a database for storing survey results for comparing to future survey results. The surveys provided the program with the means to determine if program objectives were achieved.

**2. The scoring criteria and rubrics were clear, descriptive, and explicitly related to program goals and standards.**

*Committee Comment:* Very clear descriptions and rubrics. Looks easy to implement and monitor over a long interval of time.

*Discussion:* Wiggins (1998) stated that scoring measures must provide a continuum for determining the quality or level of performance. The scoring methodologies found in Tables 3-6 (pages 40-42) provided methods to score the results. The survey system database provided the means to compare the scores obtained from surveys over several semesters or terms as required by accreditation criteria.

**3. The surveys simulate authentic, real-world challenges, contexts, and constraints faced by students, faculty, alumni, and industry.**

*Committee Comment:* It is hard to decide based on the survey questions.

*Discussion:* The program objectives define the values and goals of the program (Diamond, 1998). The surveys were based on instruments used by over 20 schools, and they measured these qualities set forth by the program objectives and learning outcomes (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf). The surveys measured the accomplishments of students and graduates that are consistent with the program objectives. In addition, the surveys measured the perceptions and attitudes of faculty and industry as they relate to the program. The faculty instructional goals were limited to one questionnaire. Additional instruments and methods can provide alternative sources for peer evaluation of learning outcomes as described by Narayanan (2005) that include the use of portfolio analysis.

**4. The surveys cover the ECE program objectives.**

*Discussion:* Criterion 3 includes the program objectives as determined by the committees, and the surveys were based on evaluation processes that measure the observations of industry and the performance of students, faculty, and alumni. A self-assessment process by constituents is accomplished through the committees. ABET requires that program objectives meet the requirements of constituents.

**5. Were the surveys a good investment of time and energy and worthy of the efforts required of constituents.**

*Committee Comments:* The number of questions will play an important role as to whether or not you would get a fair amount of participation or response from industry. Therefore, you definitely want to narrow the scope of questions on the survey, while making sure you meet your objective.

*Discussion:* The responses of alumni, industry, and the committees indicated their willingness to participate in the evaluation process. The alumni survey contained 141 questions, which is almost three times the number of questions for the other surveys. A review of the survey instruments may indicate that some of the questions do not pertain to the program's objectives and can be part of a survey outside the evaluation process.

**6. The surveys permitted appropriate latitude in style and approach necessary for students, faculty, alumni, and industry.**

*Discussion:* The use of tested rubrics for engineering programs, which is cost effective and readily evaluated, provided the source for the Web-based surveys as discussed in study by Perez, Shuman, Wolfe, and Besterfield-Sacre (2001). The rates of participation in the surveys by constituents were comparable to that found in other studies and indicated that the instruments were acceptable as a means for measuring the achievement of objectives.

**7. The Web-based surveys provided a suitable format for CBU constituents.**

*Discussion:* Web-based surveys provided easy access to constituents, data analysis, and a uniform method of assessment as described in a study by McGourty (2002b). The constituents were familiar with Web-based technology and no difficulties with the survey process were reported.

**8. It is clear which desired achievements are measured by the surveys.**

*Discussion:* The survey questions focused on the program objectives, and the measured results focused on the requirements of Criterion 3. Several questions were employed to measure attitudes and levels of confidence for each of the learning outcomes of Criterion 3. In addition, the results based on a composite score of several questions increased the likelihood of measuring the required skills.

**9. The criteria and indicators were the right one for this task and for the achievements evaluated.**

*Discussion:* The surveys and scoring methods measured the achievement of program objectives. The evaluation process measured the achievement of learning outcomes by students and accomplishments of graduates in the practice of engineering. The surveys measured the views and educational positions of industry and faculty.

**10. The surveys provided ample feedback for self-evaluation and self-adjustment as components of the evaluation process.**

*Committee Comment:* More information and feedback from the students are needed. As a student, I would suggest holding an open two-way discussion with a random class, or several classes of students, to get open and honest feedback.

*Committee Comment:* I think more industry input would be needed, especially from direct supervisors of ECE graduates.

*Discussion:* The methods employed provided latitude to the participants through the use of several questions on perceptions and confidences as described in a study by Perez et al. (2001). A review of the surveys may lead to the use of an interview process or class discussion as a component of the evaluation process as suggested by the committees. After reviewing the results of the surveys, constituents that are represented by the committees can provide feedback to the faculty for program improvement.

In summary, the committees' comments and suggestions were positive and constructive as evidenced by the following online comment of one committee member:

> While all surveys are time-consuming, I think that they do provide key insights into the needs of the business community and how graduates are perceived by themselves and their employers. My only thought is that it should include a few more opportunities for comments/suggestions on how to improve in each of the key areas and that perhaps staff/advisory board should openly discuss these ideas.

**Summary**

The study provided a framework for a model that meets accreditation criteria that involves students, faculty, and alumni. There was an expansion of the duties of the ECE Advisory Board and the formation of an ECE Curriculum Committee. These committees reviewed and approved the constituents, the Web-based survey system, and the model for an evaluation process as being appropriate.

The purpose of an evaluation process is to improve the program. The study provided results obtained from constituents to the committees. These committees assessed the results and provided input for program improvement. The CBU Online Survey System provided access to the evaluation checklist for the committees to validate the evaluation process.

The grades, as determined by Tables 3 and 5 (pages 40 and 41), increased or remained the same from the freshman survey to the senior survey except for Criterion 3k (to use the techniques, skills, and modern engineering tools necessary for engineering practice) as shown in Table 12. The student member of the ECE Curriculum stated that freshman students rate their skill level in the use of computers as high, and he believed that this is the reason for the high grade given in Table 12 for freshmen.

The grades increased or remained the same from the results of the *Alumni at graduation* to the *Graduate now* as shown in Table 12. The committees found it reasonable to expect graduates in the workplace to have more confidence in their engineering skills than they did at graduation, and the results provided a base line for further studies.

The survey system calculated the mean for quantitative measures as shown in Figure 5 and provided data for a statistical analysis. The statistical analysis of the Industry Survey indicates that CBU graduates of those industries responding to the study are considered to possess higher levels of competencies than those graduates of other institutions. In addition, the CBU graduates' competencies closely resemble the expected values of the industries as shown in Table 12. These results are encouraging. However, there is a need to temper the findings with the fact that the industries were aware that the study was associated with CBU; and the industries were chosen because of an association with CBU. Industries were chosen from a pool of companies that regularly recruit engineering graduates of CBU.

Angelo and Cross (1993) stated that faculty rank the two clusters that contain higher-order skills and discipline-specific knowledge the highest. These are the clusters ranked 1 and 2 in Tables 13 and 14. The comparison of faculty roles and cluster rankings in Table 15 shows that Liberal Arts and Academic Values ranked sixth and corresponded to fostering student development and personal growth – a role that none of the faculty chose as a primary role. These statements should be tempered with the fact that there were only six faculty members and six primary roles, and it can be expected that at least two faculty members would choose the same primary role. The Instructional Goals Inventory assisted instructors in becoming aware of their individual goals and more aware of what they wished to achieve (Angelo & Cross, 1993; Shaeiwitz, 2000).

The faculty did not choose any of the goals as essential that relate to Criterion 3g (communicate effectively) or 3j (knowledge of contemporary issues) as shown in Table 16. The percentages range from 0 to 19, and these findings indicate a need for the faculty to establish guidelines for ensuring that all program objectives as represented by Criterion 3 are contained in the curriculum.

# Chapter 5

## Conclusions, Implications, Recommendations, and Summary

### Conclusions

This dissertation assembled and tested a package of Web-based surveys that comprise an evaluation process to meet ABET accreditation criteria. The study focused on the identification of constituents, generation of performance criteria that appraise learning outcomes and program objectives, formulation of instruments needed to measure achievements in the classroom and workplace, and development of an evaluation model for the evaluation process. Engineering programs recognize these accreditation requirements, but there is concern regarding the failure of programs to formulate processes that comply with these criteria.

Four questions formed the framework for the development of the evaluation process. The discussion that follows is derived from the results of the study.

*Who are the constituents of the program?*

The dean of engineering appointed the School of Engineering Curriculum Committee (Appendix Y) in the fall of 2005. After several weekly meetings, the committee concluded that to meet accreditation requirements, input must be acquired from students, alumni, faculty, and employers. In addition, the ECE Advisory Board and the ECE Curriculum Committee agreed on these constituents. The consensus of the committees was that it would be necessary to collect data from seven groups:

- Freshmen who had declared ECE as their major or engineering students who had not declared a major
- Sophomore ECE students
- Junior ECE students
- Senior ECE students
- ECE graduates (alumni) of 2000 to 2005
- Employers (industry) of graduates (supplied by OIRE)
- ECE Faculty

*What information must be gathered from the constituents in order to satisfy accreditation requirements?*

Although initial investigations pointed to the need to determine the information needed and to develop instruments to gather the information, an in-depth search resulted in access to many available instruments that contained the information that met accreditation criteria. With permission of the authors of the instruments, the investigator modified the instruments (Appendices M, N, O, and T) to meet ECE program requirements. Following are the sources of instruments, validation data, and instruments:

- Instrument created and validated by the University of Pittsburgh and in use by over 20 other institutions (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf)
    - Freshman Engineering Attitudes Survey

  - Sophomore Engineering Learning and Curriculum Evaluation Survey
  - Junior Engineering Learning and Curriculum Evaluation Survey
  - Senior Survey
  - ECE Alumni Survey
- University of Pittsburgh and Diamond (1998) and validated by University of Pittsburgh and by the Center for Instructional Development at Syracuse University – Industry Survey
- *Teaching Goals Inventory* as developed by Angelo and Cross (1993) and adopted by Diamond (1998) – Instructional Goals Questionnaire

The consensus of the ECE Advisory Board and ECE Curriculum Committee was that the surveys with the modification performed by the investigator contained the means to measure the achievement of learning outcomes and program objectives necessary to meet accreditation requirements. In addition, committee members stated that the surveys simulated authentic engineering challenges and generated measures that provide a database for comparing the achievement of learning outcomes and program objectives with result obtained from other sources and over several terms or semesters.

*What performances are expected of graduates as a result of their educational experiences?*

Accreditation criteria require performance criteria be generated from learning outcomes and program objectives and that there must be a differentiation between the data collection for learning outcomes and program objectives. The consensus of the ECE Advisory Board and ECE Curriculum Committee was that Criterion 3 (page 23), and repeated as follows, measured the performance criteria expected of graduates as a result of their learning experiences. Programs must demonstrate that students and graduates have acquired the ability to:

a) apply knowledge of mathematics, science, and engineering
b) design and conduct experiments, as well as to analyze and interpret data
c) 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
d) function on multidisciplinary teams
e) identify, formulate, and solve engineering problems
f) recognize the importance of professional and ethical responsibility
g) communicate effectively
h) appreciate the broad education necessary to comprehend the impact of engineering solutions in a global, economic, environmental, and societal context
i) recognize the need for, and an ability to engage in life-long learning
j) employ contemporary issues in engineering problems
k) use the techniques, skills, and modern engineering tools necessary for engineering practice

In the fall of 2002, the ECE department adopted the matrix shown in Table 17 to identify specific courses in which the achievement of learning outcomes were expected (EED, 2003; Ventura, 2003). Bloom's taxonomy identifies six cognitive categories that describe levels of learning (Bloom, 1984; Bloom et al., 1956). The six categories are knowledge, comprehension, application, analysis, synthesis, and evaluation. The six categories are used to evaluate the level of learning of defined learning outcomes. The matrix is based on a level of learning of at least *analysis – student distinguishes, classifies, and relates assumptions, objects, and ideas and determines how the parts are related.*

Table 17. ECE Courses and Learning Outcomes

| **Course** | **Learning Outcomes** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** |
| Computer in Engineering Problem Solving | | | x | | x | | | | | | |
| Engineering Instrumentation | x | | | x | x | x | x | | | x | x |
| Electric Circuit Analysis I | | | x | | x | | | | | | x |
| Electric Circuit Analysis II | | | x | | x | | | | | | x |
| Digital Design | | | x | x | x | | x | | | x | x |
| Microprocessor Architecture and Programming | | | x | x | x | | x | x | | x | x |
| Engineering Economy | | | | x | x | x | x | x | x | x | x |
| Linear Control Systems | | | x | | x | x | x | x | | x | x |
| Electronics I | | | x | | x | | | | | | x |
| Electronics II | | | x | | x | | | | | | x |
| Systems, Signals, and Noise | | | x | | x | | | | | x | x |
| Junior Laboratory I | x | x | | | | | x | x | | | x |
| Electromagnetic Field Theory | x | x | x | | | | x | x | | | x |
| ECE Engineering Project | x | x | x | x | x | x | x | x | x | x | x |

Although the surveys described in the previous question contained the information necessary to meet accreditation requirement, it is imperative that the program provide and identify a set of courses in which instructional activities can be associated with the learning outcomes. Tables 12 and 16 (pages 62 and 67) relate the results of the seven surveys to the learning outcomes. In addition, the matrix can be used to modify the instructional activities in courses for specific learning outcomes based on feedback from the committees to the faculty.

*What evaluation processes may be used to measure the achievement of program objectives required by constituents of undergraduate programs?*

Initial research pointed to evaluation processes based on cyclical models that provide feedback for program improvement, such as found in ABET's *Two Loops of EC-2000,* be used to measure performance. In addition, research disclosed the increased use of Web-based methods to conduct, analyze, and store data obtained from surveys. The consensus of the committees was that the following model and online survey systems provided the framework for measuring the achievement of program objectives:

- Model for Evaluation Process (See Figure 4 on page 49) – based on models developed by Diamond (1998) and ABET's *Two Loops of EC-2000*
- CBU Online Survey System – developed at CBU (Ellis et al., 2005)
- WebCT's Survey Tools – (WebCT, 2004)

The consensus of the committees was that the surveys measured the achievement of the program objectives and learning outcomes and that the rating scales and grading criteria provided measures for assessing the performance of constituents. Following are the assessment instruments and their sources:

- Rating Scale (category) developed at the University of Pittsburgh (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf)

- Grading Criteria developed at the University of Pittsburgh (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf)
- Assessment of Importance of Goals developed by Angelo and Cross (1993)
- Cluster Assessment developed by Angelo and Cross (1993)
- Evaluation Checklist for ECE Advisory Committee and ECE Curriculum Committee – *Assessment Design Rating Checklist for Peer Review* (Wiggins 1998) and developed by the Center on Learning, Assessment, and School Structure (Appendix T)

In addition, the committees concluded that the checklist provided a means for appraising the following assessment processes:

- The surveys measured the values and perceptions of constituents.
- The scoring rubrics measured the achievement of program objectives and learning outcomes.
- The surveys measured the accomplishments of constituents that are consistent with program objectives.
- The surveys and rating algorithms provided the investigator latitude in developing surveys that meet the needs of constituents.
- The Web-based survey systems provided an appropriate format for constituents.
- The surveys and rating algorithms provided feedback for self-evaluation and self-adjustments to the program.

The faculty were members of the committees and participated in the assessment of the process and the generation of feedback for program improvement. The consensus of the committees was that the results of the surveys provided ample feedback for self-assessment and self-adjustment by the faculty.

The study provided methods for improving the program by (1) integrating the results of surveys obtained from constituents into an evaluation process, (2) formulating a model that enables faculty to demonstrate that students have achieved learning outcomes and graduates have achieved program objectives, (3) identifying and employing Web-based technologies that assisted the program in determining program effectiveness, and (4) providing feedback to the faculty based on results of surveys through recommendations of the committees. The findings of the study provided the program with survey results that supplied a baseline for developing or refining performance criteria.

By formulating the appropriate methods of scoring survey results and establishing committees to assess the survey results, a model was developed that can utilize best practices to ascertain reliability and validity for the evaluation processes. The assessment of the results by the committees provided the beginning of a continuous evaluation process to satisfy the accreditation criteria that links program objectives, learning outcomes, and constituents.

## Implications

Although the program includes ABET's General Criteria, only the program objectives (http://www.cbu.edu/engineering/eceobj.html) that are contained in Criterion 2 and Criterion 3 are included in the study. The evaluation model included portions of Criterion 1, and this model can be used to develop a paradigm to include this criterion in the evaluation model by providing measures to ensure that all students meet program requirements. Colbeck, Cabrera, and Marine (2001) described the use of surveys to measure faculty competencies and the Instructional Goals Inventory questionnaire can be used as part of a development of instruments to comply with Criterion 5.

Parker and Alam (2004) stated that constituents consist of the student body, faculty, alumni, and industrial partners. The constituents must formulate the program objectives that include the mission of the institution, long-term goals of the School of Engineering, and the 11 learning outcomes of Criterion 3. Students, alumni, and employers, and not just the faculty, must be instrumental in developing program objectives and long-term goals.

ABET has not completed its first six-year cycle for many engineering programs using EC2000. The study provided a model, instruments, and methods to assist in an evaluation process and could be used in the second visit by ABET.

A complete evaluation cycle must include implementation by faculty of feedback received from the committees. A formative evaluation process would cover at least a three- or four-year evaluation process in order to establish a database of results and achievement trends. The work performed in the study was over one semester, and the study did not address the implementation of feedback provided to faculty from the committees. The faculty must begin a process for modifying instructional activities based on feedback from the committees.

A general introduction to the principles and status of the evaluation processes found in undergraduate education and the development of a model for an evaluation process was the focus of the investigation. The study centered on an ECE program that must conform to ABET accreditation criteria. Although the work was performed in a relatively small program with a total enrollment of approximately 45 students and was limited to only constituents that comprise the CBU community that is associated with a small private Catholic university, the results obtained may be applicable to other programs.

The ability of students to assess their technical skills as self-assessor varies with maturity and level of technical competencies (Sarin & Headley, 2002; Welch, 2003). Students with poor grades tend to over assess their ability, and students with high grades tend to rate their abilities the same as instructors. Sarin and Headley (p. 5) stated, “Although the correlations between self-assessment and test scores are generally significant, their absolute values are low and suggest a low correlation between the two variables. If the purpose of student self-assessment is formative in nature, their use can be justified.” The results obtained from these surveys must be used to develop trends; and based on the resulting improvement or deterioration in scores, changes can be implemented in the curriculum. The use of results obtained from a self-assessment in a summative manner is questionable.

In describing the implementation of an online evaluation process, McGourty (2002a) stated that the design of surveys must be flexible; results from surveys must be timely; data should be stored in databases for analysis for trends by faculty or departments; and students must be able to complete the surveys at their convenience. The faculty with input from the committees must adapt curriculum in response to results formulated from the surveys and adapt the surveys in response to changing program objectives dedicated by new technology and the changing workplace. This adaptive feature of the formative model allows the evaluation process developed to be applicable to a wide range of programs and disciplines.

The survey system provided results upon completion of the surveys and a database for storing results over multi-terms for trend analysis. Students, faculty, alumni, and industry took the surveys at their convenience in a password or URL specific browser setting. In addition to the benefits described, the online evaluation model provided the committees with results obtained from the surveys and the online means to provide feedback to the faculty. Administrators must take the responsibility to provide faculty the resources to implement the evaluation model and modify the program based on feedback.

In online course assessments performed from 1999 to 2001 at two universities, the response rates for students have varied from 21% to 50% at one university and 70% to 85% at another (McGourty, 2002a). Females, juniors, seniors, and students with higher GPAs are more likely to complete the online course assessment surveys. In the case of students, these findings may affect the results of evaluation processes since males, freshmen, and sophomores may be under represented; and students who are not performing well academically may not be proportionally represented. While there is little empirical data regarding response rates for alumni and industry, constituents with close affiliations with the program may be more likely to participate in the evaluation process. Administrators must obtain information that represents results from all constituents.

**Recommendations**

While the Model for Evaluation Process of Figure 4 (page 49) is useful in developing an evaluation process, Figure 6 will provide a functional model for an ongoing formative evaluation process that integrates the model developed by Leonard and Nault (2004) with the Model for Evaluation Process. The model shown in Figure 6 provides systematic decision making procedures (loops) that allow constituents to examine the success of a program based on learning outcomes and program objectives as separate entities, but interlinked. The use of the model will assist programs that consider the achievement of program objectives as being the results of achievement of learning outcomes rather than distinct assessment and data collecting processes.

Leonard and Nault (2004) stated that an integrated approach to an evaluation process that is to evaluate program educational objectives and learning outcomes requires three distinct processes: (a) educational objective identification assessment and review; (b) learning outcome selection, assessment, and analysis; and (c) integrated process for program review and improvement. ABET's 2004-2005 version of Criteria for Accrediting Engineer Programs, which until this version contained only EC2000, requires the measuring and evaluation of the achievement of learning outcomes of students and the measuring and evaluation of the achievement of program objectives of graduates as distinct processes not evident in ABET's two-loop process used in Figure 4 (page 49). The use of the model shown in Figure 6 will provide the means to meet the new accreditation criteria.

The study was on an existing evaluation process, and it began with the *Faculty request input from constituents*. When the model is employed in an ongoing evaluation process, the model can be implemented or entered at any component of the existing program.

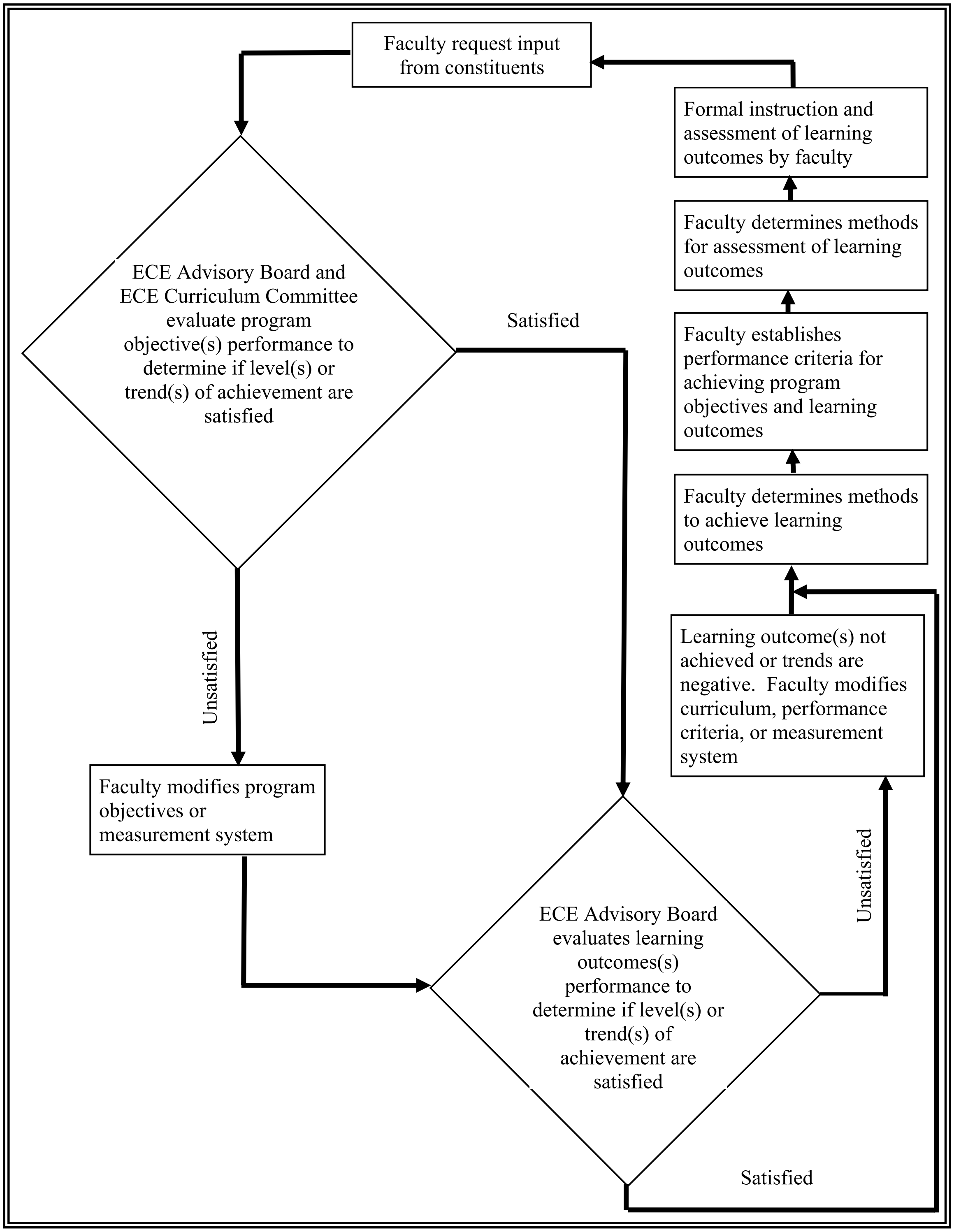



**Figure 6.** Formative Evaluation Process

The evaluation model of Figure 6 provides a continuous process to gain input from constituents, assessment of input by appropriate committees, procedures for modifying program if necessary, feedback to faculty, and implementation of feedback into the curriculum. An evaluation process requires attention to learning outcomes but also attention to the experiences that are part of these outcomes (Shaeiwitz, 2000). The model will enable faculty to integrate the multidimensional aspects of an evaluation process that provides an opportunity for constituents to communicate their perceptions of their classroom, teaching, and work experiences.

The response rates for the study were freshmen – 90%, sophomores – 60%, juniors – 100%, seniors – 85%, alumni – 60%, industry – 75%, and faculty – 86%. Faculty must develop incentives that encourage students to participate in surveys and develop methods that ensure that students are equally represented by gender, class, and academic standing. Administrators and faculty should encourage students to participate in Web-based surveys with a combination of technology-mediated communications and incentives (McGourty, 2002a). The monitoring of responses during survey administration enables the targeting of e-mails to constituents and the use of incremental urgings to persuade constituents to participate.

The use of response sets that contain the same number of responses will reduce the complexity of calculating results. The generation of a response set for the Industry Survey, as described in Table 4 (page 40), to include five responses rather than four will eliminate the need for Table 6 (page 42). In addition, a reduction in the number of different response sets, such as described in Table 3 (page 40), will reduce the complexity of grading the results of the surveys.

The seven surveys were adapted from existing surveys. Questions not related to program objectives and learning outcomes must be removed; and, if useful in other areas of program improvement such as employment placement, be given in a separate survey. The alumni survey contained 154 questions and took 30 to 45 minutes to complete. A reduction in the number of questions could improve the response rate.

The grouping of questions pertaining to particular program objectives or learning outcomes in all surveys will assist faculty in designing and assessing achievement or trends. For example, placing measurements for achievement of Criterion 3a in specific sections in the surveys will assist faculty in identifying those questions pertaining to Criterion 3a as they analyze the seven surveys.

Online survey systems that perform all the calculations necessary to score the surveys can reduce the time and errors that may occur when faculty use Tables 3 and 4 (page 40). In addition, online systems can be programmed to use algorithms that combine questions that pertain to particular objectives or outcomes to obtain grade averages or trends over several semesters or terms.

Questions should be worded so that rating scales such as described in Tables 3 and 4 (page 40) do not have to be reversed to obtain the correct grade. Question 12 of the freshman survey states, "From what I know, engineering is boring." A choice of *Strongly Disagree* would provide a grade of *F* using Table 3. The rating scale should be reversed as follows: Strongly Disagree – five, Disagree – four, Neutral – three, Agree – two, and Strongly Agree – one. Such questions can be reworded or an online grading system could be programmed to compensate for questions that require a change in the rating scale. In addition, Thomas (2004) stated that participants have certain expectations on the order of the scale and response choices. They expect high or positive choices to come first, and administrators must be trained in the development of surveys. Great care must be exercised in wording questions to ensure uniform processing.

The surveys contained several questions for many of the learning outcomes of Criterion 3. The survey system allows faculty to generate surveys that contain several questions for each outcome and course objective. These features allow faculty to generate a library of questions that can be applicable to several courses that can assist in designing surveys for program objectives and learning outcomes. The development of a national database will assist programs in designing surveys for comparison to other programs and that use professionally developed questions.

One member of the ECE Curriculum Committee stated that students need more information and suggested holding discussions with a class or group of students to generate student feedback for improving surveys. Woods and Sheardown (2004) stated that the following questions should be considered in an evaluation process:
(a) Do students and faculty have common definitions of the criteria being measured?
(b) Do students know the purpose of the surveys? (c) Will the students receive a grade for performance, for example, extra points? and (d) Have the students and faculty been trained in assessment techniques? Administrators must provide workshops to develop assessment skills in students and faculty as part of the program. Students and faculty with high levels of assessment skills will enhance evaluation processes and provide validity and reliability to these processes.

Faculty should compare the results of the student surveys with the results obtained from the Fundamentals of Engineering (FE) exam. The National Council of Examiners for Engineering and Surveying administers the FE exam, a potential assessment tool, which assesses engineering principles on a topic-by-topic basis. Seniors in the program take the FE exam on a volunteer basis, but only about 50% of the graduates take the exam. Requiring the graduates to take the FE exam and comparing the results of the student surveys and FE exam could increase the validity of the evaluation process and provide additional feedback to faculty.

Almost 50% of students entering engineering schools do not graduate in engineering. The study provided surveys to determine the attitudes and perceptions that can be associated with poor retention. Using the results of these surveys, the retention rate could be improved.

The study provided feedback to the faculty and formulated an evaluation process that includes the implementation of feedback from the committees to improve the program. A multi-year process will allow faculty to perform trend analysis by comparing results from several years. In addition, a formative model will allow the controlled integration of the science, liberal arts, and business departments into the evaluation process.

Graduates of 2000 thru 2005 participated in the surveys. Barron, Pangborn, Lee, Litzinger, and Wise (2004) described an evaluation of alumni that graduated from 1995 to 2000 to determine their perception of their education based on initial career path and full-time employment versus entry into graduate school. Alumni were sent surveys two to three years following their graduation. Data collection over several years allowed the development of patterns over time, and administrators established trends in graduates' perceptions of their education. Surveys can be sent to alumni on a staggered basis; for example, surveys can be sent to graduates of 2000, 2003, and 2006 in a 2007 evaluation cycle and then 2001, 2004, and 2007 in the 2008 evaluation cycle. While the scores from all years will provide general information about the program, trends must be established by comparing results from several years or terms. Results obtained as part of a formative process should be used in modifying program objectives and curriculum.

**Summary**

The goal of an evaluation process is to influence the intellectual development of students (Narayanan, 2005). Parker and Alam (2004, p. 2) stated, "Effective learning only comes through effective assessment of the quality of instruction." Without an evaluation process, there is no measure of progress. An evaluation process must measure the achievements of students, examine the instructional activities that influence student learning, and implement practices to improve the program.

In 2000, ABET modified its accreditation criteria to include measuring the achievement of program objectives and specific learning outcomes and an evaluation process for providing feedback to improve the program. ABET's General Criteria include program objectives that identify the knowledge graduates are expected to have achieved that are needed in the first several years in the practice of engineering and 11 learning outcomes that identify the knowledge learners have acquired by graduation.

Engineering programs must implement an evaluation process to measure the achievement of its graduates as specified in its program objectives and the level of achievement of the students as specified by its learning outcomes. In addition, the evaluation process must contain mechanisms for a continuous course of action for measuring these achievements, assessing these measurements, and providing feedback to faculty for program improvement. These processes require a systematic comparison of current measurements and past results. The continuous evaluation process must include input from its constituents or stakeholders.

Evaluation practices currently focus on documenting students' knowledge. The evaluation process must analyze and examine the interaction between constituents. First, programs must determine the constituents or stakeholders of the program. Second, determine what information to gather in order to satisfy accreditation criteria. Third, programs through their constituents must determine what skills are expected of students and graduates in the workplace. Fourth, it must be determined what evaluation processes to employ to measure the achievement of program objectives formulated by constituents.

To meet accreditation criteria, many engineering programs employ Web-based instruments for measuring the achievement of program objectives, generating results based on these measurements, and establishing databases for comparing results over several semesters or terms. Educational institutions and instructional designers developed surveys to measure the achievements of students, alumni, and faculty. These surveys were adapted to meet the requirements of an evaluation process that meets ABET's accreditation criteria. These surveys measured the values, attitudes, levels of confidence, and perceptions of students, alumni, faculty, and industry.

Surveys developed by the University of Pittsburgh (Hoare et al., 2002), Diamond (1998) and Angelo and Cross (1993) were adapted to formulate four student surveys, an alumni survey, a faculty survey, and an employee survey. These seven surveys were employed in the CBU Online Survey System and WebCT to measure performance criteria necessary to meet accreditation criteria. In 2005, the CBU Online System was developed to provide a browser-based survey system for providing surveys to constituents and to analyze results obtained from the surveys. These browser-based surveys were password protected or URL specific to provide security and provided surveys to constituents both on and off campus. The surveys were anonymous and only provided cumulative results for each group of constituents.

The administrator of the surveys monitored the responses of constituents to determine if they were participating. Other studies have shown that response rates can vary from 60% to 90%, and administrators must develop incentives that encourage constituents to participate. Constituent responses were monitored, and incremental e-mails were sent to influence the participation of constituents.

Self-assessment by students can be problematic in that the ability of students to assess their skills varies with maturity, level of technical ability, and grade point average. Students with low grades tend to overstate their ability, and students with high grades assess their ability the same level as instructors. Training faculty and students in assessment techniques will minimize the adverse conditions that are inherent in measuring achievement using self-assessment methods.

Rating scales and grading methods developed by the University of Pittsburgh (http://www.cbu.edu/~jventura/PittsburghAssessmentSystem.pdf) were adapted to obtain information from Web-based surveys to provide results to demonstrate that program objectives and learning outcomes were achieved. In addition, the results obtained by using the rating scales and grading system provided feedback for program improvement.

The survey system provided a database to store data from the measurements for comparing results over several semesters and for developing trends.

The ECE Curriculum Committee consists of members of professional organizations and societies, ECE faculty, the dean of engineering, the chair of the Master of Engineering program, a faculty member from sciences, and the chair of the student branch of IEEE. The ECE Advisory Board consists of representatives from industry and the ECE faculty. ABET is a coalition of 19 professional organizations, and the committees are representative of this coalition and the constituents of CBU. These committees determined that the constituents necessary for an evaluation process were students, alumni, employers, and faculty.

The committees determined that the program objectives as defined by the ECE department were the same as the learning outcomes of Criterion 3 for this evaluation cycle. Although the program objectives and the learning outcomes have the same performance criteria, the measurement of achievements for meeting program objectives were obtained from recent graduates; and measurement of achievements for learning outcomes were from students before graduation.

Based on results of the faculty survey, the essential goals of the faculty were ranked. The comparing of the essential goals provided by the faculty to the 11 learning outcomes demonstrated the degree to which the chosen essential goals satisfied program objectives and learning outcomes.

A complete evaluation cycle will include: a measurement of achievements of objectives and outcomes of constituents using surveys and scoring methodologies; the assessment of the results derived from these measurements by the committees and comparing the results to the stated objectives and outcomes; recommendations from the committees to the faculty; modification of the program objectives, curriculum, or system of measurement by the faculty based on the recommendations; a determination by faculty of the performance criteria needed for achieving objectives and outcomes; and improvement of instructional activities and assessment of learning outcomes by faculty. Cyclical models provide the methodology needed for evaluations processes.

Sarin and Headley (2002) stated that only formative evaluation processes should be undertaken due to the unfavorable factors inherent in information obtained from student self-assessment and that summative processes based on self-assessment is questionable. Improvements in programs must be based on trends developed from data obtained over several semesters rather than a summative assessment of a single cycle of an evaluation process.

To meet the goals of developing and implementing an evaluation process for meeting accreditation requirements, a formative model was developed that contained: surveys to measure the achievement of program objectives and skills of graduates in the workplace, surveys to assess the perceptions and attitudes of faculty and industry as they relate to the program, Web-based technologies for implementing the surveys and presenting feedback of results, algorithms for grading results obtained from surveys, and committees that are representative of constituents to monitor and administer the evaluation process. The model provided a process for comparing current and past results in order to develop trends for continuous program improvement for the every-changing needs of constituents.

# Appendix A

## Request for Participation by Students
## (CBU Online Survey)

My name is John Ventura and I am an assistant professor in the Electrical and Computer Engineering department at Christian Brothers University (CBU). In addition, I am a doctoral student in the Graduate School of Computer and Information Sciences at Nova Southeastern University working on my dissertation, *Web-Based Evaluation Process for an Electrical Engineering Department*.

*The goal of the work is* to develop and implement an evaluation process to meet accreditation requirements by assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process will be encapsulated in a model that will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvements.

As a part of this work, you are asked to participate in a survey to measure your perceptions and attitudes regarding engineering and your educational experiences at CBU. The survey is accessible via the CBU Online Survey System. You will be able to complete the survey in approximately 30 to 45 minutes. Your participation in this survey is completely anonymous, and your participation is optional. Your participation in these surveys will not affect your standing at CBU. Again, your participation is *not* mandatory.

The intent of these surveys is to improve the ECE program at CBU; and students, alumni, faculty, and industry are requested to participate. Your participation gives you a voice in the process, and I ask you to consider working toward improving the ECE program. If you have questions, you may contact me (jventura@cbu.edu or 901-321-3429) with inquiries.

In order to participate in the survey you must answer all questions contained in the document. The following URL will link you to the appropriate survey: http://www.cbu.edu/survey/tracking.PHP?survey*XX*.

# Appendix B

## Request for Participation by Students (WebCT)

My name is John Ventura and I am an assistant professor in the Electrical and Computer Engineering department at Christian Brothers University (CBU). In addition, I am a doctoral student in the Graduate School of Computer and Information Sciences at Nova Southeastern University working on my dissertation, *Web-Based Evaluation Process for an Electrical Engineering Department*.

*The goal of the work is* to develop and implement an evaluation process to meet accreditation requirements by assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process will be encapsulated in a model that will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvements.

As a part of this work, you are asked to participate in a survey to measure your perceptions and attitudes regarding engineering and your educational experiences at CBU. The survey is accessible via the WebCT course site for this class. You will be able to complete the survey in approximately 30 to 45 minutes. Your participation in this survey is completely anonymous, and your participation is optional. Your participation in the survey will not affect your standing at CBU. Again, your participation is *not* mandatory.

The intent of this survey is to improve the ECE program at CBU; and students, alumni, faculty, and industry are requested to participate in this study. Your participation gives you a voice in the evaluation process, and I ask you to consider working toward improving the ECE program. If you have questions, you may contact me (jventura@cbu.edu or 901-321-3429) with inquiries.

In order to participate in the survey, you must answer all questions contained in the document. The student survey can be found in the WebCT home site for this course under *Survey*.

# Appendix C

## Request for Participation by Alumni

*(Please do not copy or forward this document with prior approval by John Ventura)*

My name is John Ventura and I am an assistant professor in the Electrical and Computer Engineering department at Christian Brothers University (CBU). In addition, I am a doctoral student in the Graduate School of Computer and Information Sciences at Nova Southeastern University working on my dissertation, *Web-Based Evaluation Process for an Electrical Engineering Department*.

*The goal of the work is* to develop and implement an evaluation process to meet accreditation requirements by assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process will be encapsulated in a model that will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvements.

As a part of this work, you are asked to participate in a survey to measure your perceptions and attitudes regarding engineering and your educational experiences at CBU. The survey is accessible via the CBU Online Survey System. You will be able to complete the survey in approximately 30 to 45 minutes. Your participation in this survey is completely anonymous, and your participation is optional. Your participation in these surveys will not affect your standing at CBU. Again, your participation is *not* mandatory.

The intent of these surveys is to improve the ECE program at CBU; and students, alumni, faculty, and industry are requested to participate. Your participation gives you a voice in the process, and I ask you to consider working toward improving the ECE program. If you have questions, you may contact me (jventura@cbu.edu or 901-321-3429) with inquiries.

In order to participate in the survey, you must answer all questions contained in the document. The following URL will link you to the ECE Alumni Survey: http://www.cbu.edu/survey/tracking.PHP?survey*XX*.

# Appendix D

## Request for Participation by Industry

*(Please do not forward this document without prior approval by John Ventura)*

My name is John Ventura and I am an assistant professor in the Electrical and Computer Engineering department at Christian Brothers University (CBU). In addition, I am a doctoral student in the Graduate School of Computer and Information Sciences at Nova Southeastern University working on my dissertation, *Web-Based Evaluation Process for an Electrical Engineering Department*.

*The goal of the work is* to develop and implement an evaluation process to meet accreditation requirements by assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process will be encapsulated in a model that will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvement.

As a part of this work, you are asked to participate in a survey to measure your perceptions and attitudes regarding engineering and your experiences with engineering graduates. The survey is accessible via the CBU Online Survey System. You will be able to complete the survey in approximately 30 to 45 minutes. Your participation in this survey is completely anonymous, and your participation is optional. Your participation in these surveys will not affect your standing at CBU. Again, your participation is *not* mandatory.

The intent of these surveys is to improve the ECE program at CBU; and students, alumni, faculty, and industry are requested to participate. Your participation gives you a voice in the process, and I ask you to consider working toward improving the ECE program. If you have questions, you may contact me (jventura@cbu.edu or 901-321-3429) with inquiries.

In order to participate in the survey, you must answer all questions contained in the document. The following URL will link you to the Industry Survey: http://www.cbu.edu/survey/tracking.PHP?survey*XX*.

# Appendix E

## Request for Participation by ECE Faculty

My name is John Ventura and I am an assistant professor in the Electrical and Computer Engineering department at Christian Brothers University (CBU). In addition, I am a doctoral student in the Graduate School of Computer and Information Sciences at Nova Southeastern University working on my dissertation, *Web-Based Evaluation Process for an Electrical Engineering Department*.

*The goal of the work is* to develop and implement an evaluation process to meet accreditation requirements by assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process will be encapsulated in a model that will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvement.

As a part of this work, you are asked to participate in a survey to measure your perceptions and attitudes regarding engineering and your educational experiences at CBU. The survey is accessible via the CBU Online Survey System. You will be able to complete the survey in approximately 30 to 45 minutes. Your participation in this survey is completely anonymous, and your participation is optional. Your participation in these surveys will not affect your standing at CBU. Again, your participation is *not* mandatory.

The intent of these surveys is to improve the ECE program at CBU; and students, alumni, faculty, and industry are requested to participate. Your participation gives you a voice in the process, and I ask you to consider working toward improving the ECE program. If you have questions, you may contact me (jventura@cbu.edu or 901-321-3429) with inquiries.

In order to participate in the survey, you must answer all questions contained in the document. The following URL will link you to the Instructional Goals questionnaire: http://www.cbu.edu/survey/tracking.PHP?survey*XX*.

# Appendix F

## Freshman Engineering Attitudes Survey

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | This survey is an adaptation of the Pittsburg Freshman Engineering Attitudes Survey© developed by the University of Pittsburgh (used with permission) and is not to be copied or distributed. You must be 18 years of age or older to take this survey. | I agree. | | | | |
| 2 | What is your gender? | • Male<br>• Female | | | | |
| 3 | What is your age? | • 18 to 23<br>• 24 to 30<br>• 31 to 40<br>• 41 to 50<br>• Over 51<br>• Other | | | | |
| 4 | I expect that engineering will be a rewarding career. | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| 5 | I expect that studying engineering will be rewarding. | | | | | |
| 6 | The advantages of studying engineering outweigh the disadvantages. | | | | | |
| 7 | I do not care for this career. | | | | | |
| 8 | The future benefits of studying engineering are worth the effort. | | | | | |
| 9 | I can think of several other majors that would be more rewarding than engineering. | | | | | |
| 10 | I have no desire to change to another major (biology, English, chemistry, art history, math, etc.). | | | | | |
| 11 | The rewards of getting an engineering degree are not worth the effort. | | | | | |
| 12 | From what I know, engineering is boring. | | | | | |
| 13 | Engineers are well paid. | | | | | |
| 14 | Engineers contribute more to making the world a better place than people in most other occupations. | | | | | |
| 15 | Engineers are innovative. | | | | | |
| 16 | I enjoy the subjects of science and mathematics the most. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 17 | I will have no problem finding a job when I have obtained an engineering degree. | | | | | |
| 18 | Engineering is an exact science. | | | | | |
| 19 | My parent(s) are making me study engineering. | | | | | |
| 20 | Engineering is an occupation that is respected by other people. | | | | | |
| 21 | I like the professionalism that goes with being an engineer. | | | | | |
| 22 | I enjoy taking liberal arts courses more than math and science courses. | | | | | |
| 23 | Engineering is more concerned with improving the welfare of society than most other professions. | | | | | |
| 24 | I am studying engineering because it will provide me with a lot of money, and I cannot do this in other professions. | | | | | |
| 25 | Engineers have contributed greatly to fixing problems in the world. | | | | | |
| 26 | An engineering degree will guarantee me a job when I graduate. | | | | | |
| 27 | My parent(s) want me to be an engineer. | | | | | |
| 28 | Engineers are creative. | | | | | |
| 29 | Engineering involves finding precise answers to problems. | | | | | |
| 30 | I am studying engineering because I enjoy figuring out how things work. | | | | | |
| 31 | Technology plays an important role in solving society's problems. | | | | | |
| 32 | Confidence in your skills in chemistry | Strongly Not Confident | Not Confident | Neutral | Confident | Strongly Confident |
| 33 | Confidence in your physics skills | | | | | |
| 34 | Confidence in your calculus skills | | | | | |
| 35 | Confidence in your engineering skills | | | | | |
| 36 | Confidence in your writing skills | | | | | |
| 37 | Confidence in your speaking skills | | | | | |
| 38 | Confidence in your computer skills | | | | | |
| 39 | I feel I know what work engineer performs. | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |

| | | | | | | |
|---|---|---|---|---|---|---|
| 40 | Studying in a group is better than studying by myself. | | | | | |
| 41 | Creative thinking is one of my strengths. | | | | | |
| 42 | I need to spend more time studying than I currently do. | | | | | |
| 43 | I have strong problem solving skills. | | | | | |
| 44 | Most of my friends that I "hang out" with are studying engineering. | | | | | |
| 45 | I feel confident in my ability to succeed in engineering. | | | | | |
| 46 | I prefer studying/working alone. | | | | | |
| 47 | I am good at designing things. | | | | | |
| 48 | In the past, I have enjoyed working in assigned groups. | | | | | |
| 49 | I am confident about my current study habits or routine. | | | | | |
| 50 | I consider myself electrically inclined. | | | | | |
| 51 | I consider myself computer literate. | | | | | |
| 52 | I consider myself technically inclined. | | | | | |
| 53 | I enjoy solving open-ended problems. | | | | | |
| 54 | I enjoy problems that can be solved in different ways. | | | | | |
| 55 | Confidence in my ability to use my knowledge of mathematics to solve relevant engineering problems. | Poor | Fair | Good | Very Good | Excellent |
| 56 | Confidence in my ability to use my knowledge of chemistry to solve relevant engineering problems. | | | | | |
| 57 | Confidence in my ability to use my knowledge of physics to solve relevant engineering problems. | | | | | |
| 58 | Confidence in my ability to use my knowledge of engineering to solve relevant engineering problems. | | | | | |
| 59 | Confidence in my ability to design and conduct an experiment to obtain measurements or gain additional knowledge. | | | | | |
| 60 | Confidence in my ability to analyze and interrupt a set of data to find underlying meaning. | | | | | |
| 61 | Confidence in my ability to design a device or process to satisfy a given set of specifications. | | | | | |
| 62 | Confidence in my ability to function as a technically contributing member of an engineering team. | | | | | |
| 63 | Confidence in my ability to function as a responsible member of an engineering team. | | | | | |
| 64 | Confidence in my ability to formulate unstructured engineering problems. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 65 | Confidence in my ability to use appropriate engineering techniques including software or lab equipment for problem solving. | | | | | |
| 66 | Confidence in my knowledge of the professional responsibilities of an engineer. | | | | | |
| 67 | Confidence in my knowledge of the ethical responsibilities of an engineer. | | | | | |
| 68 | Confidence in my ability to write effectively. | | | | | |
| 69 | Confidence in my ability to make effective presentations. | | | | | |
| 70 | Confidence in my ability to express engineering-related ideas to others. | | | | | |
| 71 | Confidence in my ability to listen to and impartially interpret different viewpoints. | | | | | |
| 72 | Confidence in my knowledge of the potential risks and impact to the public of an engineering solution. | | | | | |
| 73 | Confidence in my ability to apply knowledge about current issues (economics, environmental, political, social, etc.) to engineering-related problems. | | | | | |
| 74 | Confidence in my ability to recognize the limitations of my engineering knowledge and skills and to know when to seek additional information. | | | | | |
| 75 | Date survey is completed. | | | | | |

# Appendix G

## Sophomore Engineering Learning and Curriculum Evaluation Survey

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | This survey is an adaptation of the Sophomore Engineering Learning and Curriculum Evaluation Instrument© developed by the University of Pittsburgh (used with permission) and is not to be copied or distributed. You must be 18 years of age or older to take this survey. | I agree. | | | | |
| 2 | What is your gender? | • Male<br>• Female | | | | |
| 3 | What is your age? | • 18 to 23<br>• 24 to 30<br>• 31 to 40<br>• 41 to 50<br>• Over 51<br>• Other | | | | |
| 4 | My freshman year prepared me for my sophomore year. | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| 5 | My freshman year helped me decide that I want to remain in engineering. | | | | | |
| 6 | I am confident that I have chosen the right major. | | | | | |
| 7 | I had enough information when I chose my major. | | | | | |
| 8 | My academic advisors were helpful. | | | | | |
| 9 | I am familiar with work performed by practicing engineers. | | | | | |
| 10 | I was able to discuss academic issues with my professors during my freshman year. | | | | | |
| 11 | During my freshman year, I was introduced to the different engineering fields. | | | | | |
| 12 | I worked on “real-world” engineering problems in my courses. | | | | | |
| 13 | I had “hands-on” engineering experience(s) during my freshman year. | | | | | |
| 14 | I had a mentor or advisor who provided guidance. | | | | | |

| | | Not At All | Very Little | Some | A Lot | A Great Deal |
|---|---|---|---|---|---|---|
| 15 | As a result of my freshman year, I can apply math to solve engineering problems. | | | | | |
| 16 | As a result of my freshman year, I can apply chemistry concepts to solve engineering problems. | | | | | |
| 17 | As a result of my freshman year, I can apply physics principles to solve engineering problems. | | | | | |
| 18 | As a result of my freshman year, I can solve unstructured engineering problems. | | | | | |
| 19 | As a result of my freshman year, I can analyze engineering data. | | | | | |
| 20 | As a result of my freshman year, I can design a device or process. | | | | | |
| 21 | As a result of my freshman year, I can use proper laboratory procedures. | | | | | |
| 22 | As a result of my freshman year, I can use computer-programming skills. | | | | | |
| 23 | As a result of my freshman year, I can use software packages to solve engineering problems. | | | | | |
| 24 | As a result of my freshman year, I can use CAD software. | | | | | |
| 25 | As a result of my freshman year, I have improved my technical writing abilities; i.e., prepare engineering reports and papers. | | | | | |
| 26 | As a result of my freshman year, I have improved my oral communication skills. | | | | | |
| 27 | As a result of my freshman year, I can function effectively in different team roles. | | | | | |
| 28 | As a result of my freshman year, I can set goals and achieve them on time. | | | | | |
| 29 | As a result of my freshman year, I can learn new things on my own. | | | | | |
| 30 | Have you had an engineering job (internship, summer, part-time, etc.), participated in cooperative education (CO-OP), or conducted undergraduate research since you began your engineering studies? | Yes | | No | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31 | I expect that engineering will be a rewarding career. | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| 32 | I do not care for this career. | | | | | |
| 33 | I have no desire to change to another major (biology, English, chemistry, art, history, math, etc.). | | | | | |
| 34 | From what I know, engineering is boring. | | | | | |
| 35 | I enjoy the subjects of science and mathematics the most of all my subjects. | | | | | |
| 36 | Engineering is an exact science. | | | | | |
| 37 | Engineering is an occupation that is respected by other people. | | | | | |
| 38 | I like the professionalism that goes with being an engineer. | | | | | |
| 39 | Engineers have contributed greatly to solving society's problems. | | | | | |
| 40 | I feel I know what an engineer does. | | | | | |
| 41 | Creative thinking is one of my strengths. | | | | | |
| 42 | I feel confident in my ability to succeed in engineering. | | | | | |
| 43 | I prefer studying/working alone. | | | | | |
| 44 | I am good at designing things. | | | | | |
| 45 | I consider myself technically inclined. | | | | | |
| 46 | I enjoy solving open-ended problems. | | | | | |
| 47 | Confidence in my ability to use mathematical concepts to solve engineering problems. | Poor | Fair | Good | Very Good | Excellent |
| 48 | Confidence in my ability to use chemistry concepts to solve engineering problems. | | | | | |
| 49 | Confidence in my ability to use physics concepts to solve engineering problems. | | | | | |
| 50 | Confidence in my ability to use engineering concepts to solve relevant engineering problems. | | | | | |
| 51 | Confidence in my ability to design an experiment to obtain measurements or gain additional knowledge about a process. | | | | | |
| 52 | Confidence in my ability to analyze a set of data to find underlying meaning(s). | | | | | |
| 53 | Confidence in my ability to design a device or process when given a set of specifications. | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 54 | Confidence in my ability to function as a responsible member of an engineering team. | | | | | | |
| 55 | Confidence in my ability to formulate unstructured engineering problems. | | | | | | |
| 56 | Confidence in my ability to use appropriate engineering techniques and tools including software and/or lab equipment for problem solving. | | | | | | |
| 57 | Confidence in my understanding of the professional and ethical responsibilities of an engineer. | | | | | | |
| 58 | Confidence in my ability to write effectively. | | | | | | |
| 59 | Confidence in my ability to make professional presentations. | | | | | | |
| 60 | Confidence in my ability to effectively communicating engineering-related ideas to others. | | | | | | |
| 61 | Confidence in my ability to listen to and impartially interpret different viewpoints. | | | | | | |
| 60 | Confidence in my ability to understand the potential risks (to the public) and impacts that an engineering solution or design may have. | | | | | | |
| 63 | Confidence in my ability to apply knowledge about current issues (economic, environmental, political, societal, etc.) to engineering-related problems. | | | | | | |
| 64 | Confidence in my ability to recognize the limitations of my engineering knowledge and abilities and to know when to seek additional information. | | | | | | |
| 65 | Date survey is completed. | | | | | | |

# Appendix H

## Junior Engineering Learning and Curriculum Evaluation Survey

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | This survey is an adaptation of the Junior Engineering Learning and Curriculum Evaluation Instrument© developed by the University of Pittsburgh (used with permission) and is not to be copied or distributed. You must be 18 years of age or older to take this survey. | I agree. | | | | |
| 2 | What is your gender? | • Male<br>• Female | | | | |
| 3 | What is your age? | • 18 to 23<br>• 24 to 30<br>• 31 to 40<br>• 41 to 50<br>• Over 51<br>• Other | | | | |
| 4 | My sophomore year prepared me for my junior year. | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| 5 | My sophomore year helped me decide that I want to remain in engineering. | | | | | |
| 6 | I am confident that I have chosen the right major. | | | | | |
| 7 | I had enough information when I chose my major. | | | | | |
| 8 | My academic advisors were helpful. | | | | | |
| 9 | I was able to discuss academic issues with my professors. | | | | | |
| 10 | I worked on "real-world" engineering problems in my courses. | | | | | |
| 11 | I had "hands-on" engineering experiences(s) during my sophomore year. | | | | | |
| 12 | I had a mentor or advisor who provided guidance. | | | | | |
| 13 | As a result of my sophomore year, I can apply math to solve engineering problems. | Not At All | Very Little | Some | A Lot | A Great Deal |
| 14 | As a result of my sophomore year, I can apply chemistry concepts to help solve engineering problems. | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | As a result of my sophomore year, I can apply physics to help solve engineering problems. | | | | | | |
| 16 | As a result of my sophomore year, I can solve unstructured engineering problems. | | | | | | |
| 17 | As a result of my sophomore year, I can analyze engineering data. | | | | | | |
| 18 | As a result of my sophomore year, I can design a device or process. | | | | | | |
| 19 | As a result of my sophomore year, I can use proper laboratory procedures. | | | | | | |
| 20 | As a result of my sophomore year, I can use computer-programming skills. | | | | | | |
| 21 | As a result of my sophomore year, I can use software packages to solve engineering problems. | | | | | | |
| 22 | As a result of my sophomore year, I can use CAD software. | | | | | | |
| 23 | As a result of my sophomore year, I have improved my technical writing abilities; i.e., prepare engineering reports and papers. | | | | | | |
| 24 | As a result of my sophomore year, I have improved my oral communication skills. | | | | | | |
| 25 | As a result of my sophomore year, I can function effectively in different team roles. | | | | | | |
| 26 | As a result of my sophomore year, I can set goals and achieve them on time. | | | | | | |
| 27 | As a result of my sophomore year, I can learn new things on my own. | | | | | | |
| 28 | Have you had an engineering job (internship, summer, part-time, etc.), participated in cooperative education (CO-OP), or conducted undergraduate research since you began your engineering studies? | Yes | | No | | | |
| 29 | My work experience increased my ability to succeed in my engineering classes. If your response to question 28 was "No," please choose "No response." | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | No Response |
| 30 | My work experience was related to my specific field of engineering. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 31 | My work experience provided me with the opportunity to pursue learning on my own. If your response to question 28 was "No," please choose "No response." | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 32 | My work experience allowed me to improve my computer skills. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 33 | My work experience provided me with the opportunity to work in a team environment. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 34 | My work experience allowed me to work on "real-world" problems. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 35 | My work experience allowed me to be a more creative problem solver. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 36 | My work experience allowed me to work in a laboratory environment. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 37 | My work experience helped me to understand what engineers do. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 38 | My work experience helped me to develop my written communication skills. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 39 | My work experience helped me to develop my oral skills. If your response to question 28 was "No," please choose "No response." | | | | | | |
| 40 | I expect that engineering will be a rewarding career. | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| 41 | I do not care for this career. | | | | | | |
| 42 | I have no desire to change to another major (biology, English, chemistry, art, history, math, etc.). | | | | | | |
| 43 | From what I know, engineering is boring. | | | | | | |
| 44 | I enjoy the subjects of science and mathematics the most of all my subjects. | | | | | | |
| 45 | Engineering is an exact science. | | | | | | |
| 46 | Engineering is an occupation that is respected by other people. | | | | | | |
| 47 | I like the professionalism that goes with being an engineer. | | | | | | |
| 48 | Engineers have contributed greatly to solving society's problems. | | | | | | |
| 49 | I feel I know what an engineer does. | | | | | | |
| 50 | Creative thinking is one of my strengths. | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 51 | I feel confident in my ability to succeed in engineering. | | | | | |
| 52 | I prefer studying/working alone. | | | | | |
| 53 | I am good at designing things. | | | | | |
| 54 | I consider myself technically inclined. | | | | | |
| 55 | I enjoy solving open-ended problems. | | | | | |
| 56 | Confidence in my ability to use mathematical concepts to solve engineering problems. | Poor | Fair | Good | Very Good | Excellent |
| 57 | Confidence in my ability to use chemistry concepts to solve engineering problems. | | | | | |
| 58 | Confidence in my ability to use physics concepts to solve engineering problems. | | | | | |
| 59 | Confidence in my ability to use engineering concepts to solve relevant engineering problems. | | | | | |
| 60 | Confidence in my ability to design an experiment to obtain measurements or gain additional knowledge about a process. | | | | | |
| 61 | Confidence in my ability to analyze a set of data to find an underlying meaning(s). | | | | | |
| 62 | Confidence in my ability to design a device or process when given a set of specifications. | | | | | |
| 63 | Confidence in my ability to function as a responsible member of an engineering team. | | | | | |
| 64 | Confidence in my ability to formulate unstructured engineering problems. | | | | | |
| 65 | Confidence in my ability to use appropriate engineering techniques and tools including software and/or lab equipment for problem solving. | | | | | |
| 66 | Confidence in my ability to understand the professional and ethical responsibilities of an engineer. | | | | | |
| 67 | Confidence in my ability to write effectively. | | | | | |
| 68 | Confidence in my ability to make professional presentations. | | | | | |
| 69 | Confidence in my ability to effectively communicate engineering-related ideas to others. | | | | | |
| 70 | Confidence in my ability to listen to and impartially interpret different viewpoints. | | | | | |
| 71 | Confidence in my ability to understand the potential risks (to the public) and impacts that an engineering solution or design may have. | | | | | |
| 72 | Confidence in my ability to apply knowledge about current issues (economic, environmental, political, societal, etc.) to engineering-related problems. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 73 | Confidence in my ability to recognize the limitations of my engineering knowledge and abilities and to know when to seek additional information. | | | | | |
| 74 | Date survey is completed. | | | | | |

# Appendix I

## Senior Survey

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | This survey is an adaptation of the Graduating Senior Survey© developed by the University of Pittsburgh (used with permission) and is not to be copied or distributed. You must be 18 years of age or older to take this survey. | I agree. | | | | |
| 2 | Year you plan to graduate or year you graduated? | • 2005<br>• 2006<br>• 2007<br>• 2008<br>• Other | | | | |
| 3 | What is your gender? | • Male<br>• Female | | | | |
| 4 | What is your age? | • 18 to 23<br>• 24 to 30<br>• 31 to 40<br>• 41 to 50<br>• Over 51<br>• Other | | | | |
| 5 | Confidence in my ability to use my knowledge of mathematics to solve relevant engineering problems. | Poor | Fair | Good | Very Good | Excellent |
| 6 | Confidence in my ability to use my knowledge of chemistry to solve relevant engineering problems. | | | | | |
| 7 | Confidence in my ability to use my knowledge of physics to solve relevant engineering problems. | | | | | |
| 8 | Confidence in my ability to use my knowledge of engineering to solve relevant engineering problems. | | | | | |
| 9 | Confidence in my ability to design and conduct an experiment to obtain measurements or gain additional knowledge. | | | | | |
| 10 | Confidence in my ability to analyze and interpret a set of data to find underlying meaning. | | | | | |
| 11 | Confidence in my ability to design a device or process to satisfy a given set of specifications. | | | | | |
| 12 | Confidence in my ability to function effectively in different team roles. | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13 | Confidence in my ability to solve unstructured engineering problems. | | | | | | |
| 14 | Confidence in my ability to use appropriate engineering techniques including software or lab equipment for problem solving. | | | | | | |
| 15 | Confidence in my knowledge of the professional and ethical responsibilities of an engineer. | | | | | | |
| 16 | Confidence in my ability to write effectively. | | | | | | |
| 17 | Confidence in my ability to make effective presentations. | | | | | | |
| 18 | Confidence in my ability to express engineering-related ideas to others. | | | | | | |
| 19 | Confidence in my ability to listen to and impartially interpret different viewpoints. | | | | | | |
| 20 | Confidence in my knowledge of the potential risks and impact to the public of a proposed engineering solution. | | | | | | |
| 21 | Confidence in my ability to apply knowledge about current issues (economics, environmental, political, social, etc.) to engineering-related problems. | | | | | | |
| 22 | Confidence in my commitment to lifelong learning. | | | | | | |
| 23 | Confidence in my ability to recognize the limitations of my engineering knowledge and skills and to know when to seek additional information. | | | | | | |
| 24 | The impact of an internship or undergraduate research on my ability to solve engineering problems. | None | Very Little | Some | A Lot | A Great Deal | Not Applicable |
| 25 | The impact of an internship or undergraduate research on my ability to apply knowledge and skills learned in courses. | | | | | | |
| 26 | The impact of an internship or undergraduate research on my communications skills. | | | | | | |
| 27 | The impact of an internship or undergraduate research on my time management skills. | | | | | | |
| 28 | The impact of an internship or undergraduate research on my ability to make contact with professional engineers. | | | | | | |
| 29 | The impact of an internship or undergraduate research on my knowledge of engineering as a profession. | | | | | | |
| 30 | The impact of an internship or undergraduate research on my ability to obtain permanent employment. | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 31 | Upon graduation, I plan to work as an engineer. | Yes | | | No | | |
| 32 | I have received a job offer. | | | | | | |
| 33 | I have accepted a permanent job offer. | | | | | | |
| 34 | If you have accepted a permanent job offer, how helpful was coursework in the department/program in securing this job? | None | Very Little | Some | A Lot | A Great Deal | Not Applicable |
| 35 | If you have accepted a permanent job offer, how helpful was coursework outside the department/program in securing this job? | | | | | | |
| 36 | If you have accepted a permanent job offer, how helpful was your participation in an internship? | | | | | | |
| 37 | If you have accepted a permanent job offer, how helpful was your participation in international experience/study abroad? | | | | | | |
| 38 | If you have accepted a permanent job offer, how helpful was your involvement in extracurricular activities? | | | | | | |
| 39 | If you have accepted a permanent job offer, how helpful was your involvement in IEEE? | | | | | | |
| 40 | After graduation, I plan to attend graduate school (even in a few years)? | Yes | | | No | | |
| 41 | If you plan to attend graduate school, it will be | Full Time | | | Part Time | Not Applicable | |
| 42 | I plan to attend… | • Graduate school of engineering<br>• Law school<br>• Medical school<br>• Graduate business school<br>• Other<br>• N/A | | | | | |

| 43 | I am satisfied with the admissions procedures at CBU. | Strongly Disagreed | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 44 | I am satisfied with the orientation received at CBU. | | | | | |
| 45 | I am satisfied that my undergraduate education has provided a solid background for my career. | | | | | |
| 46 | Courses outside my major were important. | | | | | |
| 47 | The importance of a global perspective was emphasized in courses. | | | | | |
| 48 | The need for lifelong learning was emphasized in courses. | | | | | |
| 49 | The ECE faculty prepared me for engineering work. | | | | | |
| 50 | The ECE faculty prepared me for graduate school. | | | | | |
| 51 | I am satisfied with the education I received at the School of Engineering. | | | | | |
| 52 | I would recommend the School of Engineering to a friend. | | | | | |
| 53 | Throughout my education at CBU, my primary enrollment status was | • Full Time<br>• Part Time<br>• Sometimes Full-time; Sometimes Part-time | | | | |
| 54 | I transferred to CBU from a community college. | Yes | No | N/A | | |
| 55 | I transferred to CBU from another college or university. | | | | | |
| 56 | Estimate the average number of hours per week you spent employed on campus. | None<br>0 to 5<br>5 to 10<br>10 to 15<br>15 to 20<br>20 to 25<br>25 to 30<br>30 to 40<br>Over 40 | | | | |
| 57 | Estimate the average number of hours per week you spent employed off campus. | | | | | |

| | | |
|---|---|---|
| 58 | What is the highest degree you ultimately plan to earn? | BS in engineering<br>MBA<br>MD (or comparable)<br>MS in engineering<br>LL.B or J.D.<br>Ph.D.<br>Other |
| 59 | Please provide any additional comments concerning your education at CBU. We are particularly interested in ways to improve the program. | |

# Appendix J

## ECE Alumni Survey

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | This survey is an adaptation of the Engineering Education Alumni Questionnaire© developed by the University of Pittsburgh (used with permission) and is not to be copied or distributed. You must be 18 years of age or older to take this survey. | I agree. | | | | |
| 2 | Year you graduated? | • 2000<br>• 2001<br>• 2002<br>• 2003<br>• 2004<br>• 2005 | | | | |
| 3 | What is your gender? | • Male<br>• Female | | | | |
| 4 | What is your age? | • 18 to 23<br>• 24 to 30<br>• 31 to 40<br>• 41 to 50<br>• Over 51<br>• Other | | | | |
| 5 | Please rate how competent you felt about your abilities as an electrical engineer at the time of graduation. | Poor | Fair | Good | Very Good | Excellent |
| 6 | Please rate how competent you feel about your abilities as an electrical engineer at this time. | | | | | |
| 7 | Based on your experiences as a student, rate the “curriculum’ by the ECE courses you took. | | | | | |
| 8 | Based on your experiences as a student, rate the “in-class instruction” by the classroom experiences with the faculty in the ECE Department. | | | | | |
| 9 | Based on your experiences as a student, rate the “learning through experience” by the engineering related experiences, such as senior project, in the ECE Department. | | | | | |

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| 10 | Based on your experiences as a student, rate the "advising and counseling" by the course advising and career counseling in the ECE Department. | | | | | |
| 11 | Based on your experiences as a student, rate the "culture of the school" by the attitudes toward students and encouragement to learn of the School of Engineering. | | | | | |
| 12 | Based on your experiences as a student, rate the "opportunities for engineering student growth" by the student organizations, Engineers Week, etc. provided by the School of Engineering. | | | | | |
| 13 | Based on your experiences as a student, rate the "foundation for lifelong learning" provided by the School of Engineering. | | | | | |
| 14 | What is your overall rating of the ECE program at CBU? | | | | | |
| 15 | At the time of graduation, describe your knowledge and ability in basic science (physics, chemistry, etc) and math. | | | | | |
| 16 | Based on your experience since graduation, describe your knowledge and ability in basic science (physics, chemistry, etc) and math. | | | | | |
| 17 | At the time of graduation, describe your knowledge and ability in basic engineering subjects, for example: circuits, mechanics of solids , statics, dynamics, etc. | | | | | |
| 18 | Based on your experience since graduation, describe your knowledge and ability in basic engineering subjects (circuits, mechanics of solids, statics, dynamics, etc.) | | | | | |
| 19 | At the time of graduation, describe your knowledge and ability in ECE subjects (circuit analysis, electronics, computer programming, microprocessors, energy conversion, Electromagnetic Field Theory, etc.). | | | | | |
| 20 | Based on your experience since graduation, describe your knowledge and ability in ECE subjects (circuit analysis, electronics, computer programming, microprocessors, energy conversion, Electromagnetic Field Theory, etc.). | | | | | |
| 21 | At the time of graduation, describe your ability to use computers (programming, use of software packages, networking, etc.). | | | | | |
| 22 | Based on your experience since graduation, describe your ability to use computers (programming, use of software packages, networking, etc.). | | | | | |
| 23 | At the time of graduation, describe your ability to use design experiments and analyze data. | | | | | |
| 24 | Based on your experience since graduation, describe your ability to use design experiments and analyze data. | | | | | |
| 25 | At the time of graduation, describe your knowledge of state-of-the-art technology in ECE. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 26 | Based on your experience since graduation, describe your knowledge of state-of-the-art technology in ECE. | | | | | |
| 27 | At the time of graduation, describe your ability to identify problems/opportunities, collect data, conduct analysis, make decisions, and implement them. | | | | | |
| 28 | Based on your experience since graduation, describe your ability to identify problems/opportunities, collect data, conduct analysis, make decisions, and implement them. | | | | | |
| 29 | At the time of graduation, describe your ability to think creatively and to adapt to new situations. | | | | | |
| 30 | Based on your experience since graduation, describe your ability to think creatively and to adapt to new situations. | | | | | |
| 31 | At the time of graduation, describe your ability to write effectively. | | | | | |
| 32 | Based on your experience since graduation, describe your ability to write effectively. | | | | | |
| 33 | At the time of graduation, describe your ability to make oral presentations. | | | | | |
| 34 | Based on your experience since graduation, describe your ability to make oral presentations. | | | | | |
| 35 | At the time of graduation, describe your ability to work with people in teams and groups. | | | | | |
| 36 | Based on your experience since graduation, describe your ability to work with people in teams and groups. | | | | | |
| 37 | At the time of graduation, describe your practical, hands-on, engineering experience. | | | | | |
| 38 | Based on your experience since graduation, describe your practical, hands-on, engineering experience. | | | | | |
| 39 | At the time of graduation, describe your ability to design a system, component, or process to meet desired requirements. | | | | | |
| 40 | Based on your experience since graduation, describe your ability to design a system, component, or process to meet desired requirements. | | | | | |
| 41 | At the time of graduation, describe your ability to set priorities/goals, coordinate tasks/projects, budget resources, and implement tasks; as well as have an understanding of organizational behavior and leadership concepts. | | | | | |
| 42 | Based on your experience since graduation, describe your ability to set priorities/goals, coordinate tasks/projects, budget resources, and implement tasks; as well as have an understanding of organizational behavior and leadership concepts. | | | | | |

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| 43 | At the time of graduation, describe your knowledge of ethical characteristics of the engineering profession and practice. | | | | | |
| 44 | Based on your experience since graduation, describe your knowledge of ethical characteristics of the engineering profession and practice. | | | | | |
| 45 | At the time of graduation, describe your ability to learn and think independently, desire to continue education, projection of a professional image, goal orientation, ability to manage time and organize, self-motivation. | | | | | |
| 46 | Based on your experience since graduation, describe your ability to learn and think independently, desire to continue education, projection of a professional image, goal orientation, ability to manage time and organize, self-motivation. | | | | | |
| 47 | At the time of graduation, describe your knowledge of social awareness issues of culture, race, gender, etc. | | | | | |
| 48 | Based on your experience since graduation, describe your knowledge of social awareness issues of culture, race, gender, etc. | | | | | |
| 49 | At the time of graduation, describe your knowledge of humanities and social sciences. | | | | | |
| 50 | Based on your experience since graduation, describe your knowledge of humanities and social sciences. | | | | | |
| 51 | At the time of graduation, describe your ability to place engineering in a global/societal context. | | | | | |
| 52 | Based on your experience since graduation, describe your ability to place engineering in a global/societal context. | | | | | |
| 53 | At the time of graduation, describe your knowledge of contemporary issues. | | | | | |
| 54 | Based on your experience since graduation, describe your knowledge of contemporary issues. | | | | | |
| 55 | Based on your experience since graduation, the ECE curriculum provided a broad education of the areas within the ECE discipline. | | | | | |
| 56 | Based on your experience since graduation, the ECE curriculum was fulfilling the needs of industry. | | | | | |
| 57 | Based on your experience since graduation, the ECE curriculum provided in-depth education in at least one of the areas within the ECE discipline. | | | | | |
| 58 | Based on your experience since graduation, the ECE curriculum was up-to-date with the practices in industry. | | | | | |
| 59 | Based on your experience since graduation, the ECE curriculum provided a foundation for future learning. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 60 | Based on your experience since graduation, the ECE curriculum provided a foundation for wanting to learn more. | | | | | |
| 61 | Please rate the degree of "commitment to students' education" of the School of Engineering's faculty. | | | | | |
| 62 | Please rate the degree of "respect towards students" of the School of Engineering's faculty. | | | | | |
| 63 | Please rate the degree of "communications and encouragement of high expectations from student's work" of the School of Engineering's faculty. | | | | | |
| 64 | Please rate the degree of "support and helpfulness towards students" of the School of Engineering's faculty. | | | | | |
| 65 | Please rate the degree of "commitment to students' education" of the School of Engineering's administration, clerical staff, and technicians. | | | | | |
| 66 | Please rate the degree of "respect towards students" of the School of Engineering's administration, clerical staff, and technicians. | | | | | |
| 67 | Please rate the degree of "support and helpfulness towards students" of the School of Engineering's administration, clerical staff, and technicians. | | | | | |
| 68 | Please choose the response that describes the culture exhibited by the School of Engineering on the statement, "Cheating on exams was prevalent in engineering courses." | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| 69 | Please choose the response that describes the culture exhibited by the School of Engineering on the statement, "Cheating on homework was prevalent in engineering courses." | | | | | |
| 70 | Please choose the response that describes the culture exhibited by the School of Engineering on the statement, "More emphasis was placed on getting good grades than on learning." | | | | | |
| 71 | Please choose the response that describes the culture exhibited by the School of Engineering on the statement, "The school had a negative competitive atmosphere." | | | | | |
| 72 | Please choose the response that describes the culture exhibited by the School of Engineering on the statement, "Studying/working with other students on homework and assignments was encouraged." | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 73 | Please choose the response that describes the culture exhibited by the School of Engineering on the statement, "Individual accomplishments were valued more than team accomplishments." | | | | | |
| 74 | Based on your experience as a student, please rate the ECE faculty's classroom performance in displaying organization/preparedness in the classroom. | Poor | Fair | Good | Very Good | Excellent |
| 75 | Based on your experience as a student, please rate the ECE faculty's classroom performance in encouraging students to work/study together. | | | | | |
| 76 | Based on your experience as a student, please rate the ECE faculty's classroom performance in encouraging interaction and discussion in the classroom. | | | | | |
| 77 | Based on your experience as a student, please rate the ECE faculty's classroom performance in motivating students to learn. | | | | | |
| 78 | Based on your experience as a student, please rate the ECE faculty's classroom performance in teaching how to apply knowledge and skills to new contexts. | | | | | |
| 79 | Based on your experience as a student, please rate the ECE faculty's classroom performance in using practical examples. | | | | | |
| 80 | Based on your experience as a student, please rate the ECE faculty's communication skills with students. | | | | | |
| 81 | Based on your experience as a student, please rate the ECE faculty's knowledge of the industrial environment. | | | | | |
| 82 | Based on your experience as a student, please rate the ECE faculty's competency in the subjects taught. | | | | | |
| 83 | Based on your experience as a student, please rate the ECE faculty's approachability. | | | | | |
| 84 | Based on your experience as a student, please rate the ECE faculty's availability. | | | | | |
| 85 | Please evaluate your experiences from your undergraduate laboratory activities in providing "real-world" experiences of the knowledge and skills taught. | None | Very Little | Some | A Lot | A Great Deal |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 86 | Please evaluate your experiences from your undergraduate laboratory activities in learning how to communicate your work to others. | | | | | | |
| 87 | Please evaluate your experiences from your undergraduate laboratory activities in learning how to work in teams. | | | | | | |
| 88 | Please evaluate your experiences from your undergraduate laboratory activities applying what you learned in lectures. | | | | | | |
| 89 | Please evaluate your experiences from your undergraduate laboratory activities regarding instructors were committed to their teaching assignments. | | | | | | |
| 90 | Please evaluate your experiences from your senior project in applying your problem solving abilities. | | | | | | |
| 91 | Please evaluate your experiences from your senior project in allowing me to demonstrate creativity. | | | | | | |
| 92 | Please evaluate your experiences from your senior project in providing an integration of the ECE curriculum. | | | | | | |
| 93 | Please evaluate your experiences from your senior project in increasing your written communication skills. | | | | | | |
| 94 | Please evaluate your experiences from your senior project in increasing your oral communication skills. | | | | | | |
| 95 | Please evaluate your experiences from your senior project in developing interpersonal skills. | | | | | | |
| 96 | Please evaluate your experiences from your senior project in taking responsibility for decisions. | | | | | | |
| 97 | Please evaluate your experiences from your senior project in gaining an understanding of the work environment. | | | | | | |
| 98 | Please evaluate your experiences from your senior project exercising your management skills. | | | | | | |
| 99 | Please evaluate your experiences from your senior project in increasing your computer skills. | | | | | | |
| 100 | Did you ever have an engineering job (internship, summer job, etc) prior to or while working on your undergraduate degree? | Yes | | | No | | |
| 101 | My engineering job or internship strengthened my problem solving abilities. | None | Very Little | Some | A Lot | A Great Deal | Not Applicable |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 102 | My engineering job or internship helped me to apply the knowledge and skills learned in the classroom to real problems. | | | | | | |
| 103 | My engineering job or internship helped me to communicate with others. | | | | | | |
| 104 | My engineering job or internship helped me to develop time management skills. | | | | | | |
| 105 | My engineering job or internship increased my professional development. | | | | | | |
| 106 | My engineering job or internship helped me to make contacts with practicing engineers. | | | | | | |
| 107 | My engineering job or internship helped me to become a better student. | | | | | | |
| 108 | Based on your experience as a student, please rate the ECE faculty's performance in course advising. | Poor | Fair | Good | Very Good | Excellent | |
| 109 | Based on your experience as a student, please rate the ECE faculty's performance in career counseling. | | | | | | |
| 110 | Please choose the response that describes the academic advising exhibited by the ECE Department on "Advisor took the time to know me personally." | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | |
| 111 | Please choose the response that describes the academic advising exhibited by the ECE Department on "Advisor knew where to send me to obtain information." | | | | | | |
| 112 | Please choose the response that describes the academic advising exhibited by the ECE Department on "Advisor made concrete and directive suggestions." | | | | | | |
| 113 | Please choose the response that describes the academic advising exhibited by the ECE Department on "Advisor knew the facts about courses." | | | | | | |
| 114 | Did you belong to any professional organizations or participate in engineering activities as an undergraduate? | Yes | | No | | | |

| | | None | Very Little | Some | A Lot | A Great Deal | Not Applicable |
|---|---|---|---|---|---|---|---|
| 115 | Please rate the degree to which belonging to professional organizations or participating in engineering activities as an undergraduate helped you in social interaction. | | | | | | |
| 116 | Please rate the degree to which belonging to professional organizations or participating in engineering activities as an undergraduate helped you in personal development. | | | | | | |
| 117 | Please rate the degree to which belonging to professional organizations or participating in engineering activities as an undergraduate helped you in professional development. | | | | | | |
| 118 | Please rate the degree to which belonging to professional organizations or participating in engineering activities as an undergraduate helped you in academic development. | | | | | | |

| | | Poor | Fair | Good | Very Good | Excellent |
|---|---|---|---|---|---|---|
| 119 | Based on your experience as a student, please rate the services of the university's library. | | | | | |
| 120 | Based on your experience as a student, please rate the university's computer facilities – availability. | | | | | |
| 121 | Based on your experience as a student, please rate the university's computer facilities – hardware and software reflective of current technology. | | | | | |
| 122 | Based on your experience as a student, please rate the services of the university's registration process. | | | | | |
| 123 | Based on your experience as a student, please rate the university's job/career placement services. | | | | | |
| 124 | Based on your experience as a student, please rate the university's financial aid services. | | | | | |
| 125 | Based on your experience as a student, please rate the university's instructional/study skills services. | | | | | |
| 126 | Based on your experience as a student, please rate the services of the university's campus bookstore. | | | | | |
| 127 | Based on your experience as a student, please rate the university's classrooms – maintenance and care. | | | | | |
| 128 | Based on your experience as a student, please rate the university's classrooms – properly equipped for learning. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 129 | Based on your experience as a student, please rate the university's buildings and grounds maintenance. | | | | | |
| 130 | Based on your experience as a student, please rate the university's safety services. | | | | | |
| 131 | Based on your experience as a student, please rate the university's parking. | | | | | |
| 132 | Based on your experience as a student, please rate the university's student health services. | | | | | |
| 133 | Based on your experience as a student, please rate the university's recreational services and extra-curricular activities. | | | | | |
| 134 | Was there anyone, inside or outside the university, who had a positive influence on your undergraduate education? | Yes | | No | | |
| 135 | Who was that individual(s)? (If the answer to 134 was "No" indicate by N/A) | Yes | | No | | Not Applicable |
| 136 | What characteristics did this individual(s) have? (If the answer to 134 was "No" indicate by N/A) | | | | | |
| 137 | Before beginning your undergraduate education, please rate your academic background. | Poor | Fair | Good | Very Good | Excellent |
| 138 | After completing your degree, please rate your academic background. | | | | | |
| 139 | Before beginning your undergraduate education, please rate your maturity level. | | | | | |
| 140 | After completing your degree, please rate your maturity level. | | | | | |
| 141 | Before beginning your undergraduate education, please rate your motivation to learn. | | | | | |
| 142 | After completing your degree, please rate your motivation to learn. | | | | | |
| 143 | Before beginning your undergraduate education, please rate your study skills/habits. | | | | | |
| 144 | After completing your degree, please rate your study skills/habits. | | | | | |

| | | |
|---|---|---|
| 145 | Which of the following describes the types of industries/services you have primarily worked: | • Banking/finance<br>• Communications systems (telephone, TV, etc.)<br>• Computers<br>• Construction – general contractor<br>• Construction – specialized<br>• Consumer electronics<br>• Consulting<br>• Education<br>• Government – local<br>• Government – federal (including armed forces)<br>• Government – state<br>• Healthcare<br>• Instrumentation<br>• Manufacturing – assemble<br>• Manufacturing – control systems<br>• Manufacturing – distribution<br>• Manufacturing – production<br>• Manufacturing – semiconductors<br>• Medical electronics<br>• Retail<br>• Software development and services<br>• Trade associations<br>• Transportation/ Delivery services<br>• Utilities<br>• Not working<br>• Other |

| | | |
|---|---|---|
| 146 | Which of the following best describes the types of positions you have worked: | • Administrative<br>• Educator<br>• Executive,<br>• Non-engineering<br>• Professional (other than engineer – physician, lawyer, etc.)<br>• Operations<br>• Project management/engineering<br>• Research and development<br>• Sales/marking<br>• Design<br>• Other |
| 147 | Beyond your bachelor's degree, what is the highest level of education that you have completed? | • Some postgraduate study<br>• M.S. in an electrical engineering discipline<br>• M.S. in another engineering discipline<br>• M.B.A. degree<br>• M.A. or M.S. in another field of study<br>• Ph.D. in electrical engineering or closely related field<br>• Ph.D. in another engineering field<br>• Ph.D. in another field of study<br>• M.D., D.D.S., J.D.<br>• Other |
| 148 | What is the title of your current position? | |
| 149 | Is there anything else you would like to tell us about your undergraduate engineering education – about the curriculum, the school culture, in-class instruction, etc.? | |

| | | | |
|---|---|---|---|
| 150 | Are you a member of IEEE? | Yes | No |
| 151 | Are you a member of NSPE? | | |
| 152 | Are you a member of an engineering society? | | |
| 153 | Did you attend CBU for all your undergraduate work? | | |
| 154 | Date survey is completed. | | |

# Appendix K

## Industry Survey

| | | | | |
|---|---|---|---|---|
| 1 | This survey is an adaptation of the Alumni Survey developed in *Designing & Assessing Courses & Curriculum*© by R. D. Diamond (Copyright 1998 Jossey-Bass Inc. – used with permission of John Wiley & Sons, Inc.) and Engineering Education Alumni Questionnaire© developed by the University of Pittsburgh (used with permission) and is not to be copied or distributed. You must be 18 years of age or older to take this survey. | I agree | | |
| 2 | Does the company have CBU graduates presently employed, or ever had, on which to base this survey? | Yes | No | Do Not Know |
| 3 | Which of the following describes the company: | • Banking/finance<br>• Communications systems (telephone, TV, etc.)<br>• Computers<br>• Construction – general contractor<br>• Construction – specialized<br>• Consumer electronics<br>• Consulting<br>• Education<br>• Government – local<br>• Government – federal (including armed forces)<br>• Government – state<br>• Healthcare<br>• Instrumentation<br>• Manufacturing – assemble<br>• Manufacturing – control systems<br>• Manufacturing – distribution<br>• Manufacturing – production<br>• Manufacturing – semiconductors<br>• Medical electronics<br>• Retail<br>• Software development and services<br>• Trade associations<br>• Transportation/delivery services<br>• Utilities<br>• Other | | |

| | | Not Applicable | Low | Medium | High | Very High |
|---|---|---|---|---|---|---|
| 4 | Rate the importance of professional writing at the company. | | | | | |
| 5 | Rate the writing ability of Electrical and Computer Engineering (ECE) graduates of Christian Bothers University (CBU). | | | | | |
| 6 | Rate the writing ability of other than CBU graduates. | | | | | |
| 7 | Rate the importance of oral presentations at the company. | | | | | |
| 8 | Rate the ability to make oral presentations ability of ECE graduates of CBU. | | | | | |
| 9 | Rate the ability to make oral presentations of other than CBU graduates. | | | | | |
| 10 | Rate the importance of basic mathematics at the company. | | | | | |
| 11 | Rate the mathematical ability of ECE graduates of CBU. | | | | | |
| 12 | Rate the mathematical ability of other than CBU graduates. | | | | | |
| 13 | Rate the importance of the use of basic engineering skills at the company. | | | | | |
| 14 | Rate the ability to use basic engineering skills of ECE graduates. | | | | | |
| 15 | Rate the ability to use basic engineering skills of other than CBU graduates. | | | | | |
| 16 | Rate the importance of the ability to analyze and interpret data at the company. | | | | | |
| 17 | Rate the ability to analyze and interpret data of ECE graduates of CBU. | | | | | |
| 18 | Rate the ability to analyze and interpret data of other than CBU graduates. | | | | | |
| 19 | Rate the importance of the ability to design a device or process to satisfy a set of specifications at the company. | | | | | |
| 20 | Rate the ability to design a device or process to satisfy a set of specifications of ECE graduates of CBU. | | | | | |
| 21 | Rate the ability to design a device or process to satisfy a set of specifications of other than CBU graduates. | | | | | |
| 22 | Rate the importance of the ability to function as a team member at the company. | | | | | |
| 23 | Rate the ability to function as a team member of ECE graduates of CBU. | | | | | |
| 24 | Rate the ability to function as a team member of other than CBU graduates. | | | | | |

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|---|---|---|---|---|---|---|
| 25 | Rate the importance of the use of basic leadership skills at the company. | | | | | |
| 26 | Rate the ability to use basic leadership skills of ECE graduates of CBU. | | | | | |
| 27 | Rate the ability to use basic leadership skills of other than CBU graduates. | | | | | |
| 28 | Rate the importance of the use of basic interpersonal skills at the company. | | | | | |
| 29 | Rate the ability to use basic interpersonal skills of ECE graduates of CBU. | | | | | |
| 30 | Rate the ability to use basic interpersonal skills of other than CBU graduates. | | | | | |
| 31 | Rate the importance of ethics and professional responsibility at the company. | | | | | |
| 32 | Rate the ability to apply ethics and professional responsibility to the practice of engineering of ECE graduates of CBU. | | | | | |
| 33 | Rate the ability to apply ethics and professional responsibility to the practice of engineering of other than CBU. | | | | | |
| 34 | Rate the importance of creativity at the company. | | | | | |
| 35 | Rate the creativity of ECE graduates of CBU. | | | | | |
| 36 | Rate the creativity of other than CBU. | | | | | |
| 37 | Rate the importance of enthusiasm at the company. | | | | | |
| 38 | Rate the enthusiasm of ECE graduates of CBU. | | | | | |
| 39 | Rate the enthusiasm of other than CBU graduates. | | | | | |
| 40 | Rate the importance of willingness to take reasonable risks at the company. | | | | | |
| 41 | Rate the CBU willingness to take reasonable risks of ECE graduates. | | | | | |
| 42 | Rate the willingness to take reasonable risks of other than CBU graduates. | | | | | |
| 43 | Rate the importance of appearance at the company. | | | | | |
| 44 | Rate the appearance of ECE graduates of CBU. | | | | | |
| 45 | Rate the appearance of other than CBU graduates. | | | | | |
| 46 | Rate the importance of industriousness at the company. | | | | | |
| 47 | Rate the industriousness of ECE graduates of CBU. | | | | | |
| 48 | Rate the industriousness of other than CBU graduates. | | | | | |
| 49 | Rate the importance of computer skills at the company. | | | | | |
| 50 | Rate the ability to use computer skills of ECE graduates of CBU. | | | | | |
| 51 | Rate the ability to use computer skills of other than CBU graduates. | | | | | |
| 52 | Rate the importance of engineering internships at the company. | | | | | |
| 53 | Rate the ability of ECE graduates of CBU as engineering interns. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 54 | Rate the ability of other than CBU graduates as engineering interns. | | | | | |
| 55 | In what direction do you see engineering moving toward in the next five year? | | | | | |
| 56 | What new skills or attitudes do engineers at the company need? | | | | | |
| 57 | What skills or attitudes will become obsolete? | | | | | |
| 58 | Please make any additional comments or suggestions, which will help us understand your perspective on engineering graduates. | | | | | |
| 59 | Date survey is completed. | | | | | |

# Appendix L

## Instructional Goals Questionnaire

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | This survey is an adaptation of the Teaching Goals Inventory developed in *Classroom Assessment Techniques* by T. A. Angelo and K. P. Cross© (Copyright 1993 Jossey-Bass Inc. – used with permission of John Wiley & Sons, Inc.) and is not to be copied or distributed. | I agree. | | | | |
| 2 | Please select one course you are currently teaching and rate the importance of each goal you aim to have students accomplish in the course. Indicate the course level: | • Freshman<br>• Sophomore<br>• Junior<br>• Senior | | | | |
| 3 | Develop ability to apply principles and generalizations already learned to new problems and situations. | Essential – a goal you achieve or nearly always achieve | Very important – a goal you often try to achieve | Important – a goal you sometimes try to achieve | Unimportant – a goal you rarely try to achieve | Not Applicable – a goal you never try to achieve |
| 4 | Develop analytic skills. | | | | | |
| 5 | Develop problem-solving skills. | | | | | |
| 6 | Develop ability to draw reasonable inferences and observations. | | | | | |
| 7 | Develop ability to synthesize and integrate information and ideas. | | | | | |
| 8 | Develop ability to think holistically, to see the whole as well as the parts. | | | | | |
| 9 | Develop ability to think creatively. | | | | | |
| 10 | Develop ability to distinguish between fact and opinion. | | | | | |
| 11 | Improve skill at paying attention. | | | | | |
| 12 | Develop ability to concentrate. | | | | | |
| 13 | Improve memory skills. | | | | | |
| 14 | Improve listening skills. | | | | | |
| 15 | Improve speaking skills. | | | | | |
| 16 | Improve reading skills. | | | | | |
| 17 | Improve writing skills. | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18 | Develop appropriate study skills, strategies, and habits. | | | | | |
| 19 | Improve engineering and mathematical skills. | | | | | |
| 20 | Learn terms and facts on this subject. | | | | | |
| 21 | Learn engineering concepts and theories on this subject. | | | | | |
| 22 | Develop skill in using material, tools, and /or technology central to this subject. | | | | | |
| 23 | Learn to appreciate perspectives and values of this subject. | | | | | |
| 24 | Prepare for graduate study. | | | | | |
| 25 | Learn techniques and methods used to gain new knowledge in this subject. | | | | | |
| 26 | Learn to evaluate methods and materials in this subject. | | | | | |
| 27 | Learn to appreciate important contributions to this subject. | | | | | |
| 28 | Develop an appreciation of the liberal arts, engineering, and sciences. | | | | | |
| 29 | Develop openness to new ideas. | | | | | |
| 30 | Develop an informed concern about contemporary social issues. | | | | | |
| 31 | Develop a commitment to exercise the rights and responsibilities of citizenship. | | | | | |
| 32 | Develop a lifelong love of learning. | | | | | |
| 33 | Develop aesthetic appreciation. | | | | | |
| 34 | Develop an informed historical perspective of engineering. | | | | | |
| 35 | Develop an informed awareness of the role of engineering and science. | | | | | |
| 36 | Develop an informed appreciation of other cultures. | | | | | |
| 37 | Develop capacity to make informed ethical and professional decisions. | | | | | |
| 38 | Develop ability to work productively with others. | | | | | |
| 39 | Develop management skills. | | | | | |
| 40 | Develop leadership skills. | | | | | |
| 41 | Develop a commitment to present accurate work. | | | | | |
| 42 | Improve ability to follow directions, instructions, and plans. | | | | | |
| 43 | Improve ability to organize and use time effectively. | | | | | |
| 44 | Develop a commitment to personal achievement. | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 45 | Develop ability to perform work efficiently. | | | | | | |
| 46 | Cultivate emotional health and well-being. | | | | | | |
| 47 | Improve self-esteem/self confidence. | | | | | | |
| 48 | Develop a commitment to one's own values. | | | | | | |
| 49 | Develop respect for others. | | | | | | |
| 50 | Cultivate emotional health and well-being. | | | | | | |
| 51 | Cultivate physical health and well-being. | | | | | | |
| 52 | Cultivate an active commitment to honesty. | | | | | | |
| 53 | Develop capacity to think. | | | | | | |
| 54 | Develop capacity to make wise decisions. | | | | | | |
| 55 | In general, how do you see your primary role as an instructor? | • Teaching students facts and principles of the subject matter<br>• Providing a role model for students<br>• Helping students develop higher-order thinking skills<br>• Preparing students for jobs/careers<br>• Fostering student development and personal growth<br>• Helping students develop basic learning skills | | | | | |
| 56 | Date survey is completed. | | | | | | |

# Appendix M

## Permission to Adapt University of Pittsburgh School of Engineering Student Assessment System's Surveys

From: John Ventura [jventura@midsouth.rr.com]
Sent: Friday, July 15, 2005 1:25 PM
To: 'Shuman, Larry'
Cc: 'Besterfield-Sacre, Mary'
Subject: RE: Use of surveys in a dissertation

Attachments: Survey summary.doc; PittsburghAssessmentSystem.pdf

Dr. Shuman,

I appreciate your allowing me to use the surveys described in the "University of Pittsburgh School of Engineering Student Assessment System" as found in the attached document.

I have placed it on my website (http://www.cbu.edu/~jventura/) under the link University of Pittsburgh School of Engineering Student Assessment System as a pdf file, hereto attached.

Your generosity is appreciated. These surveys will be part of several that will be used to develop a model for an ECE program evaluation.

Best always,
John Ventura

--------------------------------------------------------------------------------

From: Shuman, Larry [mailto:Shuman@engr.pitt.edu]
Sent: Wednesday, July 13, 2005 9:04 AM
To: jventura@midsouth.rr.com
Cc: Besterfield-Sacre, Mary
Subject: RE: Use of surveys in a dissertation

Hi John,

Please use and refer to this document. Please keep us apprised of the progress of your research and your results. We would be happy to answer any questions you might have.

Good luck,

Larry

--------------------------------------------------------------------------------

From: John Ventura [mailto:jventura@midsouth.rr.com]
Sent: Tuesday, July 12, 2005 4:34 PM
To: Besterfield-Sacre, Mary; Shuman, Larry
Subject: RE: Use of surveys in a dissertation

Dr. Besterfield-Sacre and Dr. Shuman:
Re:

- Pittsburgh Freshman Engineering Attitudes Survey
- Sophomore Engineering Learning and Curriculum Evaluation Survey
- Junior Engineering Learning and Curriculum Evaluation Instrument
- Graduating Senior Survey
- Engineering Education Alumni Questionnaire

The use of these surveys will be limited to approximately 70 undergraduate students at Christian Brothers University (CBU), approximately 50 graduates of CBU, and 30 employers. The surveys will reside in the following:

- A password protected or URL specific Web site (http://www.cbu.edu/engineering/survey/).
- A password protected WebCT account (http://webct.cbu.edu/webct/public/home.pl).

I am the administrator of these sites. The use of the surveys can be limited to one year. I will gladly share my results.

I have attached modified versions of the surveys. The changes are due to the program at CBU and the format of CBU's survey Web site. CBU or my dissertation committee at Nova Southeastern University may require additional changes to the surveys. In addition, I would like to modify the alumni questionnaire so that it may be used for surveying the industries that employ CBU's graduates.

Your assistance will be appreciated. I look forward to a reply at a suitable time.

Respectively submitted,
John Ventura
901-321-3429

--------------------------------------------------------------------------------

From: John Ventura [mailto:jventura@midsouth.rr.com]
Sent: Tuesday, July 05, 2005 1:16 PM
To: 'Mary Besterfield-Sacre'; Larry Shuman, Associate Dean of Academic Affairs
Subject: RE: Use of surveys in a dissertation

Dr. Besterfield-Sacre and Dr. Shuman,

It is important to the study to have an informed understanding of students' perceptions and attitudes regarding their experiences at Christian Brothers University (CBU) and those of graduates. My use of these surveys will be limited, and the surveys will reside on a password protected or URL specific Web site http://www.cbu.edu/engineering/survey/) or in an ECE course that uses a password protected WebCT account (http://webct.cbu.edu/webct/public/home.pl). I am the administrator of the Web site and less than 200 constituents of CBU will access these surveys.

I intend to modify or adapt the surveys only to the extent necessary to meet CBU's ECE program and Nova Southeaster University's dissertation requirements. The fact that CBU does not have a co-op program and this is an ECE program rather than mechanical are examples of needed changes in the surveys.

The use of the surveys can be limited to one year. In addition, any results of your past survey results would be of benefit to this study, and I will share my results.

In the event that I am allowed to use the surveys, the following are suggested references:

- Pittsburgh Freshman Engineering Attitudes Survey – Copyright ???? by University of Pittsburgh
- Sophomore Engineering Learning and Curriculum Evaluation Survey – Copyright ???? by University of Pittsburgh
- Junior Engineering Learning and Curriculum Evaluation Instrument – Copyright ???? by University of Pittsburgh
- Graduating Senior Survey – Copyright ???? by University of Pittsburgh
- Engineering Education Alumni Questionnaire – Copyright 1977 by University of Pittsburgh
- Definition of the 13 Attitude Measures – Copyright ???? by University of Pittsburgh

The only instrument that I have a copyright date is 1977 for Engineering Education Alumni Questionnaire.

I will be glad to call you at your convenience, or you may call me on my cell phone at 901-486-7981.

Sincerely,
John Ventura

-------------------------------------------------------------------------------

From: John Ventura [mailto:jventura@midsouth.rr.com]
Sent: Thursday, June 23, 2005 3:25 PM
To: 'Mary Besterfield-Sacre'
Subject: Use of surveys in a dissertation

Dr. Besterfield-Sacre,

I am an assistant professor in the Electrical and Computer Engineering Department at Christian Brothers University in Memphis, Tennessee, working on a Ph.D. in the Graduate School of Computer and Information Sciences at Nova Southeastern University in Fort Lauderdale, Florida. The title of my dissertation is *Web-Based Evaluation Process for an Electrical and Computer Engineering Department*.

In 2003, you sent me the following surveys:
·Pittsburgh Freshman Engineering Attitudes Survey
·Sophomore Engineering Learning and Curriculum Evaluation Survey
·Junior Engineering Learning and Curriculum Evaluation Instrument
·Graduating Senior Survey
·Engineering Education Alumni Questionnaire
·In addition, I later acquired Defamation of the 13 Attitude Measures from http://www.engrng.pitt.edu/~outcomes/#.

I am requesting permission to use and/or adapt these questionnaires and surveys in this dissertation and within a Web site associated with this work (http://www.cbu.edu/engineering/survey/). Proper credit will be given to all cited material.

The goal of the study will be to provide faculty a model for developing and implementing an evaluation process that promotes continuous quality improvement in a program based on the accreditation requirements of the Commission on Colleges of the Southern Association of Colleges and Schools (SACS) and the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). The model will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvement.

Your assistance will be appreciated. I look forward to a reply at a suitable time.

Respectively submitted,
John Ventura
901-321-3429

# Appendix N

## Permission to Adapt and Republish Several Figures, Tables, Exhibits, and Surveys from *Classroom Assessment Techniques* by T. A. Angelo and K. P. Cross

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June 8, 2005

John Ventura
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# Appendix P

## ECE Curriculum Committee

1. A member of the executive board of the Memphis Chapter of IEEE (Allan Long, section chair of the Memphis Section of IEEE)
2. A member of the executive board of the Memphis Chapter of the Tennessee Society of Professional Engineers (Billy Allen, chapter director of the Memphis Chapter of the Tennessee Society of Professional Engineers)
3. A member of the Organizing Committee of the Memphis Area Engineering and Sciences Conference (Dr. Siripong Malasri, a founding member of the Memphis Area Engineering and Sciences Conference)
4. Chair of the IEEE Student Chapter at CBU (Nathan Wellikoff, student chair)
5. ECE faculty (Dr. Eric Welch, Dr. Fred Terry, Dr. Robert Drake, Dr. Juan Carlos Olabe, and John Ventura)
6. Dean of Engineering (Dr. Eric Welch)
7. Chair of the Master of Engineering Management (Dr. Neal Jackson)
8. A faculty member from the School of Sciences (Dr. Pascal Bedrossian, chair of the Department of Mathematics and Computer Science)

# Appendix Q

## Advisory Board for Electrical and Computer Engineering
## Christian Brothers University

Ulysses Polk
Bellsouth Communications
Memphis, TN

Shannon Reed
Army Corps of Engineers
Brighton, TN

Brian Wolfe
Sharp Corp
Memphis, TN

Tom Stoll
The Bodine Company
Collierville, TN

Rebecca Jones
FedEx
Collierville, TN

Mark Driver
Kilgore Flares
Toone, TN

# Appendix R

## ECE Advisory Board and ECE Curriculum Committee Model for an Evaluation Process for an Electrical and Computer Engineering Department

Nationally, engineering programs have recognized the need for engineering programs to develop measurable outcomes, data collection methods, assessment procedures, evaluation standards, and processes for program improvements in order to comply with the accreditation criteria. A three and-a-half year study indicated that 2004 graduates in the aggregate have significantly higher skill levels than their counterparts a decade ago.

Your assistance is requested to develop and validate an evaluation process for meeting accreditation requirements, and provide responses to the following questions:

1. What performances are expected of graduates as a result of their educational experiences?
2. What evaluation processes may be used to measure the achievement of program objectives required by constituents of undergraduate programs?

**Educational Objectives**

The educational objectives of the ECE program are to prepare students to enter and continue the practice of engineering and/or to continue their education by study in graduate or professional schools. Graduates will demonstrate:

1. The ability to apply mathematics, engineering sciences, computational methods, and natural sciences to ECE engineering problems.
2. Entry-level competency of discipline-specific principles and practices within the following major areas of electrical engineering: communications, continuous/discrete systems, electronics, controls, and power systems. This knowledge base includes the development of analytical and experimental skills.
3. The ability to synthesize principles and techniques from engineering, mathematics, and natural/social sciences to develop and evaluate alternative design solutions to electrical engineering problems with specific constraints.
4. Professional responsibility and a sensibility to a broad range of societal concerns, such as ethical, environmental, economic, regulatory, and global issues.
5. Successful contribution to a team, effective communication, and an awareness of the necessity for personal and professional growth.

*Criterion 3: Program Outcomes and Assessment.* Engineering programs must demonstrate that students have acquired (http://www.abet.org/forms.shtml):

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
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
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an ability to comprehend the importance of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to comprehend the impact of engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

**Problem**

To meet accreditation standards, programs must demonstrate that they have implemented evaluation processes that measure the achievement of outcomes and objectives based on input from constituents. Without a clear understanding of accreditation requirements and a framework for developing and implementing learning outcomes and program objectives, faculty will be limited to content-driven objectives. Course content can no longer be the sole consideration in curriculum development, in that, EC2000 and SACS' Principles of Accreditation require that programs measure the achievement of specified learning outcomes and educational objectives.

**Goal**

The goal is to develop and implement an evaluation process for meeting accreditation requirements: assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process will be encapsulated in a model that will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvement.

The model will provide a continuous course of actions that consider the needs of constituents: faculty, students, employers, industry, and alumni. As a final point, the evaluation processes provide for a systematic comparison of current measurements and past results.

*ECE Curriculum Committee.* A committee comprised of members from professional societies, faculty, student branches of professional societies, and faculty from other science and engineering management departments. The committee provides input for improvement in the evaluation processes.

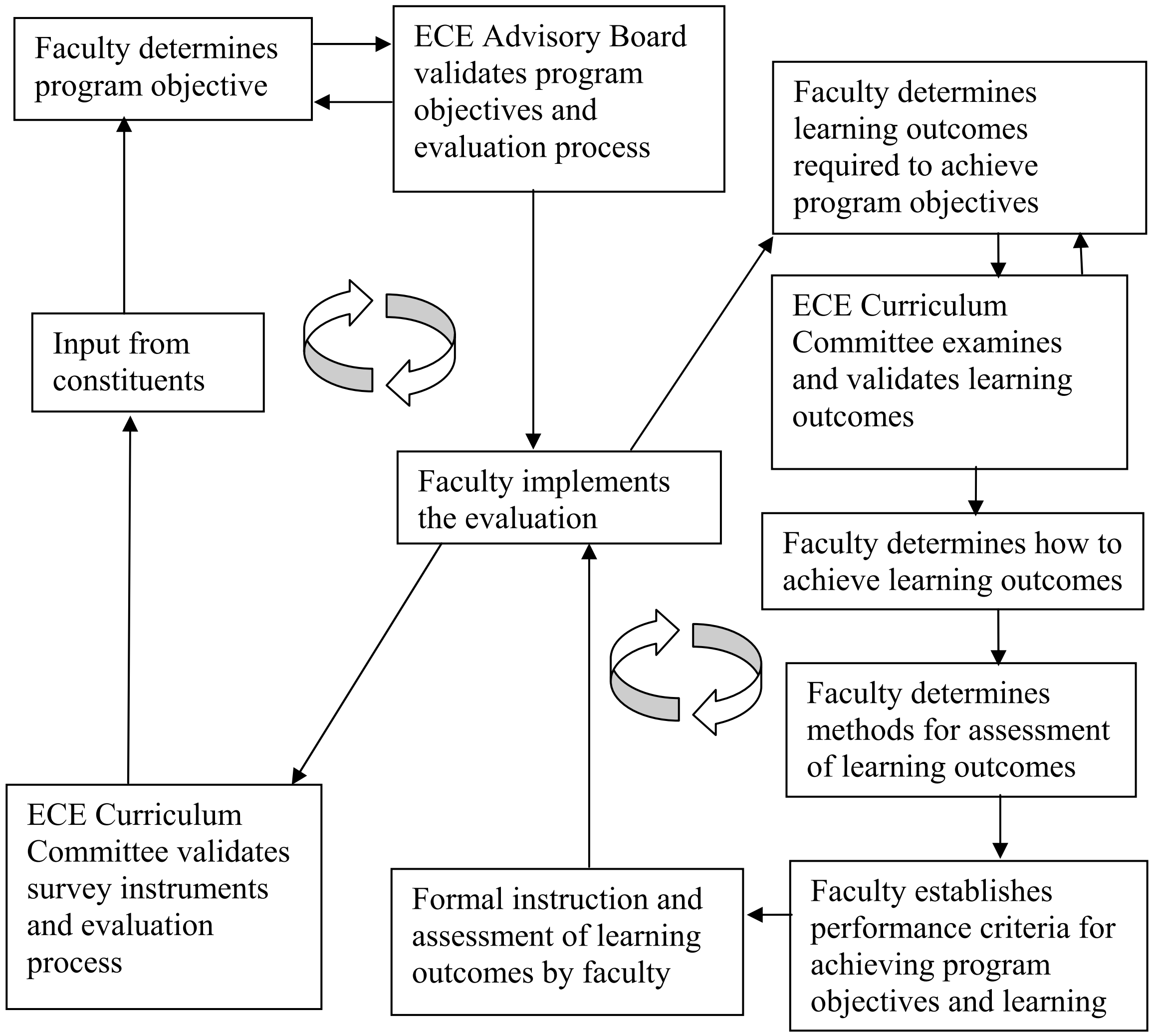


**Figure 1. Model for Evaluation**

**Methodology**

Institutions can develop and implement Web-based assessment and evaluation processes that minimize the time required by faculty to assess students' progress, make use of existing computer skills of faculty, and employ existing computer networks and resources. Web-based assessment and evaluation processes facilitate measurements of performance criteria and level of achievement of program objectives.

**Procedures**

The following procedures will be required:

1. Employ surveys/questionnaires to measure the achievement of program objectives using Web-based technologies.
2. Establish an ECE Curriculum Committee that will contain members from local engineering societies and organizations, the student chapter of IEEE, and faculty.
3. Expand the responsibilities of the ECE Advisory Board to include the examination and validation of the evaluation processes.
4. Provide constituents with instruments that measure the level of achievement of program objectives.
5. Provide the ECE Advisory Board and Curriculum Committee with program objectives as determined by input from constituents.
6. Provide results of surveys/questionnaires to the ECE Advisory Board and ECE Curriculum Committee to enable recommendations to improve the quality of the program by the faculty.

The ECE Curriculum Committee includes:

1. A member of the executive board of the Memphis Chapter of IEEE
    i. (Allan Long)
2. A member of the executive board of the Memphis Chapter of the Tennessee Society of Professional Engineers (TSPE) (Billy Allen)
3. A member of the Organizing Committee of the Memphis Area Engineering and Sciences Conference (Dr. Siripong Malasri)
4. President of the IEEE Student Chapter at CBU (Nathan Wellikoff)
5. ECE faculty
6. Dean of Engineering (Eric Welch)
7. Chair of the Master of Engineering Management (Dr. Neal Jackson)
8. A faculty member from the School of Sciences (Dr. Pascal Bedrossian)

**Table 1. Surveys/Questionnaire and Participants**

| Surveys/Questionnaire | Participants |
|---|---|
| Freshman Engineering Attitudes Survey (75) | Freshman ECE students (9) |
| Sophomore Engineering Learning and Curriculum Evaluation Survey (65) | Sophomore ECE students (9) |
| Junior Engineering Learning and Curriculum Evaluation Survey (74) | Junior ECE students (8) |
| Senior Survey (59) | Senior ECE students (11) |
| ECE Alumni Survey (154) | ECE graduates from May 2001 to May 2005 (21) |
| Industry Survey (59) | Employers or potential employers of ECE graduates (15) |
| Instructional Goals Questionnaire (56) | ECE faculty (6) |

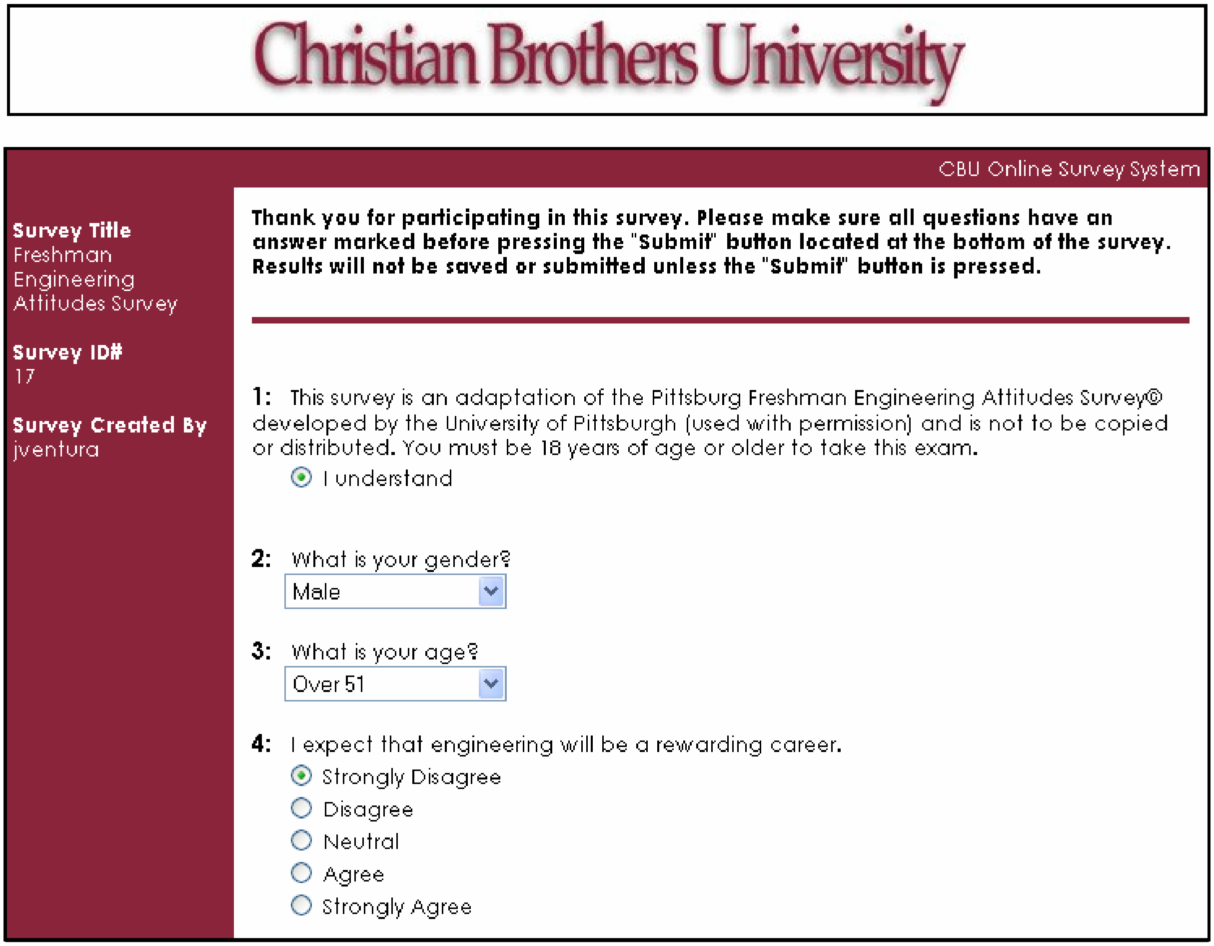


**Figure 2. Example of the Freshman Engineering Attitudes Survey (first four questions)**

| Category | Criterion |
|---|---|
| 1 | Strongly Disagree |
| 2 | Disagree |
| 3 | Neutral |
| 4 | Agree |
| 5 | Strongly Agree |

**Figure 3. Rating scale (category) for criterion used in surveys**

**Table 2. Grading Criteria for ABET Learning Outcomes**

| Grade | Criteria |
|---|---|
| A+ | >= 75% of responses in categories 5 and 4; > = 50% rated as 5 |
| A | >= 75% of responses in categories 5 and 4; > = 37.5% rated as 5; |
| A– | >= 75% of responses in categories 5 and 4; < 37.5% rated as 5 |
| B+ | 50 to <75% in categories 5 and 4; >= 37.5% rated as 5 |
| B | 50 to <75% in categories 5 and 4; >= 25% rated as 5 |
| B– | 50 to < 75% in categories 5 and 4; < 25% rated as 5 |
| C+ | Highest frequency of ratings for category 3 but <= 50% in category 3 or number of (4 + 5) and (1 + 2) <= 50%; number of (4+5) > number of (1+2) |
| C | 50 to <75% in category 3 or number of (4 + 5) and (1 + 2) <= 50%; number of (1+2) = number of (4+5) |
| C– | Highest frequency of ratings for category 3 but < =50% in category 3 or number of (4 + 5) and (1 + 2) <= 50%; number of (1+2) > number of (4+5) |
| D+ | <75% to >= 50% in categories 1 and 2; < 25% are in category 1 |
| D | <75% to >= 50% in categories 1 and 2; >= 25% to < 37.5% are in category 1 |
| D– | <75% to >= 50% in categories 1 and 2; >= 37.5% are in category 1 |
| F | >= 75% are in categories 1 and 2 |

**Table 3. Grading Criteria 3a – An ability to apply knowledge of mathematics, science, and engineering**

| | | |
|---|---|---|
| Confidence in my ability to use my knowledge of mathematics to solve relevant engineering problems. (55) | Freshman | **C+** |
| Confidence in my ability to use my knowledge of chemistry to solve relevant engineering problems. (56) | Freshman | **D** |
| Confidence in my ability to use my knowledge of physics to solve relevant engineering problems. (57) | Freshman | **D+** |
| Confidence in my ability to use my knowledge of engineering to solve relevant engineering problems. (58) | Freshman | **C–** |
| Confidence in my ability to use mathematical concepts to solve engineering problems. (47) | Sophomore | **B–** |
| Confidence in my ability to use chemistry concepts to solve engineering problems. (48) | Sophomore | **C–** |
| Confidence in my ability to use physics concepts to solve engineering problems. (49) | Sophomore | **C+** |
| Confidence in my ability to use engineering concepts to solve relevant engineering problems. (50) | Sophomore | **C** |
| Confidence in my ability to use mathematical concepts to solve engineering problems. (56) | Junior | **C–** |
| Confidence in my ability to use chemistry concepts to solve engineering problems. (57) | Junior | **C–** |

| | | |
|---|---|---|
| Confidence in my ability to use physics concepts to solve engineering problems. (58) | Junior | **B–** |
| Confidence in my ability to use engineering concepts to solve relevant engineering problems. (59) | Junior | **C+** |
| Confidence in my ability to use my knowledge of mathematics to solve relevant engineering problems. (5) | Senior | **A** |
| Confidence in my ability to use my knowledge of chemistry to solve relevant engineering problems. (6) | Senior | **D +** |
| Confidence in my ability to use my knowledge of physics to solve relevant engineering problems. (7) | Senior | **B –** |
| Confidence in my ability to use my knowledge of engineering to solve relevant engineering problems. (8) | Senior | **B –** |
| At the time of graduation, describe your knowledge and ability in basic science (physics, chemistry, etc) and math. (15) | Alum Then | **B–** |
| Based on your experience since graduation, describe your knowledge and ability in basic science (physics, chemistry, etc) and math. (16) | Alum Now | **B–** |
| Rate the importance of basic mathematics at the company. (10) | Industry | **A** |
| Rate the mathematical ability of ECE graduates of CBU. (11) | Industry CBU Graduate | **A** |
| Rate the mathematical ability of other than CBU graduates. (12) | Industry Non-CBU Graduate | **B–** |

**Table 4. Grading Criteria 3b – An ability to design and conduct experiments, as well as to analyze and interpret data**

| | | |
|---|---|---|
| Confidence in my ability to design and conduct an experiment to obtain measurements or gain additional knowledge. (59) | Freshman | **C** |
| Confidence in my ability to analyze and interrupt a set of data to find underlying meaning. (60) | Freshman | **C+** |
| Designing an experiment to obtain measurements or gain additional knowledge about a process (51) | Sophomore | **C** |
| Analyzing a set of data to find underlying meaning(s) (52) | Sophomore | **B–** |
| Designing an experiment to obtain measurements or gain additional knowledge about a process (60) | Junior | **C** |
| Analyzing a set of data to find underlying meaning(s) (61) | Junior | **C** |
| Designing an experiment to obtain measurements or gain additional knowledge about a process (9) | Senior | **B–** |
| Analyzing a set of data to find underlying meaning(s) (10) | Senior | **C** |
| Designing an experiment to obtain measurements or gain additional knowledge about a process (23) | Alum Then | **C+** |

| | | |
|---|---|---|
| My ability to design and conduct an experiment to obtain measurements or gain additional knowledge (24) | Alum Now | **B–** |
| Analyzing a set of data to find underlying meaning(s) (27) | Alum Then | **C** |
| My ability to analyze and interpret a set of data to find underlying meaning (28) | Alum Now | **B** |
| Rate the importance of the ability to analyze and interpret data at the company. (16) | Industry | **A** |
| Rate the ability to analyze and interpret data of ECE graduates of CBU. (17) | Industry CBU Graduate | **A–** |
| Rate the ability to analyze and interpret data of other than CBU graduates. (18) | Industry Non-CBU Graduate | **C** |

**Table 5. Grading Criteria 3c – 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**

| | | |
|---|---|---|
| Confidence in my ability to design a device or process to satisfy a given set of specifications. (61) | Freshman | **C–** |
| Confidence in my ability to design a device or process when given a set of specifications. (53) | Sophomore | **C** |
| Confidence in my ability to design a device or process when given a set of specifications. (62) | Junior | **C** |
| Confidence in my ability to design a device or process to satisfy a given set of specifications. (11) | Senior | **B** – |
| At the time of graduation, describe your ability to design a system, component, or process to meet desired requirements. (39) | Alum Then | **C–** |
| Based on your experience since graduation, describe your ability to design a system, component, or process to meet desired requirements. (40) | Alum Now | **B–** |
| Rate the importance of the ability to design a device or process to satisfy a set of specifications at the company. (19) | Industry | **A+** |
| Rate the ability to design a device or process to satisfy a set of specifications of ECE graduates of CBU. (20) | Industry CBU Graduate | **B** |
| Rate the ability to design a device or process to satisfy a set of specifications of other than CBU graduates. (21) | Industry Non-CBU Graduate | **C** |

**Table 6. Grading Criteria 3d – An ability to function on multidisciplinary teams**

| | | |
|---|---|---|
| Confidence in my ability to function as a technically contributing member of an engineering team. (62) | Freshman | **B–** |
| Confidence in my ability to function as a responsible member of an engineering team. (63) | Freshman | **B–** |
| Confidence in my ability to function as a responsible member of an engineering team. (54) | Sophomore | **C** |
| Confidence in my ability to function as a responsible member of an engineering team. (63) | Junior | **B** |
| Confidence in my ability to function effectively in different team roles. (12) | Senior | **B –** |
| At the time of graduation, describe your ability to work with people in teams and groups. (35 | Alum Then | **C+** |
| Based on your experience since graduation, describe your ability to work with people in teams and groups. (36) | Alum Now | **B** |
| Rate the importance of the ability to function as a team member at the company. (22) | Industry | **A–** |
| Rate the ability to function as a team member of ECE graduates of CBU. (23) | Industry CBU Graduate | **B–** |
| Rate the ability to function as a team member of other than CBU graduates. (24) | Industry Non-CBU Graduate | **C** |

**Table 7. Grading Criteria 3e – An ability to identify, formulate, and solve engineering problems**

| | | |
|---|---|---|
| Confidence in my ability to formulate unstructured engineering problems. (64) | Freshman | **C–** |
| Confidence in my ability to formulate unstructured engineering problems. (55) | Sophomore | **C–** |
| Confidence in my ability to formulate unstructured engineering problems. (64) | Junior | **C–** |
| Confidence in my ability to solve unstructured engineering problems. (13) | Senior | **B –** |
| At the time of graduation, describe your ability to identify problems/opportunities, collect data, conduct analysis, make decisions, and implement them. (27) | Alum Then | **C** |
| Based on your experience since graduation, describe your ability to identify problems/opportunities, collect data, conduct analysis, make decisions, and implement them. (28) | Alum Now | **B** |
| Rate the importance of the use of basic engineering skills at the company. (13) | Industry | **B+** |

| | | |
|---|---|---|
| Rate the ability to use basic engineering skills of ECE graduates. (14) | Industry CBU Graduate | **B–** |
| Rate the ability to use basic engineering skills of other than CBU graduates. (15) | Industry Non-CBU Graduate | **B–** |

**Table 8. Grading Criteria 3f – An ability to comprehend the importance of professional and ethical responsibility**

| | | |
|---|---|---|
| Confidence in my knowledge of the professional responsibilities of an engineer. (66) | Freshman | **C** |
| Confidence in my knowledge of the ethical responsibilities of an engineer. (67) | Freshman | **C+** |
| Confidence in my understanding of the professional and ethical responsibilities of an engineer. (57) | Sophomore | **C+** |
| Confidence in my ability to understand the professional and ethical responsibilities of an engineer. (70) | Junior | **B–** |
| Confidence in my knowledge of the professional and ethical responsibilities of an engineer. (15) | Senior | **A –** |
| At the time of graduation, describe your knowledge of ethical characteristics of the engineering profession and practice. (43) | Alum Then | **C** |
| Based on your experience since graduation, describe your knowledge of ethical characteristics of the engineering profession and practice. (44) | Alum Now | **B–** |
| Rate the importance of ethics and professional responsibility at the company. (31) | Industry | **A+** |
| Rate the ability to apply ethics and professional responsibility to the practice of engineering of ECE graduates of CBU. (32) | Industry CBU Graduate | **A–** |
| Rate the ability to apply ethics and professional responsibility to the practice of engineering of other than CBU. (33) | Industry Non-CBU Graduate | **C** |

**Table 9. Grading Criteria 3g – An ability to communicate effectively**

| | | |
|---|---|---|
| Confidence in my ability to write effectively. (68) | Freshman | **C+** |
| Confidence in my ability to make effective presentations. (69) | Freshman | **C–** |
| Confidence in my ability to express engineering-related ideas to others. (70) | Freshman | **C** |
| Confidence in my ability to write effectively. (58) | Sophomore | **C+** |
| Confidence in my ability to make professional presentations. (59) | Sophomore | **D+** |

| | | |
|---|---|---|
| Confidence in my ability to effectively communicating engineering-related ideas to others. (60) | Sophomore | **C–** |
| Confidence in my ability to write effectively. (67) | Junior | **C+** |
| Confidence in my ability to make professional presentations. (68) | Junior | **C** |
| Confidence in my ability to effectively communicate engineering-related ideas to others. (69) | Junior | **B–** |
| Confidence in my ability to write effectively. (16) | Senior | **C** |
| Confidence in my ability to make effective presentations. (17) | Senior | **C +** |
| Confidence in my ability to express engineering-related ideas to others. (18) | Senior | **C** |
| At the time of graduation, describe your ability to write effectively. (31) | Alum Then | **C+** |
| Based on your experience since graduation, describe your ability to write effectively. (32) | Alum Now | **B–** |
| At the time of graduation, describe your ability to make oral presentations. (33) | Alum Then | **C+** |
| Based on your experience since graduation, describe your ability to make oral presentations. (34) | Alum Now | **C+** |
| Rate the importance of professional writing at the company. (4) | Industry | **B–** |
| Rate the writing ability of Electrical and Computer Engineering (ECE) graduates of Christian Bothers University (CBU). (5) | Industry CBU Graduate | **C** |
| Rate the writing ability of other than CBU graduates. (6) | Industry Non-CBU Graduate | **D+** |
| Rate the importance of oral presentations at the company. (7) | Industry | **C** |
| Rate the ability to make oral presentations ability of ECE graduates of CBU. (8) | Industry CBU Graduate | **C** |
| Rate the ability to make oral presentations of other than CBU graduates. (9) | Industry Non-CBU Graduate | **D+** |

**Table 10. Grading Criteria 3h – Acquired the broad education necessary to comprehend the impact of engineering solutions in a global, economic, environmental, and societal context**

| | | |
|---|---|---|
| Confidence in my ability to apply knowledge about current issues (economics, environmental, political, social, etc.) to engineering-related problems. (73) | Freshman | **C+** |
| Confidence in my ability to apply knowledge about current issues (economic, environmental, political, societal, etc.) to engineering-related problems. (63) | Sophomore | **C+** |

| | | |
|---|---|---|
| Confidence in my ability to apply knowledge about current issues (economic, environmental, political, societal, etc.) to engineering-related problems. (72) | Junior | **C–** |
| Confidence in my ability to apply knowledge about current issues (economics, environmental, political, social, etc.) to engineering-related problems. (21) | Senior | **C** |
| At the time of graduation, describe your knowledge of social awareness issues of culture, race, gender, etc. (47) | Alum Then | **C+** |
| Based on your experience since graduation, describe your knowledge of social awareness issues of culture, race, gender, etc. (48) | Alum Now | **B–** |
| At the time of graduation, describe your ability to place engineering in a global/societal context. (51) | Alum Then | **C** |
| Based on your experience since graduation, describe your ability to place engineering in a global/societal context. (52) | Alum Now | **B–** |
| Rate the importance of the use of basic interpersonal skills at the company. (28) | Industry | **B+** |
| Rate the ability to use basic interpersonal skills of ECE graduates of CBU. (29) | Industry CBU Graduate | **B** |
| Rate the ability to use basic interpersonal skills of other than CBU graduates. (30) | Industry Non-CBU Graduate | **C** |

**Table 11. Grading Criteria 3i – A recognition of the need for, and an ability to engage in life-long learning**

| | | |
|---|---|---|
| Confidence in my ability to recognize the limitations of my engineering knowledge and skills and to know when to seek additional information. (74) | Freshman | **C+** |
| Confidence in my ability to recognize the limitations of my engineering knowledge and abilities and to know when to seek additional information. (64) | Sophomore | **B** |
| Confidence in my ability to recognize the limitations of my engineering knowledge and abilities and to know when to seek additional information. (73) | Junior | **B** |
| Confidence in my commitment to lifelong learning. | Senior | **B –** |
| Confidence in my ability to recognize the limitations of my engineering knowledge and skills and to know when to seek additional information. | Senior | **B –** |
| At the time of graduation, describe your ability to learn and think independently, desire to continue education, projection of a professional image, goal orientation, ability to manage time and organize, self-motivation. (45) | Alum Then | **C+** |

| | | |
|---|---|---|
| Based on your experience since graduation, describe your ability to learn and think independently, desire to continue education, projection of a professional image, goal orientation, ability to manage time and organize, self-motivation. (46) | Alum Now | **B+** |
| Rate the importance of creativity at the company. (34) | Industry | **A–** |
| Rate the creativity of ECE graduates of CBU. (35) | Industry CBU Graduate | **C** |
| Rate the creativity of other than CBU. (36) | Industry Non-CBU Graduate | **C** |

**Table 12. Grading Criteria 3j – A knowledge of contemporary issues**

| | | |
|---|---|---|
| Confidence in my knowledge of the potential risks and impact to the public of an engineering solution. (72) | Freshman | **C–** |
| Confidence in my ability to understand the potential risks (to the public) and impacts that an engineering solution or design may have. (60) | Sophomore | **B** |
| Confidence in my ability to understand the potential risks (to the public) and impacts that an engineering solution or design may have. (71) | Junior | **C** |
| Confidence in my ability to listen to and impartially interpret different viewpoints. (19) | Senior | **B** |
| Confidence in my knowledge of the potential risks and impact to the public of a proposed engineering solution. (20) | Senior | **B –** |
| At the time of graduation, describe your knowledge of contemporary issues. (53) | Alum Then | **C–** |
| Based on your experience since graduation, describe your knowledge of contemporary issues. (54) | Alum Now | **B–** |
| Rate the importance of the use of basic leadership skills at the company. (25) | Industry | **C** |
| Rate the ability to use basic leadership skills of ECE graduates of CBU. (26) | Industry CBU Graduate | **B–** |
| Rate the ability to use basic leadership skills of other than CBU graduates. (27) | Industry Non-CBU Graduate | **C** |

**Table 13. Grading Criteria 3k – An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**

| | | |
|---|---|---|
| I feel confident in my ability to succeed in engineering. (45) | Freshman | **A–** |
| I consider myself electrically inclined. (50) | Freshman | **B–** |
| I consider myself computer literate. (51) | Freshman | **A–** |
| I consider myself technically inclined. (52) | Freshman | **A–** |
| I enjoy solving open-ended problems. (53) | Freshman | **C+** |
| Confidence in my ability to use appropriate engineering techniques including software or lab equipment for problem solving. (65) | Freshman | **C+** |
| Confidence in my ability to use appropriate engineering techniques and tools including software and/or lab equipment for problem solving. (56) | Sophomore | **C+** |
| Confidence in my ability to use appropriate engineering techniques and tools including software and/or lab equipment for problem solving. (65) | Junior | **C** |
| Confidence in my ability to use appropriate engineering techniques including software or lab equipment for problem solving. (14) | Senior | **C +** |
| At the time of graduation, describe your knowledge of state-of-the-art technology in ECE. (25) | Alum Then | **C–** |
| Based on your experience since graduation, describe your knowledge of state-of-the-art technology in ECE. (26) | Alum Now | **C+** |
| At the time of graduation, describe your ability to use computers (programming, use of software packages, networking, etc.). (21) | Alum Then | **B–** |
| Based on your experience since graduation, describe your ability to use computers (programming, use of software packages, networking, etc.). (22) | Alum Now | **B+** |
| At the time of graduation, describe your ability to think creatively and to adapt to new situations. (29) | Alum Then | **C+** |
| Based on your experience since graduation, describe your ability to think creatively and to adapt to new situations. (30) | Alum Now | **A-** |
| Rate the importance of computer skills at the company. (49) | Industry | **B** |
| Rate the ability to use computer skills of ECE graduates of CBU. (50) | Industry CBU Graduate | **A** |
| Rate the ability to use computer skills of other than CBU graduates. (51) | Industry Non-CBU Graduate | **B–** |

**Table 14. Instructional Goals Questionnaire (First 5 questions)**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | This survey is an adaptation of the Teaching Goals Inventory developed in *Classroom Assessment Techniques* by T. A. Angelo and K. P. Cross© (Copyright 1993 Jossey-Bass Inc. – used with permission of John Wiley & Sons, Inc.) and is not to be copied or distributed. | I agree. (6 faculty members) | | | | | | | | |
| 2 | Please select one course you are currently teaching and rate the importance of each goal you aim to have students accomplish in the course. Indicate the course level: | • Freshman (1)<br>• Sophomore (2)<br>• Junior (2)<br>• Senior (1) | | | | | | | | |
| | | Essential – a goal you achieve or nearly always achieve | Very important – a goal you often try to achieve | Important – a goal you sometimes try to achieve | Unimportant – a goal you rarely try to achieve | Not Applicable – a goal you never try to achieve | Means – CBU Faculty | Means – 1990 Study of Four-Year Colleges | % of CBU Faculty rating item essential | % of teacher in 1990 study rating item essential |
| Cluster I: Higher-Order Thinking Skills (3-10) | | 12 | 18 | 15 | 1 | 2 | 3.77 | 3.05 | 25 | 43 |
| 3 | Develop ability to apply principles and generalizations already learned to new problems and situations. | 2 | 3 | 1 | 0 | 0 | 4.16 | 3.37 | 33 | 59 |
| 4 | Develop analytic skills. | 3 | 3 | 0 | 0 | 0 | 4.50 | 3.2 | 50 | 49 |
| 5 | Develop problem-solving skills. | 3 | 3 | 0 | 0 | 0 | 4.50 | 2.89 | 50 | 40 |

**Table 14. Evaluation of Instructional Goals Questionnaire**

| Cluster Number and Name | | Goals Included in Cluster (Item #) | Total Number of *Essential* Goals in Each Cluster (Six Faculty) | Cluster Ranked for 1st to 6th by Number of *Essential* Goals |
|---|---|---|---|---|
| I | Higher-Order Thinking Skills | 3-10 | 12 | 1 |
| II | Basic Academic Success Skills | 11-19 | 3 | 4 |
| III | Discipline-Specific Knowledge and Skills | 20-27 | 9 | 2 |
| IV | Liberal Arts and Academic Values | 28-37 | 2 | 5 |
| V | Work and Career Preparation | 38-45 | 1 | 6 |
| VI | Personal Development | 46-54 | 7 | 3 |
| How many of the 52 goals were rated as *essential*? 34 (Average 5.66 for six faculty members) | | | | |

# Appendix S

## Evaluation Checklist for ECE Advisory Committee and ECE Curriculum Committee
(Circle your choice)

1. Yes No Do the surveys measure the values, attitudes, level of confidence, and perception of students, faculty, alumni, and industry in order to develop an evaluation process?

2. Yes No Are the scoring criteria and rubrics clear, descriptive, and explicitly related to program goals and standards?

3. Yes No Do the surveys simulate authentic, real-world challenges, contexts, and constraints faced by students, faculty, alumni, and industry?

4. Yes No Do the surveys cover the program objectives?

5. Yes No Were the surveys a good investment of time and energy and worthy of the efforts required of constituents?

6. Yes No Do the surveys permit an appropriate latitude in style and approach necessary for students, faculty, alumni, and industry?

7. Yes No Do Web-based surveys provide a suitable format for CBU constituents?

8. Yes No Is it clear which desired achievements are being measured by the surveys?

9. Yes No Are the criteria and indicators the right one for this task and for the achievements being evaluated?

10. Yes No Will the surveys provide ample feedback for self-evaluation and self-adjustment as components of the evaluation process?

11. Comment:____________________________________________________

# Appendix T

## Permission to use and/or adapt Figure 6.4 Assessment Design Rating Checklist for Peer Review and Figure 6.5 Assessment Design Self-Assessment Checklist (Copyright 1996 by Center on Learning, Assessment, and School Structure) found in Educational Assessment (1998) by Grant Wiggins

-----Original Message-----
From: Carol Wander [mailto:carol@authenticeducation.org]
Sent: Tuesday, December 06, 2005 9:45 AM
To: jventura@midsouth.rr.com
Subject: Re: Permission Requests - Copyright 1996 by Center on Learning,Assessment, and School Structure

Hello again, Mr. Ventura
Per Dr. Wiggins‹permission granted!

Sorry for the delay.
:) grin
Sincerely,
Carol W.

On 12/5/05 10:58 PM, John Ventura at jventura@midsouth.rr.com wrote:

Dear Sir/Madame,

I am an assistant professor in the Electrical and Computer Engineering Department at Christian Brothers University in Memphis, Tennessee, working on a Ph.D. in the Graduate School of Computer and Information Sciences at Nova Southeastern University in Fort Lauderdale, Florida. The title of my dissertation is Web-Based Evaluation Process for an Electrical and Computer Engineering Department. The attached file contains permission from John Wiley & Sons, Inc. to use material in Educational Assessment (1998) by Grant Wiggins (ISBN 0-7879-0848-7).

I am requesting permission to use and/or adapt Figure 6.4 Assessment Design Rating Checklist for Peer Review and Figure 6.5 Assessment Design Self-Assessment Checklist (Copyright 1996 by Center on Learning, Assessment, and School Structure) found in Educational Assessment (1998) by Grant Wiggins (ISBN 0-7879-0848-7). Proper credit will be given to all cited material.

The goal of the study will be to provide faculty a model for developing and implementing an evaluation process that promotes continuous quality improvement in a program based on the accreditation requirements of the Commission on Colleges of the Southern

Association of Colleges and Schools (SACS) and the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Your assistance will be appreciated. I look forward to a reply at a suitable time.

Respectively submitted,
John Ventura
901-321-3429

# Appendix U

## Permission to Conduct Study at CBU

### Permission to Conduct Study and Publish Dissertation

Dissertation Topic: Web-Based Evaluation Process for an Electrical and Computer Engineering Department

We hereby grant John Ventura the right to investigate the development of a model for program improvement that demonstrates the achievement of program objectives by students and graduates and incorporates the results into a systematic evaluation process at Christian Brothers University in Memphis, Tennessee.

Nationally, engineering programs have recognized the need for engineering programs to develop measurable outcomes, data collection methods, assessment procedures, evaluation standards, and processes for program improvements in order to comply with the accreditation criteria. Computer technologies afford means to develop Web-based assessment and evaluation processes. Institutions use Web-based assessment instruments to verify that learning outcomes satisfy program objectives. Whereas these on-line services deliver instructional materials and report achievement, the proposed study will provide one measure of the level of quantity to which a program meets its program objectives and provide results for improving the program.

*The goal of the study is* to develop and implement an evaluation process for meeting accreditation requirements: assessing program objectives, reviewing achievement in the workplace by recent graduates of the program, and formulating a course of action for quality improvement of the program. The process will be encapsulated in a model that will contain a Web-based component for measuring results and presenting feedback for formulating a course of action for program improvement.

We understand that the study will be used to fulfill the dissertation requirements for a Degree of Doctor of Philosophy at Nova Southeastern University (http://www.nova.edu) for John Ventura. This dissertation and study will be published and distributed in whole or in part.

Dr. Fred Terry, Department Chairman – Electrical and Computer Engineering at CBU

18 July 2005

Date

Dr. Eric Welch, Dean of Engineering at CBU

July 18, 2005

Date

Appendix V

Institutional Review Board Approval – Nova Southeastern University

**NOVA SOUTHEASTERN UNIVERSITY**
Office of Grants and Contracts
Institutional Review Board

**MEMORANDUM**

**To:** John Ventura

**From:** James Cannady, Ph.D.
Institutional Review Board

Signature

**Date:** August 15, 2005

**Re:** *Web-Based Evaluation Process for an Electrical and Computer Engineering Department*

**IRB Approval Number:** cannady08150504

I have reviewed the above-referenced research protocol at the center level. Based on the information provided, I have determined that this study is exempt from further IRB review. You may proceed with your study as described to the IRB. As principal investigator, you must adhere to the following requirements:

1) CONSENT: If recruitment procedures include consent forms these must be obtained in such a manner that they are clearly understood by the subjects and the process affords subjects the opportunity to ask questions, obtain detailed answers from those directly involved in the research, and have sufficient time to consider their participation after they have been provided this information. The subjects must be given a copy of the signed consent document, and a copy must be placed in a secure file separate from de-identified participant information. Record of informed consent must be retained for a minimum of three years from the conclusion of the study.

3301 College Avenue • Fort Lauderdale, FL 33314-7796 • (954) 262-5369
Fax: (954) 262-3977 • Email: *inga@nsu.nova.edu* • Web site: www.nova.edu/cwis/ogc

2) ADVERSE REACTIONS: The principal investigator is required to notify the IRB chair and me (954-262-5369 and 954-262-2085 respectively) of any adverse reactions or unanticipated events that may develop as a result of this study. Reactions or events may include, but are not limited to, injury, depression as a result of participation in the study, life-threatening situation, death, or loss of confidentiality/anonymity of subject. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, number or types of subjects, consent forms, investigators, etc.) must be approved by the IRB prior to implementation. Please be advised that changes in a study may require further review depending on the nature of the change. Please contact me with any questions regarding amendments or changes to your study.

The NSU IRB is in compliance with the requirements for the protection of human subjects prescribed in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46) revised June 18, 1991.

Cc: Protocol File
Office of Grants and Contracts (if study is funded)

3301 College Avenue • Fort Lauderdale, FL 33314-7796 • (954) 262-5369
Fax: (954) 262-3977 • Email: *inga@nsu.nova.edu* • Web site: www.nova.edu/cwis/ogc

# Appendix W

## Institutional Review Board Approval – CBU

COMMITTEE ON HUMAN RESEARCH
IRB – CHRISTIAN BROTHERS UNIVERSITY

Title of Research: Web-Based Evaluation Process for an Electrical and Computer Engineering Department

Name(s) of Researcher(s): John Ventura (jventura@cbu.edu and 901-321-3429)

Date submitted: August 18, 2005

**Note: Nova Southeastern University (NSU) is the primary reviewer. Upon approval by the NSU IRB, documentation will be submitted to the IRB at CBU. The IRB at NOVA approved the referenced research protocol (See Exhibit A).**

**Research With Human Participants**

Note: *You must obtain the approval of only* ***3*** *of the following committee members:*

**Dr. Rena Durr**

____________ date 8/18/05

__✓__ Approved ______ Approved with changes ______ Not approved

**~~Dr. Rod Vogl~~**

____________ date_________

______ Approved ______ Approved with changes ______ Not approved

**Dr. Conrad Brombach**

____________ date 8/19/05

__✓__ Approved ______ Approved with changes ______ Not approved

**Dr. Elizabeth Nelson**

____________ date_________

______ Approved ______ Approved with changes ______ Not approved

MARGARET MILLER

____________ date 8/19/05

__✓__ Approved ______ Approved with changes ______ Not approved

# Appendix X

## ECE Faculty at Christian Brothers University

**Full Time**

Robert L. Drake, P. E.
Professor
B.S., M.S., Tulane University
Ph.D., Mississippi State University

Juan Carlos Olabe-Basogain I. T.
Professor
M.S., Ph.D., Universidad Politecnica de Madrid

Fred H. Terry, P.E.
Professor & Department Chair
B.S., M.S., Rose Polytechnic Institute
Ph.D., Case Institute of Technology

John Ventura, P.E. (Retired)
Assistant Professor
B.S., Christian Brothers College
M.S., University of Florida
Ed.S., Nova Southeastern University
Ph.D. (ABD), Nova Southeastern University

**Part-Time**

Louis Althaus, F.S.C.
Professor and Executive Assistant to the President
B.S., St. Mary's College
M.S., Ph.D., Notre Dame University

Chadwick Baker
Adjunct Faculty
B.S., Christian Brothers College
M.S., Ph.D., Duke University

Pascal Bedrossian
Associate Professor
B.S., Christian Brothers University
M.S., Ph.D., Memphis State University

Christine Roueche
Adjunct Assistant Professor
M.S., Universite de Technologie de Compiegne (France)
Ph. D., Universite de Rennes (France)

Eric B. Welch
Associate Professor & Dean
B.S., M.S., Ph.D., Mississippi State University

Arthur A. Yanushka
Professor
B.A., Fordham University
M.S., State University of New York at Stony Brook
Ph.D., University of Illinois

**Emeriti**

Donald L. Glaser
Professor
B.S., Christian Brothers College
M.E.E., University of Louisville

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Professor
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# Appendix Y

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