APPLICATIONS AND OUTCOMES OF CONTINUOUS IMPROVEMENT PROTOCOLS IN CIVIL ENGINEERING PROGRAMS:
A PERSPECTIVE OF THE PROCESSES, PRACTICES, AND PITFALLS

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ABSTRACT

In 2000, the Accreditation Board for Engineering and Technology (ABET) instituted a set of accreditation standards known as Engineering Criteria 2000 (EC2000). Embedded in this set of criteria was the mandate that engineering institutions implement continuous improvement protocols in planning and curriculum development. The directive required educators to employ student learning data as a primary means of improving student learning outcomes.

In the years since ABET adopted EC2000, little has appeared in the literature regarding the value and utility of the assessment-based program-improvement process from the perspective of engineering educators.

This study surveys the views and observations of 21 civil engineering program leaders concerning the assessment-based program-improvement practices of their home institutions. Respondents address the mechanics of the ABET process, its utility and value as a driver of program improvement, and specific applications and outcomes.
Engineering programs involved in the study ranged across the United States. Respondent data was collected in semi-structured phone interviews relative to a survey instrument possessing five lines of inquiry.

Major findings in the study include: Sixty-two percent of participating institutions experienced faculty climates that were less than receptive to the ABET program-improvement model. Sixty-seven percent of respondents reported that the ABET program-improvement process and/or accreditation review team members lacked clarity and consistency in the expectations of programs. Forty-three percent of respondents reported that the benefits associated with the assessment-based program-improvement process were at least as great as the costs associated with the process. The ABET program-improvement model places a larger burden on smaller programs.
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CHAPTER ONE
INTRODUCTION

As early as the mid-1980s institutes of higher learning began assessing educational quality based on student learning outcomes (Ewell, 2008). This movement arose from two fronts, one that concerned program accountability and another that concerned program improvement (Ewell, 2008). In the accountability paradigm data is used to convince funding organizations that programs are worthy of public support, while in the improvement paradigm data is used to improve teaching and learning (Ewell, 2008).

In the late 1990s, the Accreditation Board for Engineering and Technology (ABET) began accrediting engineering schools based on a set of criteria now known as Engineering Criteria 2000 or simply EC2000. Central to this set of criteria was the mandate that engineering schools shift their orientation from input-based to output-based in the manner in which they work to meet the educational and professional needs of students. What this meant was that schools were to transition from employing inputs, such as what is taught, to outputs, such as what was learned (ABET, 2012). This new approach to program improvement was based on the Continuous Quality Improvement (CQI) model.

*The Continuous Quality Improvement Model*

The CQI process is both a management philosophy and a method for improving an organization’s functionality and output (McLaughlin & Kaluzny, 1994). The application of CQI processes started in business and industrial settings,
but has since moved into health care and educational applications. Philosophically, the CQI movement is founded on the assumption that inferior quality products result from poor job design, failure of leadership, or unclear purpose (Radawski, 1999). The vehicle for the CQI process is the Plan-Do-Check-Act (PCDA) cycle (Radawski, 1999). The plan stage identifies and studies a “problem;” the do stage implements a “solution” to the problem; the check stage analyzes the “results” of the solution toward verification that improvement occurred; and the act stage consists of standardizing the new process if the results were favorable and reworking through the cycle (Radawski, 1999).

The assessment-based program-improvement model promoted by ABET closely resembles the CQI process. Learning objectives are studied and identified in the plan stage; program modifications are implemented in the do stage; the impact of the modification on the educational outcome is assessed in the check stage; and the process recycles in the act stage.

For optimal program outcomes, ABET’s assessment-based program-improvement model necessitates clear program goals, faculty consensus and participation in meeting those goals, well designed assessment instruments, and an appropriate time frame in which to apply the process. The idea is rich in its formulation. The process appears to be a template for program success, yet in practice achievement of the referenced requirements is not a simple matter.
The goals associated with EC2000 are oriented towards responding to the changing demands of the engineering profession, promoting quality and innovation in education, and responding to the needs of constituencies (ABET, 2012). The current study examines the effectiveness of the ABET program-improvement model in meeting these objectives. The achievement of well-chosen program objectives is of particular importance in an age marked by rapid advances in civilization, technological breakthroughs, a growing global workforce, and the strong need for engineers capable of filling the roles of the 21st century workforce (Fantz, De Miranda, & Siller, 2011).

The ABET Program Improvement Model

EC2000 is composed of eight criteria. Criterion 1 provides the foundation upon which the ABET accreditation process is built: “The quality and performance of the students and graduates are important considerations in the evaluation of an engineering program” (Lattuca, Terenzini, & Volkwein, 2006, p. 18). Criterion 2 establishes essential program documentation and procedures that are designed to ensure the achievement of educational objectives (Lattuca et al., 2006).

Criterion 3 of EC2000 specifies 11 learning outcomes and requires engineering programs to assess and demonstrate student achievement in each (Lattuca et al., 2006). These specified learning objectives, labeled a-k, involve the achievement of objective-goals such as: (a) [Engineering programs must demonstrate that their graduates have] an ability to apply knowledge of mathematics, science, and
engineering, to goals of a more subjective nature such as: (h) [Engineering programs must demonstrate that their graduates have] the broad education necessary to understand the impact of engineering solutions in a global and societal context (Lattuca et al., 2006). Criterion 3 also established a framework for the methodology by which programs would apply assessment to drive program improvement in each of the a-k objectives. Criterion 3 states:

Each program must have an assessment process with documented results.

Evidence must be given that the results are applied to the further development and improvement of the program. The assessment process must demonstrate that the outcomes important to the mission of the institution and the objectives of the program, including those listed above, are being measured. Evidence that may be used includes, but is not limited to the following: student portfolios, including design projects; nationally-normed subject content examinations; alumni surveys that document professional accomplishments and career development activities; employer surveys; and placement data of graduates (Lattuca et al., 2006, pp. 18-19).

The process.

The assessment-based program-improvement process promoted by ABET involves developing consensus on the definition of learning outcomes, collecting student learning data to identify specific learning objectives that require improvement, developing an appropriate program modification that can affect the
desired change, using student data to determine the impact of the program modification, and recycling through the process, repeatedly, to create a climate of continuous improvement.

The Current Study

The literature contains very little information about the effect of assessment-based program-improvement processes on student learning outcomes. This study seeks to examine the utility and value of the assessment-based process from the standpoint of civil engineering program leaders.

The purpose of the study is to answer the following questions:

(1) What effect, if any, has the assessment-based program-improvement process had on student learning outcomes?

(2) What stages of the assessment-based program-improvement process present the greatest challenges?

(3) To what degree do faculty members believe that student assessment data provides useful information that can be used to improve programs?

(4) Which sources of student learning data provide the most useful information?

(5) What specific applications of the assessment-based program-improvement process have led to the greatest program successes?

(6) How do the costs associated with the assessment-based program-improvement process compare with its benefits?
The study employs semi-structured phone interviews with program leaders from 21 civil engineering programs. Institutions involved in the study are located across the United States and represents a cross-section of Carnegie Classifications ranging from undergraduate institutions to Research I institutions.

While this study focuses on engineering programs, its importance spans across all levels of education. Outcome-based or assessment-based program improvement is at the heart of most every accreditation model in use in higher education in the United States today (CHEA, 2012). The motivation for focusing the study on engineering schools had its origin in the belief that engineers were particularly well-suited for success in assessment-based program improvement by virtue of the strong mathematical and scientific foundations on which the engineering profession is built.

*Thesis Structure*

Chapter Two provides an overview of the literature relative to the accreditation process; the theory and development of continuous-improvement processes; the assessment of student learning; the ABET approach to continuous improvement; and specific concerns regarding continuous improvement models and their application.

Chapter Three provides specific information regarding the process by which the research was carried out and administered, including: the sampling procedure that was utilized in identifying participants; a descriptions of the participants; a
description of the interview instrument’s design and structure, including evidence of its appropriate use; the human subject protections that were employed; the protocols and procedures associated with the interview; and a description and justification of the analysis utilized in the study.

Chapter Four provides the results of the study, including: all relevant data, tables, and statistical techniques.

Chapter Five provides a discussion of the study by merging the findings of the research effort with what is found in the literature. This chapter addresses student learning outcomes in the context of sustained application of assessment-based program improvement. The chapter also provides significant analysis to the various outgrowths that have become associated with the implementation of the ABET program-improvement model. In closing, this chapter provides an overview of respondent/program views concerning the value and utility of the practice of assessment-based program improvement.

Chapter Six provides a brief summary of findings of the study, its limitations, and recommendations for future research.
CHAPTER TWO
LITERATURE REVIEW

Overview of Accreditation

As a consequence of the Tenth Amendment, individual state charters have traditionally guarded schools against federal control (Neal, 2008). To some degree, becoming accredited has been considered to be a voluntary act; however, when the GI Bill passed in the 1940s, doing so was linked with the distribution of federal dollars (Neal, 2008). At that time it was the view of congress that accreditors were to be “reliable guarantors of educational quality” (Neal, 2008, p. 25). In the present era, the U.S. Secretary of Education annually certifies which accreditors are fit to accomplish the process, and becoming accredited is anything other than a voluntary activity (Neal, 2008).

The accreditation process.

In a generalized sense, the accreditation process is one that involves demonstration that the candidate school has clearly articulated its purpose and goals, possesses high expectations for its students, employs multiple measures in the collection and analysis of student data, and possesses a commitment to ongoing program improvement and accountability (Western Association of Schools and Colleges (WASC), 2012). Frequently, accreditation agencies follow a six-year accreditation cycle, where intermediate reporting may be an annual requirement (Accreditation Board for Engineering and Technology (ABET), 2012; WASC, 2012). Accreditation visits are characterized by a team of evaluators who examine
every aspect of the candidate school’s day-to-day operation; included in such study is the inspection of records, mission statements, facilities, and visits with individuals from the various stakeholder groups associated with the candidate institution (WASC, 2012).

In recent years accreditation agencies have shifted their focus from inputs such as what is taught to outputs such as what is learned. The next section will describe early developments in the continuous improvement process in the business sector, and efforts to introduce the process into the classroom environment.

Basis of the Continuous Improvement Theory

The Continuous Improvement (CI) process is closely related to other quality movements such as continuous quality improvement (CQI) and total quality management (TQM). The CI process originated as a business model and is founded on the work of several individuals whose pioneering efforts will be addressed later in this section.

Total quality management has been described as the development of an organizational culture that is defined by the constant quest and attainment of customer satisfaction through an integrated system of tools, practices, and training (Sashkin & Kiser, 1993). Continuous quality improvement has been described as an organizational philosophy where scientific measurements of outcomes are utilized in conjunction with systematic management techniques and teamwork toward the achievement of an organization’s mission (Freed, Klugman, & Fife, 1994).
At the close of WWII it was recognized that it was in America’s best interest to rehabilitate and transform Japan toward the creation of a stable alliance between the two nations. What follows here is a brief description of the work of two men who helped make Japan’s recovery possible through their independent application and development of continuous improvement protocols, and the work of a third man who built upon the foundation they set into place.

Deming, Juran, and Crosby.

W. Edwards Deming pioneered the continuous quality improvement movement in his work rebuilding the manufacturing infrastructure of post-WWII Japan (Krzykowski, 2010). Deming is remembered for his statistical process control approach to quality development; quality, he believed is the end product of mass assessment and the development of procedure (Farooq, Akhtar, Ullah, & Memon, 2007). Deming’s TQM work was of such great success in retooling and transforming Japan into an industrial powerhouse that he developed his Fourteen Point program as advice to American manufactures, believing that follow-through with the program was essential if the U.S. was to be spared from economic doom at the hands of Japanese industrialists (Deming, 1982).

Other early pioneers of the quality management movement were Joseph M. Juran and Philip B. Crosby (Farooq et al., 2007). Juran’s contribution to the enterprise involved application of his so-called quality trilogy: planning for quality, maintaining quality control, and developing quality improvement practices (Farooq
et al., 2007). Juran, though independent of Deming, put his program to work toward transforming Japan from a military power to an economic power (Juran, 1986).

Philip Crosby championed the idea that quality is free and that the products of industry should possess zero defects, and that appropriate management practices would lead to getting it right the first time (Farooq et al., 2007). Crosby believed that the definition of quality is conformance to requirements, whether the requirements are product specifications or customer expectations (Crosby, 1979).

**Malcolm Baldrige National Quality Award.**

The Baldrige criteria, and hence the Malcolm Baldrige National Quality Award (MBNQA) program (1987), supported and built on the body of work contributed by Deming, Juran, and Crosby. Similar to previous quality management protocols, the Baldrige criteria focused on quality awareness and provided guidelines for management and labor (Neves & Nakhai, 1993). Baldrige Awards are granted annually for outstanding quality management practices and achievement in the fields of business, health care, and education (Baldrige, 2012). What follows here is a brief overview of the MBNQA in business and education.

**Business award.**

Baldrige Awards are presented to business organizations and nonprofits based upon how candidates score relative to the Criteria for Performance Excellence (CPE) (Baldrige, 2012). The seven components of the criteria are (1) Leadership; (2) Strategic Planning; (3) Customer Focus; (4) Measurement, Analysis, and Knowledge
Management; (5) Workforce Focus; (6) Operations Focus; and (7) Results (Baldrige, 2012). Categories 1-3 form a triad that is organized around leadership with a focus on strategy and customers; categories 5-7 form a triad with a focus on performance results; and, singularly, category 4 serves a regulatory role through measurement, analysis, and knowledge management (Baldrige, 2012). The Baldrige organization refers to the category 4 as the system foundation, and the two associated triads as the performance system (Baldrige, 2012).

The seven category criteria form a scorecard totaling 1000 points, where candidates are rated in individual categories which range in point value from 85 for both the strategic planning and customer focus categories, to 450 for the results category (Baldrige, 2012). A detailed rubric is employed to assign scores to individual candidates, one rubric serving the results category and another for the remaining six categories (Baldrige, 2012). It is important to note that scoring, concerning the CPE, is heavily weighted toward results, consequently making it impossible to score high on the CPE without the production of high quality output in the form of product specifications or customer satisfaction (Baldrige, 2012).

*Education award.*

The design of the Baldrige Educational Criteria for Performance Excellence (ECPE) is almost identical to that of the CPE; the most distinct difference is apparent in the results category (Baldrige, 2012). In the CPE, the first subcategory in the results criterion is product and process outcomes; in the ECPE this item becomes
student learning and process outcomes (Baldrige, 2012). The rubrics utilized in both
the CPE and the ECPE are nearly identical (Baldrige, 2012). Does the near identical
nature of the CPE and the ECPE, and the common rubric designed to measure each,
suggest that managing a quality business is directly analogous to managing a quality
school? While the connection between running a business and running a school may
not be clear, the Baldrige Award, and now the Baldrige model for total quality
management, has served as a catalyst for total quality management in both industry
and education (Neves & Nakhai, 1993).

The Malcolm Baldrige National Quality Award program was the result of a
private- and public-sector partnership to coordinate efforts to restore American
productivity and competitiveness (Baldrige, 2012).

*Early movements to assess student learning.*

Even before the development of the Baldrige Criteria, educators were
beginning to look to student data as a means of improving teaching practices and
enhancing student learning outcomes (Ewell, 2002).

Initial movements to use the assessment of student learning to improve
teaching practice rose to the level of administrative policy discussion as early as
1985 (Ewell, 2002). Two influential papers argued that systematic evidence,
concerning what and how much students learn, is an essential prerequisite toward
methodical improvements in undergraduate curricula and pedagogy (Ewell, 2008).
The papers, *Involvement in Learning* (National Institute of Education, 1984), and
Integrity in the College Curriculum (Association of American Colleges, 1985), presented arguments that led to early examples of student assessments as individual colleges and universities redeployed existing examinations and surveys toward the collection of data to be used to improve academic programs (Ewell, 2008).

By 1990, two-thirds of the states had established assessment mandates and guidelines, the majority opting for institution-centered approaches to assessment (Ewell, Finney, & Lenth, 1990). By the early 1990s, 90 percent of colleges and universities were in one way or another committed to the assessment process, and such activity had become the mandate of many accreditation agencies (El-Khawas, 1995).

The next section addresses current trends in educational accreditation programs and the impetus that gave structure to such trends.

Current Trends in Accreditation

In response to public outcry concerning the changing needs of modern students, accreditation agencies have mandated measures designed to improve student learning outcomes and other educational experiences of students (Harper & Lattuca, 2010).

Accreditation is a process of external quality review used by higher education to scrutinize colleges, universities, and educational programs for quality assurance and quality improvement. In the United States, accreditation is
carried out by private, nonprofit organizations designed for this specific purpose (Council for Higher Education Accreditation (CHEA), 2012).

In education venues, continuous improvement (CI) generally replaces the terms total quality management (TQM) and continuous quality improvement (CQI).

In higher education, CI principals have become the foundation of both regional and disciplinary accreditation. Nationwide, regional accreditation agencies have all adopted some form of the continuous improvement model that involves setting explicit learning objectives, ongoing assessment, making modifications based on assessment data and then repeating the measurement-feedback cycle to make incremental improvement over time. Accreditation agencies in disciplines as diverse as business, nursing, education, and engineering have adopted the CI process (E. V. Van Duzer, personal communication, November 2011).

Today the continuous improvement business model turned education model is unmistakably entrenched in all facets of public and private instruction as is evidenced by accreditation criteria from many accreditation organizations including the Western Association of Schools and Colleges (WASC, 2012), the Accreditation Board for Engineering and Technology (ABET, 2012), and the Southern Association of Colleges and Schools (SACS, 2012).

One of the fundamental changes that this approach has engendered in higher education is the shift from an emphasis on inputs, delivering the educational
material, to outcomes, where it is the student’s learning that becomes the focus of educational evaluation and change (Bai & Pigott, 2004).

Where education is concerned, students have become the focus, the effectiveness of instruction the medium, and student assessment the standard by which educators gauge what works versus what is ripe for improvement (Wolverton, 1994).

**Regional accreditation.**

Regional accreditation agencies are the best known and most active accreditation agencies operating in the United States (CHEA, 2012). Regional accreditation agencies work predominantly with academically orientated, non-profit institutions (CHEA, 2012). There are six regional accreditation agencies recognized by the Council for Higher Education and the U.S. Department of Education (CHEA, 2012; U.S. Department of Education, 2012). As the name implies, regional accreditation agencies are responsible for the accreditation of schools and colleges in particular geographical regions or clusters (CHEA, 2012).

Regional accreditation is a process based on self-review and peer assessment. It is comprehensive in scope, covering an institution’s financial status, governance, faculty and staff relations, institutional achievements, student services, and student learning outcomes (Volkwein, 2009, p. 6).

Accreditation activities in California and Hawaii are directed by the regional accreditation agency WASC (CHEA, 2012).
It is the individual regional accreditation agencies that are responsible for the development of specific standards that guide schools and colleges through the activities and procedures that qualify each for the seal of approval that accreditation provides to responsive and capable learning institutions (CHEA, 2012).

The WASC criteria are divided into the following categories: A. Organization for Student Learning; B. Curriculum and Instruction; C. Support for Student Personal and Academic Growth; and D. Resource Management and Development (WASC, 2012). Section 7 of category A and section 3 of category B specifically reference CI processes (WASC, 2012). Section A, subsection 7 addresses continuous improvement from the standpoint of school leadership. The section reads:

The school leadership facilitates school improvement which (a) is driven by plans of action that will enhance quality learning for all students, (b) has school community support and involvement, (c) effectively guides the work of the school, and (d) provides for accountability through monitoring of the schoolwide action plan (WASC, 2012).

Section B, subsection 3 addresses continuous improvement relative to the student learning process. The section reads:

Teacher and student uses of assessment are frequent and integrated into the teaching/learning process. The assessment results are the basis for (a) measurement of each student’s progress toward the expected schoolwide
learning results, (b) regular evaluations and improvement of curriculum and instruction, and (c) allocation of resources (WASC, 2012).

*Engineering accreditation: ABET.*

The Accreditation Board for Engineering and Technology provides accreditation to schools offering degrees in engineering and specific technological fields. Currently, ABET accredits over 3,100 engineering, applied science, computing, and technology programs, servicing 660 colleges and universities in more than 23 countries. More than 80,000 students graduate from ABET accredited programs each year (ABET, 2012).

ABET maintains that its vision is to “provide world leadership in assuring quality and in stimulating innovation in applied science, computing, engineering, and technology education” (ABET, 2012, p. 1).

In 1996, the ABET Board of Directors adopted a new set of standards referred to as Engineering Criteria 2000 (EC2000) (Lattuca, et. al., 2006), a document that outlines the qualifying criteria by which engineering programs become accredited, some being accredited under this standard as early as 1998 (Williams, 2001). Incorporating continuous improvement protocols into undergraduate engineering programs began with an ABET pilot program involving two engineering institutions during the 1996-1997 school year (M. A. Weiss, personal communication, January 31, 2012). Embedded in ABET’s new accreditation philosophy is a shift in focus from inputs, such as what is taught, to the
collection of output data specific to student learning (Bai & Pigott, 2004). Additional schools became involved in continuous improvement on a voluntary basis throughout the late 1990s and into the early 2000s (M. A. Weiss, personal communication, January 31, 2012). By 2002, participation in continuous improvement activities was mandated by ABET as an accreditation requirement, and, in consequence of ABET’s six-year accreditation cycle, all engineering programs were to be actively engaged in continuous improvement practices by 2006 (M. A. Weiss, personal communication, January 31, 2012).

As evidence of compliance with EC2000, ABET expects candidate institutions to demonstrate that procedures are in place for setting objectives and outcomes, developing curricula relative to such objectives and outcomes, evaluating results from outcomes, and utilizing the results toward ongoing program improvement (ABET, 2012).

A major theme in ABET’s accreditation practice is the mandate that schools frequently and continually collect and analyze student outcome data toward improving educational programs and student learning outcomes (ABET, 2012). Criteria 3 and 4 of the 2012-2013 Criteria for Accrediting Engineering Programs specifically address student outcomes and continuous improvement, respectively (ABET, 2012). Student outcomes, labeled a-k, cover conventional engineering objectives such as the ability to apply knowledge of mathematics, science, and
engineering, to professionally oriented objectives such as the understanding of professional and ethical responsibility (ABET, 2012).

The next section examines continuous improvement models and the corresponding means of assessing student outcomes relative to such models.

Elements of the continuous improvement model.

Continuous improvement, in its design to improve student learning outcomes, has been interpreted and described in many different ways; however, certain elements of the process are characteristic of the generalized model.

As schools increasingly adopted continuous improvement strategies in their academic planning, it became necessary to measure the extent to which schools were taking part in the practice (Harper & Lattuca, 2010). It was reasoned that in the absence of a means to identify and measure the extent of CQI activities practices within an academic program, it would be impossible to measure the effect of such practices on student learning outcomes (Harper & Lattuca, 2010). In response to this void, Briggs, Stark, and Rowland-Poplawski (2003) identified four common practices as characteristic of CQI curriculum and program development: (1) continuous and frequent curricular planning, (2) awareness and responsiveness to curricular change, (3) participation and teamwork concerning collective curricular goals, and (4) evaluative and adaptive curricular change based upon assessment data collected from multiple sources. Establishing a procedure for the implementation of CQI minimized the tendency of schools to “virtually” adopt the practice, closing the
gap where schools could gain from the prestige of innovation without the cost of implementation (Harper & Lattuca, 2010).

The ABET approach to continuous program improvement employs a two-loop feedback cycle (ABET, 2012). One loop of the process addresses program-level assessment and improvement, while the other loop addresses improvement at the program outcomes level (ABET, 2012).

The first loop involves the collection of input from constituencies, determining educational objectives, and the evaluation/assessment process relative to the identified objectives (ABET, 2012). The program-outcome loop cycles through (A) the determination of necessary outcomes required to achieve the identified educational objectives, (B) the determination of methods that will be utilized toward the achievement of objectives, (C) the determination and design of measures toward the assessment of student learning outcomes, (D) the establishment of benchmark indicators signifying the achievement of objectives, (E) the application of formal instruction and student activities toward achieving acceptable outcomes, and (F) the evaluation and assessment of student outcome data (ABET, 2012) Once positioned at location F, the process can cycle through to either data gathering, reassessment, or additional incremental improvement (ABET, 2012).

Despite the widespread adoption and the undeniable logic of CI to improve educational effectiveness, a number of researchers have questioned how effective this model is in practice. Just as some firms made significant gains
by transitioning from mass production to quality production models, other companies quickly abandoned the CI practices when they did not produce results. There is evidence that the commitment to the effectiveness of CI in higher education is likely to be more beneficial in some cases than in others (Van Duzer, 2000).

Early CI movements in education were fueled by speculation and cautious optimism, and sometimes buttressed with claims suggestive of controversy.

“If we can do it for widgets, why not students?” (Brigham, 1993, p. 47).

“Who could argue with improving service or with taking the needs of students into account?” (Schwartzman, 1995, p. 12).

It [TQM] cannot be dismissed as another management fad. It is not academic whimsy. It is too well-grounded in the scientific approach to problem solving, and it has been tested, scrutinized, and revised in thousands of organizations.

… Bottom line: It works! (Seymour, 1992, p. ix).

The next section examines continuous improvement and the design of assessment instruments used to measure student learning outcomes.

*Continuous improvement and the assessment of learning outcomes.*

There are two paradigms concerning the purpose of assessment (Ewell, 2008). The improvement paradigm evolved from the institution-centered-assessment approaches of the mid-1980s, and the accountability paradigm came about in response to early state assessment mandates (Ewell, 2008). The improvement
paradigm addresses purpose and strategy, and focuses on student learning outcomes; the accountability paradigm focuses on methods and the implementation of procedure (Ewell, 2008). The improvement paradigm employs assessment data to improve teaching and learning, while the accountability paradigm employs data to convince policy makers and the public that continued funding of particular educational programs is a reasonable expenditure of public resources (Ewell, 2008). Agreeable statistics provided by either division have the potential to justify the legitimacy of an institution’s function to outside entities; and in fact, organizational structures of postsecondary institutions, by design, manifest traits intended to preserve the legitimacy of their function (Morest, 2009; Meyer & Rowan, 1977). Institutions are prone to focus on generating data and information that will positively influence the status of the institution (Morest, 2009). “All organizations, even those maintaining high levels of confidence and good faith are in environments that have institutionalized the rationalized rituals of inspection and evaluation” (Meyer & Rowan, 1977, p. 359).

The next section focuses on student outcome data and how such data might be employed to support the goals associated with the improvement paradigm.

*Outcome data: developing a culture of evidence.*

Accreditation in institutes of higher education continues to be regarded as the seal of collegiate quality even while questions have been raised about its
effectiveness and what the process accepts as evidence of improved student learning (Schwass, 2010).

Popular among policy and assessment experts is the term “culture of evidence;” this term reflects the belief that institutes of higher learning can enhance student success and associated learning outcomes through the systematic collection and examination of relevant data (Morest, 2009). Historically, institutions have gathered and processed student data for a variety of purposes ranging from securing government funding to meeting accreditation requirements. Now, data collection and evaluation has shifted toward gathering evidence for the purpose of demonstrating ongoing enhancement of student learning outcomes (Morest, 2009).

The following is from a report published by the Educational Testing Service (ETS):

Postsecondary education today is not driven by hard evidence of its effectiveness. Consequently, our current state of knowledge about the effectiveness of a college education is limited. The lack of culture oriented toward evidence of specific student outcomes hampers informed decision-making by institutions, by students and their families, and by future employers of college graduates (Dwyer, Millett, & Payne, 2006, p. 1).

Data collection and analysis must be comprehensive, thorough, and systematic for a culture of evidence to become a part of institutional reform (Morest, 2009).
Retrieving and analyzing valid data is the most common barrier colleges and universities encounter when working toward building a culture of evidence (Brock et al., 2007).

The 1992 reauthorization of the Higher Education Act (HEA) of 1965 required accreditation agencies to be significantly more aggressive in demanding evidence of student academic achievement as part of the accreditation process (Ewell, 2008). Paradoxically, current accreditation schematics direct schools to not only determine their own educational objectives but to develop the very indicators that signify the obtainment of such objectives (ABET, 2012; WASC, 2012).

To develop an understanding of the implications of such a practice, consider an engineering program that identifies as a learning objective that students reach a certain level of writing proficiency, a skill-level to be determined by achieving a particular score on a departmentally constructed writing assessment. How does the department convince an outside entity that students are improving in their writing ability, and more-so that this improvement is a result of the department’s ongoing continuous improvement practices? Meyers and Rowan (1994) suggest that one well-traveled pathway occurs through the institutionalized use of variable ambiguous technologies that generate outputs that are difficult to evaluate.

The Association to Advance Collegiate Schools of Business (AACSB) International is the premier accrediting agency for business colleges worldwide (LaFleur, Babin, & Lopez, 2009). A major challenge for most AACSB accredited
business schools is follow-through with the set of points known as the assurance of learning standards (LaFleur et al., 2009). Central to these standards is the requirement that business educators assess student outcomes, which require that metrics be identified/developed that can be used in such evaluations (LaFleur et al., 2009). The general means in which business schools assess student learning is through course-embedded assessment instruments, instruments that lack the extensive testing required to verify reliability and the validity of interpretations (LaFleur et al., 2009). Another challenge to external validation of locally developed assessment instruments is the variance that exists in specific learning goals from institution to institution (LaFleur et al., 2009).

*Measuring outcomes in engineering programs: ABET study.*

In 2002, ABET commissioned Pennsylvania State University researchers to enter upon a multi-year study toward the determination of whether implementation of ABET’s EC2000 criteria was leading to enhanced learning outcomes for students (Lattuca et al., 2006). The study’s intent was to answer two questions: (1) What impact, if any, has EC2000 had on student learning outcomes in ABET-accredited programs and institutions?; and (2) What impact, if any, has EC2000 had on organizational and educational policies and practices that may have led to improved student learning outcomes? (Lattuca et al., 2006). To answer these questions, Penn State researchers studied the educational practices in place in engineering programs
and assessed student performance pre- and post-EC2000 implementation (Lattuca et al., 2006).

The Lattuca et al. study was based on data collected from 40 engineering institutions that offer more than 200 engineering programs. Analyses in the study were based on survey data collected from 1,243 faculty members, 147 program chairpersons, 5,494 graduates of the class of 1994, 4,330 graduates of the class of 2004, 39 engineering program deans, and 1,622 employers (Lattuca, Terenzini, Volkwein, & Peterson, 2006).

The study employed a two-stage, disproportionate, stratified, random-sampling design designed to ensure that sample sizes were sufficient and that individual program disciplines, accreditation review years, and participation in a National Science Foundation (NSF) funded coalition that occurred during the 1990s were taken into account (Lattuca et al., 2006). The following sections describe the results of the Penn State study.

Differences in student experiences.

ABET reported that it collected evidence that suggests the program changes resulting from ABET mandates have had a measurable impact on the educational experiences of undergraduates (Lattuca et al., 2006). While these differences are small, the study suggests that they are indicative of EC2000 as establishing itself as a positive force toward enhanced student outcomes (Lattuca et al., 2006). Researchers arrived at this conclusion based on directional changes reported by students in seven
of ten measures of differences in student experiences (Lattuca et al., 2006). The measures that failed to show improvement were differences in the teaching skills of faculty members, hours spent by students in internship programs, and the level of climate diversity perceived by students (Lattuca et al., 2006). Positive changes in student experiences were found in active engagement in the learning experience, increased interaction with instructors, increased feedback from instructors, greater times spent studying abroad, increased international travel, greater involvement in engineering design competition, and increased emphasis on openness to diverse ideas and people (Lattuca et al., 2006). “The evidence provides no guidance in the way of an explanation” (Lattuca et al., 2006, p. 6).

*Differences in learning outcomes.*

As was the case with assessing the quality of student experiences, the ABET commissioned study relied on self-reporting from students to assess the quality of student learning outcomes (Lattuca et al., 2006). Carrying out program assessments in such a manner is reasonable as there is a body of research that suggests that self-reported measures of learning serve as reasonable proxies for objective measures of the same skills or traits (Lattuca et al., 2006). Over the course of the study, correlations between such proxy measurements and objective criterion measurements such as the American College Testing (ACT) Comprehensive Test and the Graduate Record Exam (GRE) were reported in the range of 0.50 to 0.70 (Lattuca et al., 2006). The sole use of the self-reporting assessment protocol resulted from the inability to
secure objective data from the National Council of Examiners for Engineering and Surveying (NCEES) relative to NCEES’s Fundamental of Engineering examination (FE) (Lattuca et al., 2006). This is to say, Penn State researchers were unable to gain access to examination data on the standard examination that serves as the first step toward becoming a professional engineer, an examination that has been deemed reliable and valid by NCEES, and hence ABET (Lattuca, 2012). Additional validity is provided to the FE by state licensing boards, as it is these entities that provide licensure to professional engineers (NCEES, 2012).

The study concluded that 2004 engineering graduates were better prepared than their 1994 counterparts, that professional skills were increased, and technical skills remained constant (Lattuca et al., 2006).

Untested outcomes measures in engineering programs.

Various engineering schools have developed their own instruments to assess the learning outcomes of their students.

For example, Texas Tech University has developed what they call a program assessment portfolio (PAP) (Bai & Pigott, 2004). The PAP consists of 12 assessment methods designed to evaluate the quality of student learning experiences and to evaluate departmental success in achieving the 11 (a-k) learning outcomes described in Criterion 1 of Engineering Criteria 2000 (EC2000) (Bai & Pigott, 2004). The assessment methods include an alumni survey, a fundamentals review exam, a graduate questionnaire, a seminar attendance report, a pre- and post-course
assessments, and seven additional measures (Bai & Pigott, 2004). The PAP contains formal evaluation methods and informal evaluation methods, alumni surveys and the fundamentals review exam serving as examples of the former and focus group interviews and seminar attendance reports serving as examples of the latter (Bai & Pigott, 2004). The engineering department teaches the fundamentals of engineering review course with the FE in mind; however the department has exercised reluctance in requiring students to pass the FE as a graduation requirement (Bai & Pigott, 2004). The department has developed its own fundamentals exam that students must pass as a graduation requirement (Bai & Pigott, 2004).

The pre- and post-course assessments contain identical questions and seek to determine (1) whether students entering the course of reference possess ample background for success without remediation, (2) whether exiting students have acquired the knowledge gains intended for the course, and (3) possible improvements in course content and approach that might lead to course improvements (Bai & Pigott, 2004). Ultimately, the Texas Tech Engineering Department determined that the pre- and post-course assessment was an effective method to assess course effectiveness and instructor teaching ability (Bai & Pigott, 2004).

As an example of an internally designed and institute-specific assessment instrument, the PAP would require additional testing for external validity and reliability were it to gain general acceptance as an assessment instrument (Carmines
& Zeller, 1979). In general, validity must be tested to determine “the degree to which evidence supports the interpretation of test scores” (Millett, Payne, Dwyer, Stickler, & Alexiou, 2008, p. 5) or for that matter, the validity of any other assessment instrument (Banta, Jones, & Black, 2009).

**Concerns Regarding Implementation of the Continuous Improvement Model**

A number of concerns exist regarding the implementation and practice of the continuous improvement model in educational venues. The first portion of this section addresses faculty response to the implementation of continuous improvement practices and the importance of developing a faculty climate willing to work together to improve school programs and student learning outcomes. The second portion of the section addresses the goodness-of-fit of the business model to service in the schools environment.

*Challenges associated with faculty acceptance of the CI model.*

One of the greatest hurdles to overcome when implementing change in academic programs is agreement concerning the type of change that is desired and the measures that will be used to achieve such change (Ebersole, 2009). The academic diversity and variation in professional experiences of faculty members naturally gives rise to different interpretations regarding the importance and role that assessment serves in program improvement, yet consensus must be achieved if improvement programs are to lead to meaningful outcomes (Ebersole, 2009).
Requisite cultural change in the school environment is not a natural consequence of the simple desire of faculty, staff, and administrators to improve school programs and student learning outcomes (Ebersole, 2009). Expecting that school employees will band together and place their collective trust in assessment data to drive instruction, practice, and policy is a tall-order, both in its complexity and demand on school personnel (Morest, 2009). Mandates, whether internal or external, do not facilitate campus engagement (Banta, 2011). Efforts to establish reform in education are often met with turbulence when enthusiastic inner-circle faculty and administrators direct the hand-off to frontline faculty members working in the trenches (Hendricson et al., 2007).

Faculty members need to be made to feel that they are a part of an important process if they are to fully invest themselves (Banta, 2009). Educators need to see that their efforts give rise to program improvement if such efforts are to persist (Ebersole, 2009). “Good assessment programs have to have “face-validity” for faculty, who should be able to see how the information gathered during assessment will help them in the classroom” (Banta, 2011, p. 24).

It is a common faculty position that assessment efforts too often focus on the process rather than the product, and that such practices must lead to knowledge that improves learning outcomes if they are be purposeful (Ebersole, 2009). “The goal of assessment is not just to gather evidence, after all, but to make evidence-informed changes” (Banta, 2011, p. 25).
Banta (2009) reported that her research group found that only 9 of 146 respondent schools (6%) reported evidence that assessment driven program changes led to improved student learning. It can take two years to convince faculty that change is needed, another two years to craft and implement appropriate change, and another two years to collect data toward the determination of whether the implemented change positively impacted student learning outcomes (Banta, 2009). Banta (2009) pointed out that the low rates of evidence of improved student learning may indicate that participant schools have had insufficient time to work through the process. Banta (2009) acknowledged that changes in faculty priorities and specific educational objectives have the potential to diminish improvement returns over time.

Seventy-five percent of engineering department chairpersons reported that a majority of their faculties were mostly supportive of continuous improvement efforts; and 60% of department chairpersons reported moderate to strong support for the assessment of student learning (Lattuca et al., 2006). Further data from the Penn State study suggested, “For the most part… faculty members do not perceive their assessment efforts to be overly burdensome” (Lattuca et al., 2006, p. 5).

Beyond the expectation that school faculties become united for the common goal of continuous program improvement is the requirement that schools develop benchmarks or indicators capable of signifying the achievement of educational goals. ABET expects each engineering program to identify individual educational objectives, and to design the very assessment instruments through which program
success or failure is to be measured (ABET, 2012). In many ways, the yardstick that accreditation agencies employ to measure a school’s worth is not so much whether a school can demonstrate enhancements in its programs or student learning outcomes, but rather whether what a school reports to accreditation agencies during the outcome stage corresponds with what it reported as desired outcomes during the planning stage (Volkwein, 2006).

*Students as customers and other metaphors.*

“Quality is defined in terms of customer satisfaction: the customer’s judgment of quality not only determines how quality is measured but how it is defined in the first place” (Peters, 1987; Fenwick, 1992; Schwartzman, 1995, p. 4).

Another matter that requires attention is whether it makes sense, in an all-landscapes-equivalent approach, to assume that what may have been successful as a business model, a health-care model, or any other non-educationally based model would serve well in the practice of optimizing quality in education, and hence lead to enhancements in student learning outcomes. The next section sheds some insight on disconnections in making such an assertion.

*Students as customers.*

Many educators find the student/customer metaphor troublesome as it allows student satisfaction to serve as surrogate for teaching quality (Chambers & Fernandez, 2004). To others, the analogy casts concerns of generating a student clientele consisting of passive recipients or the genesis of educational environments
where faculty members “pander” to students (Aliff, 1998). Schwartzman (1995) reasons that the student-as-customer metaphor has the potential to create a student vision where, “customers can buy immediate satisfaction at the expense of [their] own long-term best interest;” (p. 21) Schwartzman further alluded to the indeterminate damage to higher education that would follow were such a pattern to become established. Student desires may not be consistent with their needs, and as such students are generally not in a position to make thoughtful determinations regarding the appropriate level of rigor in their coursework or the demands placed upon them by their instructors (Schwartzman, 1995).

_Students as products? or Knowledge and skill as products? Or ?_

A “product” within business and industrial applications can be defined through the description of the physical properties and specifications of its components (Arnold, 2011). A manufacturer of a particular bolt would know the composition of the alloy used in its construction, the topology of its thread pattern and other specifications of its physical anatomy. All bolts of such lineage would possess properties within certain measurable thresholds of the parent bolt.

If we accept the notion that students are the product of educational programs we find it impossible to provide an adequate description of the product line (Arnold, 2011).
Assuming that the product of education is a combination of knowledge, skill, and judgment fails to patch up the mangled metaphor due to the intangibilities associated with such measures (Arnold, 2011).

“Whether TQM should extend into higher education has been considered ‘the most pressing question of the TQM movement’” (Keller, 1992, p. 50; Schwartzman, 1995, p. 4).

Are CI Efforts Correlated with Enhanced Student Learning Outcomes?

Accreditation agencies have vigorously pushed the practice of continuous improvement on educators; much as if the practice were in itself a law-of-nature, unwavering and inevitable in its enhancement of student learning outcomes and program improvement (Arnold, 2011). In response, teachers and administrators have devoted their time and energies to the process and its assumed outcome, apparently never demanding evidence that their efforts are well-founded or whether the fruits of their labor are consistent with those promised.

Extensive examination of the literature failed to reveal evidence of institutionalized interest in pursuing the development of definitive instruments capable of assessing the success of continuous improvement practices.

This literature review sets the stage to examine the cumulative effects of sustained application of the criteria associated with EC2000 on student learning outcomes, the current state of the art of the practice of assessment-based program improvement, and the impact that such change has imparted on the educators who
are responsible for the implementation of assessment-based program-improvement efforts.
CHAPTER THREE

METHODOLOGY

Introduction

This chapter describes the approach and procedures that were applied to collect and analyze the observations and views of civil engineering educators concerning the specifics of their individual experiences with the application of continuous quality improvement protocols and the effects of such activity on specific program attributes, most notably being those pertaining to student learning outcomes.

Focus of Research

This study examines the ABET program-improvement model associated with EC2000 from the perspective of those educators responsible for implementing assessment-based program improvement practices. The aim of the study was to gain a clearer picture of the actual state of the ABET process, its implications, specific time-effects concerning the success of continuous improvement practices, explicit evidence of program success, and information regarding the costs and benefits associated with the implementation and furtherance of the practice. The study focused on those faculty members who were most directly involved in the implementation and follow-through of continuous improvement efforts; largely, this translated to individuals serving in the capacity of department heads or chairpersons.
Institutions were identified to take part in the study based on a file provided by ABET that listed accredited civil engineering schools and the school-calendar year that each engineering program received its initial accreditation under the criteria associated with EC2000.

Participants

The engineering schools participating in the study were selected from a random sample of a subset of the 248 ABET accredited civil engineering programs. This subset was composed of engineering schools that received their first accreditation review under the criteria of EC2000 during the 2001-2002, 2003-2004, or 2005-2006 school-calendar years. Seventy-five schools were members of this subset. A stratified random sample of 30 civil engineering schools was selected from the subset, thus obtaining ten schools from each review year classification. Educators associated with 21 of the 30 schools (70%) agreed to participate in the study. The sample included eight institutions from the 2001-2002 classification, five institutions from the 2003-2004 classification, and eight institutions from the 2005-2006 classification. The study’s respondents consisted of 4 female subjects and 17 male subjects whose home institutions were located across the United States. The sample of institutions in the study included four schools granting solely the undergraduate degree, three schools granting undergraduate through the master degree, and fourteen schools granting undergraduate through the PhD degree. The sample of institutions was composed of eighteen public schools and three private
schools. The mean department faculty size of the institutions associated with the study was 15.7 members, with a standard deviation of 8.8 members. The faculty size ranged from a low of 6 faculty members to a high of 45 faculty members.

Contact procedure.

Once the identities of the 30 institutions described above were determined, the program leaders of each department were identified through official school websites. A list of the names of the program leaders and their contact information was compiled. Phone calls were directed to each potential subject and where contact was made directly, an attempt was made to set up an appointment. In some instances leadership changes were noted and the list of potential subjects was modified to reflect such changes. When no contact was made through a phone call, an email was sent that provided an introduction by the principal investigator, a brief description of the research, and information concerning the time commitment required of respondents. It was generally necessary to follow up with one or more phone calls prior to receiving a response. Subsequent phone calls were always accompanied by brief email messages. In some incidences, the department chairperson or department head provided the contact information of a colleague whom he/she felt was better qualified to take part in the study. In this situation the referenced individual was invited to become a participant in the manner previously described. All scheduled appointments were entered into a calendar that included the time of the interview, the
number through which to direct the phone interview, and notes that concerned time zone information.

The subjects in the study were assigned pseudonyms to protect their identities. For simplicity, the 21 fictitious names were configured using the first 21 letters of the alphabet as leading letters for each pseudonym. Hence, the 4th subject, a female; and the 21st subject, a male, were designated in the study as Darla and Upton, respectively.

The mean number of years that participants served in their specific capacities under EC2000 was 6.3 years, with a median service period of 6.0 years. The minimum number of years of service in these capacities of reference was 3 years and the maximum number of years in such capacities was 11 years.

Sixteen of the respondents were either department heads or department chairpersons, two respondents were ABET coordinators, one respondent was a dean of engineering, one respondent was an associate department head, and one respondent was an undergraduate director. Information concerning the participants in the study is compiled in Appendix A.

Data collection took place during the spring of 2012.

*The Survey Instrument*

The survey instrument was designed for implementation in the form of a semi-structured telephone interview. The questionnaire was built around a participant time-commitment of around 30 minutes; however, individual interviews
were scheduled to allow subjects to address the content of the survey without time limitations. Actual interview times ranged from 20 to 75 minutes, with the average interview lasting approximately 45 minutes; only three of the interviews extended beyond 50 minutes. The 20 minute interview was an anomaly; no other interview was shorter than 35 minutes. Field notes recorded the responses of participants as well as the intonations that provided nuance and emphasis to specific replies.

Each respondent was read a script that was prepared in accordance with Humboldt State University’s Institutional Review Board (IRB) policy. The script informed subjects of the purpose of the study, personal rights of subjects taking part in the study, and protocols for maintaining the anonymity of subjects and their corresponding institutions. In closing, the script provided participants with the contact information of the study’s principal researcher, his advisor, and Humboldt State University’s dean of research and sponsored programs.

Survey design.

This section provides a detailed explanation of the structure and design of the interview instrument utilized in the study. The actual interview instrument is found in Appendix B. The survey was checked for face-validity by the principal investigator’s adviser, who teaches resource methods courses, and an engineering professor experienced with the ABET accreditation review process.

Table 1 compiles the topics and strands of inquiry associated with the interview instrument. The main topics addressed in the interview were: (1)
Distribution of Responsibility; (2) The Assessment Process; (3) Preferred Assessment Instruments; (4) Effort Sustainment Practices; (5) Cost/Benefit Profile of ABET Process; and, (0) Specific Accreditation Data.

Table 1: Inquiry Topics and Strands Associated with the Interview Instrument

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Item 1: distribution of responsibility.

According to ABET, educational objectives experience the highest rates of success when all faculty members have explicitly defined duties that are meaningful in their formulation and that work toward the achievement of common goals (ABET, 2012). In the literature, this idea translates to shared values and vision, collective responsibility for student learning, reflective professional inquiry, and collaboration (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).

The introductory item of the survey seeks to determine the degree to which engineering programs work to engage and/or immerse faculty members into the process of assessment-based program improvement. Specifically, this first item requests the respondent to provide a description of the distribution of assessment-based program-improvement responsibilities within their department. This inquiry and its companion inquiry provide subjects the opportunity to address their department’s commitment to the equitable distribution of responsibilities relative to their program’s assessment-based program-improvement effort.

Item 2: the assessment process

Central to assessment-based program-improvement efforts is the idea of collecting and analyzing student data toward the development of program modifications that promote targeted improvements in student learning outcomes. The second set of inquiries seeks to identify specific examples of program modifications
that arise from the ABET model and specific evidence of improved student learning outcomes that resulted from those program modifications.

The section begins by describing the three-stage assessment-based schema, attributed to Dr. Trudy Banta, designed to identify the ranges of progress associated with the implementation of assessment-driven program-improvement processes (Banta, 2009). Stage 1 of the process involves collecting sufficient evidence to convince faculty members that change is necessary; Stage 2 of the process involves crafting and implementing an appropriate program modification to enact the desired change; and, Stage 3 of the process involves collecting sufficient data to determine the impact of the selected program modification. In the first part of this set of inquiries, respondents are requested to identify the stage they believe to present the greatest challenge. Determining where programs are in their pursuit to implement assessment-based program-improvement practices is important, as it is recognized that it takes substantial experience in each stage of the process for programs to reach maturity in assessment-based practices (Banta, 2009).

The next inquiry in this section asks the respondent to describe the extent to which their faculty colleagues believe that the assessment of student data provides information that can be used to improve their programs. Banta, et al., has made it clear that it is the duty of academic leaders to serve in advocacy roles for the assessment process, and that so doing enhances the likelihood that assessment-based program-improvement practices will be valued and sustained (Banta, Jones, & Black,
2009). Extension of Banta’s, et al., conjecture to include faculty members provides validation to this inquiry that is consistent with the face-validity associated with this item’s function in gauging levels of faculty buy-in. This item is important in that it would seem to suggest potential connections between program success in applying assessment-based program improvement principals and the strength of faculty buy-in to assessment-based processes.

The follow-up question asks that respondents identify the extent to which program modifications implemented by their department come about from the assessment of student data. To learn of the successes associated with an institution’s program improvement model, it is essential that they become informed of the extent to which assessment data drives program improvement.

This section closes with the request that each respondent provide an example where assessment has been the driving-force in a program modification or change and to provide, if possible, evidence that the referenced program modification led to the planned outcome. In the event that a respondent indicated their inability to provide an assessment-based program modification, such respondents were asked to describe a program change or modification of their choice, the information source that initiated the program modification, and a description of any pertinent outcome that resulted from the undertaking.

The purpose of the second item was two-fold. First, it provided a vehicle to access the extent of faculty buy-in and the level of group cooperation, and/or shared
vision, regarding assessment-based program-improvement practices. Second, the section allowed for a snap-shot of the current state of affairs regarding where programs stood in their individual pursuits to become assessment-based in their program-improvement strategies.

*Item 3: preferred assessment instruments.*

The third set of inquiries seeks to discover, from among all data types and/or sources, those specific instruments or data collection devices that are most useful in providing information that can be used to facilitate program improvement. The potential list of candidate metrics includes student portfolios, projects, student surveys, departmental examinations, the FE (the fundamentals of engineering examination), and more.

The importance of the third set of inquiries lies in its ability to provide the respondent with an opportunity to bring forth departmental program-improvement strategies involving data procurement from multiple sources. Respondents were permitted to submit as many as three data producing instruments. The closing item in the third set of inquiries requested respondents to predict whether their colleagues would likely choose the same instruments as providing the most useful information. This last inquiry was omitted early in the study in result of hesitation of respondents to second guess the preferences of their colleagues.
Item 4: effort sustainment practices.

The fourth item examines the sustainment of program-improvement practices and the measures taken by departments to maintain faculty effort and focus concerning defined learning objectives. A viable program-improvement practice must have among its components active planning and support functions (Stark, Lowther, Sharp, & Arnold, 1997). This item provides information that may be used to gauge the strength and quality of departmental efforts designed to sustain focus and effort on program improvement strategies and objectives.

Item 5: cost/benefit profile of ABET process

The fifth item is designed to gain a collective overview of the costs and benefits associated with the practice of ABET-mandated program-improvement protocols and their practice. This interesting probe requests that respondents provide information concerning the process and practice of assessment-based program-improvement in terms of a cost/benefit analysis. Costs are those inputs that need be expended to keep the process up and running, while benefits are those gains that are or that can be realized from the practice of assessment-based program improvement.

In this study, the benefit of greatest interest is the improvement in student learning outcomes. The objective of this item is to gauge the degree to which engineering educators feel that assessment-based program improvement practices are valuable. Learning if educators believe that their effort and expense (costs) provides commensurate returns, in the form of benefits, is important if the process is to
receive the continued support necessary for its use as a tool toward the betterment of an engineering education.

Item 0: specific accreditation data

While ABET provided the accreditation history of participating institutions, this item was included to gauge individual respondent’s understanding of that history. This section of the interview asked respondents to identify when their department was first reviewed under the criteria associated with EC2000 and the year that their department received its last accreditation review.

This last item also set out to learn whether respondents had served as members of an ABET accreditation-review team. It was felt that if a respondent had served in such a capacity that it might add depth or additional meaning to their specific responses that might not be available in the responses of other subjects. This inquiry was widened to include determining whether respondents had received qualifying training to become accreditation review team members or whether subjects had taken part in ABET’s Institute for the Development of Excellence in Assessment (IDEAL) program. This step was added as it appeared that there might be a possible connection between a department’s success in deploying assessment-based program improvement efforts and the amount of assessment-based training received by a department’s faculty members.
Data Collection and Analysis

The data was organized into thematic units that reflected the organizational design of the interview instrument. Once organized into a suitable grid, this qualitative data was utilized to support arguments in the study that arose from quantitative data.

This study utilized Minitab 16 to carry out statistical calculations.
CHAPTER FOUR

RESULTS

Introduction

Starkly absent in the data and subsequent analysis was any evidence that indicated improvement in student learning outcomes had resulted from the continuous improvement practices associated with the EC2000 mandate and the present time, let alone that systematic variation in student improvement existed among the three adoption-year classifications that composed the sample.

An interesting conundrum emerged from the data. The majority of subjects relayed that ABET’s program-improvement criteria lacked clarity, consistency, and/or definition (66.7%); yet the preponderance of respondents reported that their programs benefited from being obliged to undergo ABET’s periodic internal reviews (71.4%).

The Unity Factor and the Distribution of Responsibility

Virtually every educator interviewed in the course of this work relayed a deep conviction and commitment toward the betterment of their individual engineering programs, which in and of itself was not particularly noteworthy. What was extraordinary were the voice tones and the accompanied qualification that added depth and emphasis regarding individual views concerning the enrichment of individual engineering programs employing ABET program-improvement protocols. In many cases, the intonations of respondents suggested a certain sense of
indignation that ABET, as a third party, dictated the pathway through which program-improvement must be achieved. Oscar, the department chairperson from a PhD-granting institution located in the Pacific Northwest, confided, “To be honest with you, I’m kind of an ABET skeptic on all of this [using assessment data to drive program improvement].” Ted, the chairperson from a Pacific Northwest PhD-granting institution, commented, “I’m not sure that just following through with ABET’s directives is sufficient to say or prove that we have a great program.”

Five of the twenty-one (23.8%) respondents stated that faculty members in their department were in general agreement that the assessment of student data provided useful data that could be used to improve their programs. Ken, the department chairperson from a prestigious military academy, commented:

It [assessment-based program improvement] is an all-hands activity; every faculty member takes part in the process and contributes to the success of our program. We’re kind of into it. I would say that the entire faculty believes that the process has merit.

Herb, the department chairperson from an undergraduate institution located in the mid-west, suggested that shared responsibility is essential for faculty unity, “We [the entire faculty] believe that it is critically important that responsibilities are equitably distributed. We believe in the process and we believe that sharing the responsibility is important.” Herb went on to report that student data provided the best avenue to assess the need for program change and to verify that changes in student learning
outcomes had come about from specified program modifications. It should be noted that Herb reported that he received advanced assessment-based training from ABET and that he, in addition, is qualified to serve as a member of an ABET accreditation review team. Additional discussion concerning the assessment-based training is addressed later in the chapter.

Thirteen out of twenty-one (61.9%) respondents reported that their faculty members did not believe that the assessment of student data provided useful information that could be used to improve their programs. In 17 out of 21 instances (81.0%) respondents responded that the assessment-based program-improvement effort was inequitably distributed within their departments. In some PhD-granting institutions, assessment-based program-improvement activities were the sole responsibility of those faculty members with undergraduate teaching assignments. In other instances, including some PhD-granting institutions, it was evident that department chairpersons assumed increased accreditation-driven responsibility to shield other faculty members from accreditation-based activities. In some PhD-granting institutions, department chairpersons assumed this role so as not to inhibit faculty members from their research-based responsibilities such as writing grant proposals and overseeing individual research efforts. Frank, the department chairperson from a California PhD-granting institution, offered, “My faculty members need to focus on their classes, their research proposals, their research, and other obligations – so their time is valuable.”
In other cases it appeared that department chairpersons and/or other appointed staff absorbed the bulk of the responsibility as a path of least resistance regarding faculty members who were either skeptical of the process or adverse to the workload associated with its administration. Baxter, the department head from a masters’ degree-granting institution located in the Gulf Coast region of the southern United States, offered:

The faculty would rather be doing other things. We have specialists do the mechanics. At first, there was a lot of complaining from faculty members that, “this [the assessment-based program-improvement process] is stupid.” but now the faculty have accepted the process, and they just go on with their work.

It became apparent that a number of respondents in this study, due to perceptions they sensed regarding faculty discomfort with assessment-based program-improvement practices, have chosen to internalize the respective process as a personal responsibility.

Not engaging faculty members in the process has the potential to leave department chairpersons/heads in the dark concerning faculty views regarding ABET-driven program-improvement ventures. When asked to assess the extent of his faculty members’ belief in the utility of assessment-based program-improvement practices, Ted, who, along with a paid dedicated coordinator, completes the bulk of assessment-based program-improvement activities, commented, after a deep sigh, “I
don’t know. I don’t know what they think.” Irv, the department chairperson from a PhD-granting institution located in the Mid-Atlantic region, commented, “I haven’t polled them, but I would bet that only a third of my faculty find the process useful.”

In some larger and/or better-funded institutions it was observed that engineering departments were able to hire dedicated staff members to coordinate assessment-based activities, to compile program self-assessments, and to document accreditation-driven activities. Stan, the associate department head of a PhD-granting institution located in the mid-west shared:

Most of the surveys are done [collected, processed, and analyzed] out of our main office by staff people that we put in touch with our alumni, graduating seniors, and industrial contacts. So they do the reviews and collect the information.

In other institutions, some respondents referenced the heavy workload associated with the assessment-based program-improvement process. Gail, the department chairperson from a private East Coast PhD-granting institution added, “Inherently this is a good process in that it forces schools to periodically evaluate their programs, but it is poorly suited for a small department with few faculty members and resources.” Gail later provided, “Our faculty doesn’t believe that assessment produces particularly useful information. The faculty thinks that ABET and its approach to continuous improvement is bunk!” Upton, the dean of engineering from an undergraduate institution located in California, made note of the
financial challenge of being in compliance with ABET’s expectations, “There is not enough money to do what ABET expects of us well.” Neil, the department chairperson from a masters’ degree-granting institution located in California, who was in agreement with the financial strain incurred by smaller schools, counseled, “One thing I wish to stress is the impact the process has on smaller programs. The amount of work involved in the process can be overwhelming to smaller programs.”

Even when a department is able to afford a paid dedicated staff member to administer assessment-based activities there is no guarantee that such efforts reduce the strain of department members. Jeff, the department chairperson from a PhD-granting institution located on the eastern seaboard, expressing certain dismay regarding his department’s enlistment of an under-skilled assessment coordinator, relayed, “I carry out the bulk of the work although there is a person who has been hired concerning assessment. He doesn’t know anything about assessment and as such he has been ineffective.”

When the bulk of the workload is placed on a single individual, a certain level of personal distress can result. Darla, the ABET coordinator from an East Coast PhD-granting institution commented, “The process takes an enormous amount of time, at virtually no compensation to the coordinators. This is a c***** job to be assigned. It stinks!” Darla continued:

Only one in five of the faculty thinks that the process is valuable. I don’t get anything from it. I don’t get any relief from teaching for this. No
compensation. It is expected. It is something that the remaining part of the faculty resents having to do.

Frank had similar feelings concerning the lack of desirability of the ABET accreditation coordinating effort:

> Beyond the large time commitment, the process never provides joy or feelings of accomplishment. No one wants this job; it is a real downer! The process and the work offer no reward. We do what we do because we want an accredited program.

Quinn, the ABET coordinator from a PhD-granting institution located in the northern New England region, added:

> I do all of this for nothing [virtually no compensation]. We don’t have a paid coordinator or an administrator or any of that stuff. We have 440 undergraduates and all of this other stuff is just an extra load on the professors. Meanwhile, I have 113 students in an introductory course and I’m trying just to track them. Fancier programs pay people just to coordinate the process.

Ted, whose content and tone suggested a lack of professional intimacy with his faculty, and who, while cordial, was in many respects the most pugnacious subject partaking in the study, expressed his frustration with the process in the form of a less than modest selection of rhetorical questions, two of which are presented here. When asked if his department had recognized improvements in student learning
outcomes as a result of his department’s assessment-based program-improvement effort, Ted replied, “How do you measure increases in student learning outcomes?”

When requested to share any benefits that either he or his faculty members had identified as resulting from departmental assessment-based program-improvement efforts, Ted queried, “What types of benefits are you talking about?”

Regardless of the reasoning behind such occurrences, it is clear that most of the time, the lion’s share of responsibility concerning assessment-based program-improvement efforts falls on the department chairperson or a selected member, or members, of specific departments. Laura, the department chairperson from a PhD-granting institution located in the Great Basin region, summed the situation up, “The costs [the workload] are borne largely on those who carry the torch – the department chair, and those on the assessment and evaluation committee.”

*The sustainment of faculty focus and effort.*

The interview instrument’s fourth set of items prompted respondents to provide information concerning the nature, degree, and quality of effort exerted by their individual departments to promote long-term faculty focus and advancement regarding assessment-based program-improvement objectives and practices. Appendix C contains the rubric (see Section 4A) that was employed to gauge the strength and quality of the effort. The assigned coding for this item ranged from a low of 1 (failure to articulate the effort taken or effort amounts to going through the motions, or effort that appears ineffectual) to a high of 5 (faculty is highly trained
and motivated in assessment-based program-improvement and meets regularly toward the achievement of increased growth in assessment-based program-improvement and its practices). This category of numerical rating is from this point onward referred to as the *sustainment quotient* (Sustainment Q.). (See Appendix D) Table 2 summarizes the sustainment quotient distribution of the institutions that participated in the study.

Table 2: Effort Sustainment Data

<table>
<thead>
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<th>Sustainment Q.</th>
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<tr>
<td>5</td>
<td>1</td>
<td>4.80</td>
<td>21</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The average sustainment quotient rating received by an institution was ≈ 2.38 (50/21). The bracketed quotient is simply a weighted average formed from the sums of the products of the first two columns. This relatively low effort-sustainment quotient mean reflects the level of difficulty that many programs are experiencing in coordinating their individual sustainment efforts.

In the case of the sole institution that received an effort-sustainment quotient of 5, 40% of the faculty received advanced training in ABET’s *Institute for the*
Development of Excellence in Assessment (IDEAL) program. Ken reported “Four out of the ten members of the civil engineering faculty, including myself, have participated in ABET’s week-long IDEAL program.” According to Ken, “It [the IDEAL program] teaches you best practices in assessment and outcome-based assessment.” Ken further relayed, “We have lots of folks who are trained and have been practicing what ABET wants right now, and they have been practicing it for two or three years. So, we’re kind of into it.” Only four respondents reported that either they or a member, or members, of their departments had participated in the IDEAL program. In result, only 19.0% (4/21) of the institutions in the study claimed that one or more faculty members in their department received ABET’s assessment-based program-improvement training. The data presented only makes reference to those institutions that reported that a member or members of their department were participants in ABET’s IDEAL program. The data is not meant to suggest that faculty members of the associated institutions that took part in the study didn’t receive some other form of assessment-based training in a comparable professional enrichment program. The only training program that was mentioned in the study that specifically addressed assessment-based program-improvement practices was ABET’s IDEAL program.

The majority of the seven respondents who received an effort-sustainment quotient of 1 failed to articulate distinct strategies that outlined measures taken by their individual departments to sustain assessment-based program-improvement
activities and progress. Several members of this group suggested that their faculty members were either uncomfortable with the concept of assessment-based program-improvement or possessed views that the assessment of student data was not the best approach to program improvement. Alan, the department chairperson from a large PhD-granting institution located in the greater Pacific-Northwest, stated, “The faculty does not feel that the process is the best approach for the achievement of departmental program-improvement goals. The process doesn’t really tell you anything that you don’t all ready know.” Cody, the department chairperson from an undergraduate institution located in the upper mid-west, provided, “We have anguished over assessment. They’re [the faculty] not really comfortable with the process. We have not done an acceptable job sustaining faculty interest and effort.”

Other participants who received an effort-sustainment quotient of 1 did so in recognition that their sustainment effort appeared to amount to little more than going-through-the-motions. Stan commented, “I don’t know if we formally look at the process much more than in preparation for ABET [an ABET review].” Darla stated:

We meet once a year. We do what is necessary to satisfy ABET. The faculty resent being pushed into doing what they don’t want to do. They resent having to take part in the process. We have some doubt in our minds that the process is a valid approach to improve student learning outcomes.
Rose, the undergraduate director of a private PhD-granting institution located in the Midwest, chimed in similarly. “The process makes a lot of work for faculty members and I think they resent the extra work as they tend to perceive no value in the process.” Rose, who relayed sincere dedication and commitment to making the assessment-based process work for her department, reported that “probably only 25%” of the faculty believed in the utility of the process. Gail, who participated in the week long IDEAL program, shared stronger feelings concerning the matter. “In reality the process takes place at the level of a formality. Our faculty does not believe that assessment produces particularly useful information. We feel that the process is detrimental to our growth.” Darla summarized, “We do assessments to satisfy ABET. We make program changes based on other information.” Oscar commented, “The process only takes place on an ad hoc basis, the process has very little steady-state.”

Even institutions receiving sustainment quotients of 2 and above were prone to faculty assessment-based program-improvement efforts that appeared to be little more than formal adornments. Frank commented, “The faculty is now at the point where they are just going through the motions. They just throw their binders together. I’m not convinced that they are putting the thought into it to make it valuable.”

Several respondents indicated a general discomfort or uneasiness with the process of assessment-based program-improvement and/or its administration. Alan,
whose program was first accredited under the criteria associated with EC2000 in 2003, stated, with some optimism, “If we get deeper into it [the process and its administration], it will become a manageable process.” Similarly, Irv, whose program was first accredited under the criteria associated with EC2000 in 2005, responded, “It should become easier over time to keep the faculty motivated, once we get into stride. We still have adjustments to make in our assessment-based cycles.” Cody provided, “We don’t have much experience working with assessment data to drive program improvement.” Perry, the department chairperson from a masters’ degree-granting institution located in the greater Pacific Northwest commented, “Our faculty weren’t educated in the practice of assessment-based improvement; many of our faculty don’t understand the assessment approach.” It should be noted that Perry is from an institution where two faculty colleagues have taken part in ABET’s IDEAL program.

Receiving training in assessment-based program-improvement practices and their application appears to be a central component of a meaningful strategy designed to sustain departmental focus and effort on program-improvement objectives and their development. Ken offered:

We have made it a departmental priority to learn what ABET expects from us. We are constantly reviewing and refining our objectives. If we are successful in what we do, it is only because we have all hands at work on the process of program improvement.
Ken later shared the views of his department regarding the importance of equitable sharing of the program-improvement responsibilities, “Since our program-improvement practice is an all-hands endeavor, we, as a faculty, share in the triumphs and the frustrations, so no one individual is more burdened with the process than any other.”

Nine of the twenty-one (42.9%) engineering programs received an effort-sustainment quotient of 3 or above, based on the responses provided by the respondents in the study. In essence, this suggests that 43% of the respondents’ programs fared mid-range or above in their efforts to sustain faculty focus and activity on assessment-based program-improvement objectives. A common perspective of members of this group was that – regardless of the value of the process, the cumbersome nature of its implementation, or the complexities associated with documentation – compliance with the process is not negotiable, but rather is a fact of accreditation. Miles, the department chairperson from a PhD-granting institution located in the mid-west, commented:

   It has proven very hard to keep faculty focus concerning our program-improvement objectives. But, the short answer is, the faculty has no choice in the matter other than to follow through with the process as it is an accreditation requirement.

Baxter concurred, “Most of the faculty views the process as a fact of accreditation.” Not surprisingly, every respondent in the study took this stance in one manner or
another. It could not be determined whether or not this viewpoint was more prevalent in research institutions than in those institutions strictly dedicated to instruction.

Ken, the sole respondent whose institution received a sustainment quotient of 5, took the stance:

ABET is a massive machine and they do not have to provide evidence to anyone that their methods are productive or that they amount to the best possible approach to program improvement. They’re too big to have to prove anything to anybody.

Baxter commented, “[Our] faculty members are too busy to think about the value of the approach.”

One of the most prominent obstacles to obtaining faculty unity, regarding the practice and promotion of assessment-based program improvement, is convincing faculty members, some of whom serve as department chairpersons, of the utility and value of the process. Many faculty members equate the adoption of ABET-driven program-improvement practices with the abandonment of time-tested improvement strategies that they had employed throughout their careers. Many respondents also referenced the debasement experienced by many faculty members relative to the regular scrutiny their activities received as a byproduct of the assessment-based program-improvement movement. Frank stated:
There should be some respect that they [the faculty] know how to teach and refine their classes. You know, they have earned the respect, and when someone comes along and asks them to show that their teaching is outcome-based – you know, it is hard to get them excited about that.

Upton added:

The faculty does not like to be subjected to continuous scrutiny. They know that there is no evidence [that assessment-based program-improvement leads to improved student learning outcomes]. We still deal with this issue [dilemma] from time to time as do most programs… It is extra work for the faculty, and most know how extra work is generally received.

Neil, who went right to the heart of the matter, stated, “It took considerable culture change for the faculty to respond agreeably concerning the process and its activities.” Neil relayed that it took his faculty close to six years, a full accreditation cycle, to initiate the buy-in process. Neil stated, “After our second review under EC2000, it started affecting the faculty. Essentially, the culture was changing because they realized this is an important part of what we do.” Neil continued, “So you know, I guess the process was gradual. I can now see the majority of the faculty believe that assessment is an important task.”

Two respondents directly commented on the difficult nature of convincing senior faculty members to engage in assessment-based program-improvement practices. Frank commented:
It is hard to get them [faculty members] excited about that [assessment-based program improvement]. And, then you have senior faculty who don’t really want to do it and there is really no mechanism to get them to want to work with the process.

Upton stated, “It is very difficult to push faculty members when they are tenured, but we try to get faculty members into the process of becoming aware of their progress and course outcomes through various forms of available data. We have a mechanism; we call this a post-tenure review. So there is a means of maintaining a currency among faculty.”

Some program leaders referenced the open-minded nature of their faculty members and their general willingness to want to believe that the process was a reasonable approach to improve the quality of their programs. However, it became clear that faculties who held such views were pragmatic in their optimism. Faculty members, while open-minded to the potential value of the practice of assessment-based program improvement, were often more concerned with the actual value associated with the practice, rather than with its theoretical or speculative value or merit. Oscar stated:

Given that our people are engineers, they understand the potential value of data. But from a practical standpoint, there is a fair amount of skepticism among the faculty concerning the quality of the data we are able to collect.
We don’t have any controls in the process. It’s kind of like assessment-theater.

Frank added, “There are just too many inconsistencies in the process and in individual classroom applications.”

Quinn stated, “The department chair hasn’t bought into the process.” As evidenced elsewhere in this section, this view is hardly isolated. It is difficult to imagine a scenario where an assessment-based program-improvement effort flourished in an environment where program leadership impugns its practice and its principles. Quinn went on to relay, “At best, I would say that faculty buy-in to the process is moderate.” According to Banta, Jones, and Black (2009, pp. 11-12):

Academic leaders – including presidents, provosts, deans, department chairs, and leaders in student affairs – must be public advocates for assessment and provide appropriate leadership as well as support for the faculty and staff closest to the assessment process. Through public and private statements and actions, these leaders can enhance the likelihood that the assessment process will be valued and sustained.

Even when a program-leader expressed strong feelings about the importance of the process, such conviction was found to be insufficient to transfer reverence to a department’s faculty. Quinn commented, “I’m convinced that this stuff [assessment data] matters, but if I tell the other faculty, they’re just my colleagues, and they say that is just Quinn going on again.”
Some respondents alluded to the elusive nature of sustained continuous program-improvement over time. Quinn stated:

Hey, we’ve got an excellent program – we’ve picked the branches clean, and I don’t mean just the low-lying fruit. When you’ve got to the point that our department has – you begin to realize that the probability that a program modification leads to improved student learning outcomes is about equal with the probability that a modification may lead to reduced student learning outcomes.

Ted noted, “We have scored so well on the FE [fundamentals of engineering examination] over the last few years; we have scored so high compared to national averages, we haven’t felt the need to change anything.”

The next section examines the importance of developing a healthy relationship with assessment-based program-improvement practices and some specific factors that have led to faculty discontent with the process and its application.

*Faculty Buy-In*

Many educators in the study appeared to recognize the importance of faculty buy-in. Upton was quick to comment, “We realize that complete faculty buy-in is necessary for the process to be successful. If we don’t have faculty buy-in, then the process isn’t working.” Though most educators in the study were cognizant of
Upton’s conjecture, they too understood the difficult nature of engaging entire faculties to embrace the practice of assessment-based program improvement.

This query was approached along several avenues, most notably via the question: To what extent does your faculty believe that assessment of student data produces useful information that can be applied to improve your program?

To evaluate the degree to which faculty members believed in the assessment-based program-improvement process, a rating system was developed. This rating system is referred to as the belief quotient, and the system’s scale ranges from 1 to 3. A belief quotient of 1 represented the situation where less than 50% of the faculty believed that assessment produced useful data, where a belief quotient of 3 represented the instance where greater than 50% of the respondent’s faculty held the belief that the process produced useful data. A belief quotient of 2 signified the case where the faculty was fairly evenly split concerning usefulness of the data that could be collected. See Appendix D.

Table 3 summarizes the belief quotient data for the institutions that participated in the study.

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<th>Belief Quotient</th>
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When a belief quotient of 1 was warranted, the rating typically translated to a situation where very few faculty members believed in the assessment-based process. Generally, this rating meant that less than a third of a particular faculty possessed favorable views regarding the process and its potential to lead to measurable program improvement. This data indicates that 62% of the schools in our study observed less than 50% faculty buy-in regarding the process of assessment-based program improvement.

On the other hand, it was learned that only 24% of the respondents in the study reported that greater than half of their faculty members bought into the process. It should be recognized that this result does not imply that such programs experienced across-the-board appeal of the process among their faculty members. Strong statements that spoke to a high degree of faculty buy-in were in short supply in the study. However, Ed, a department chairperson from a PhD-granting institution located in the northeast, commented, “Close to four out of five faculty members believe that assessment produces useful information. Those that do not value the process tend to think that it involves too much work.”

A couple of respondents were able to relay a healthy relationship that their faculties had forged with the process and its application. Ken stated:

The vast majority of the data we collect is not useful, but that doesn’t mean you stop collecting data. We never know which data might be useful, so we
collect much more than we know is necessary. Every now and then something really prophetic comes about that we must act on.

Herb relayed, “The faculty believes in the process. This isn’t to say that issues of causality don’t exist – they certainly do.” Herb’s faculty has embraced the process, yet they remain conscious of the challenges associated with determinations of cause and effect.

Those programs that have best learned to coexist with the assessment-based program-improvement process have learned to accept the process for the value it can provide and learned not to condemn the process relative to its limitations.

More common were respondent statements that indicated that they and/or their departments were at odds with assessment-based processes. Perry stated, “Most faculty members do not see value in the practice. It’s hard to convince the faculty of the utility of the process.”

Sometimes a lack of faculty buy-in was apparent in the way faculty members undertook their assessment-based program-improvement responsibilities. Quinn reported:

Our faculty members are responsible for providing course summaries [course notes that record milestones and suggestions for improvement] at the end of each term and some of our faculty members put down almost nothing. [They do this] so that they don’t have to be responsible for almost anything, and that is their way of avoiding the bureaucracy.
In many instances respondents described their departmental improvement efforts as improvisational frontiers where structured and formal program-improvement efforts fall wayside to old school practices lacking rigor, refinement, and/or sophistication. In these institutions faculty members often have little faith in assessment-based program-improvement efforts or the provision offered by the process toward learning outcomes that are commensurate with faculty effort and resource allocations. Alan commented, “We do not believe that the process provides any information that you don’t know. We know the strengths and weaknesses of our students and we know intuitively how to attend to these needs.” Baxter commented, “Our program is small and we employ a good faculty who instinctively know what must be done.” Cody offered council regarding his department’s program-improvement preference of what he referred to as the “direct approach,” “The direct approach to implementing change seems more useful, but it can appear subjective.” It is not uncommon for departments to place emphasis on trusting their instincts where program modification is concerned. Jeff commented, “A number of faculty members feel that the effort is not worth the results. We tend to make changes irrespective of data.” It should be noted that Jeff’s department was one of the three institutions that participated in this study that purportedly experienced a 50:50 split concerning faculty buy-in to the belief that student assessment data provided useful information.
Some respondents expressed no shame in implementing program-improvement practices that lacked rigor or which could be interpreted as appearing impulsive. Ken, the career military educator, confided, “Sometimes we adopt a program modification because a certain activity is fun towards energizing a course. If a modification is fun, then the students will become more engaged and they will learn more.” Oscar commented, “Sometimes you will make a change – just because it is clearly the right thing to do. You don’t wait for some sort of ABET talk like, ‘you need to get feedback from all of your constituencies, blah, blah, blah…’”

Some respondents expressed annoyance at ABET for getting in the way of departmental program improvement. Frank stated, “I mean you come to feel like ABET should have some respect that we are conscientious about being a good program and they should just let us do our job.” Frank continued, “We know what we are looking for and we know what signifies this.” Gail expressed a firmer stance concerning the implementation of program modifications, “We know when a change is necessary, and we can’t, and will not, wait to make changes until a time might come along where we collect sufficient and statistically relevant data to drive change.”

Seventy-six percent of the respondents in the study reported that less than or about equal to 50% of their faculty members were in support of the notion that the assessment of student data produced useful information that could be employed to improve their programs. Using faculty consensus as a benchmark, this equates to
76% of the schools in the study as operating in educational environments that are largely unsupportive of their program’s assessment-based program-improvement efforts. Of course, this does not imply that such a faculty does not support some form of a program-improvement practice, but it may suggest that such a faculty evolution reflects a state of disorganization or preemergence from the achievement of its steady-state.

Sometimes a lack of faculty support of the process is overt. Rose stated, “The large majority of our faculty doesn’t particularly believe in the process as being important or valuable.” And, at other times the lack of faculty support of the process is more subtle, perhaps, only evidenced by hastily prepared, or incomplete, faculty assessment reports and/or documentation, as has been suggested in this work by Frank and Quinn.

It should be noted that no respondent expressing information indicative of belief quotients of 1 or 3 offered any evidence that their faculty was anything close to being evenly divided concerning the perceived value of student data in promoting program improvement. With only three exceptions, the subjects involved in the study were very decisive concerning the views of faculty members regarding the value of student data relative to their individual quests for program improvement. Largely, faculty members were either in general agreement or general disagreement that student data provided valuable information that could be utilized to improve their programs. As we shall see in the next section, the individual belief systems of faculty
members are often founded on practical considerations rather than those that are considered theoretical.

*Why faculty members don’t buy in.*

A preponderance of data suggests general faculty disregard for the ABET-mandated program-improvement model.

Alan stated, “The process consumes huge amounts of time and money, and, in the end, the practice doesn’t really tell you anything you don’t already know.” Baxter, upon reflecting on an apparent change of climate at work in his department, commented:

Generally, the faculty does not feel that the process is valuable, but it depends on whom you ask. Faculty members continue to voice their discontent with the process and its utility, but to a lesser degree than when we first started the process.

Irv commented:

It is really challenging keeping the faculty motivated in this area. I mean, the faculty wants to see evidence that their work is leading to beneficial outcomes, and the evidence can’t just be marginally significant or it can take the appearance that it is merely anecdotal.

Quinn commented, “Convincing professors with data – when there is no evidence in the data – doesn’t encourage the faculty to warm-up to the process.”
Some respondents commented on mankind’s uneasy relationship with change. Quinn stated, “This is hard – people don’t like change. And, so it is tough to get people to invest time and effort.” Stan stated, “Nobody wants to collect data unless it is easy to collect.”

The next section addresses various barriers that have served as impediments to the achievement of full faculty buy-in to the practice of assessment-based program improvement.

*Faculty culture.*

Upton, on some level equating the situation to an issue of academic freedom, stated:

The first thing you have to remember is there is a thing called academic freedom. They [the faculty] say, “I already know what I am doing. Why are you putting extra work on me? It is a burden on me. I have other things to do.”

Ken presented a perceived conflict experienced by some educators:

I do feel that the time component the practice imposes on faculty may deter faculty from pursuing potentially more valuable approaches to program-improvement such as becoming more intimate with their curriculum or reaching out to other experts in the core course area to improve their individual effectiveness.
Neal honed in on a core issue and its relevance, “You know the thing is that it is really related to cultural change. In the beginning, it is very difficult for the faculty to look and understand that this is a very important aspect of what we do.”

Some respondents commented on the personal dismay they felt resulting from the apparent apathy of their colleagues regarding their assessment-based responsibilities. Quinn commented, “Some of our faculty find the ABET process annoying. The faculty takes a passive role in the process and its practice.” This predilection among some faculty members often makes the job of the faculty coordinator more work than it should be. Laura stated, “I spend a lot of time shaking down the faculty to turn in their paperwork.”

On some level, virtually every institution in the study exhibited evidence of personal struggle resulting from their individual departmental adaption’s to outcome-based program improvement. In the next section, it becomes apparent that some of the conflict appears to be worth the fight, as some of the very practices associated with the assessment-based program-improvement movement are brought into question.

*Practical considerations.*

Sometimes educators cannot, in good conscience, wait for data to support a program change that they know to be well-founded. When program change is in order, sometimes practical considerations must override those decisions that might
come about from time-consuming study and analysis. Ken spelled out his personal belief:

When you have a faculty with a lot of experience, sometimes decisions are based to some degree on faith rather than intensive documentation toward the justification of a department’s every potential program-improvement activity. Sometimes decisions are more holistic than what might take place in a laboratory study.

Oscar provided an example concerning the practicalities of obtaining and utilizing data. Oscar cited an example where a student survey revealed that, in a certain course, a large majority of the students independently reported their inability to hear a particular professor’s lectures. In Oscar’s eyes, this was a good example where data could be used to improve the student experience, if not directly lead to increases in student learning outcomes. Oscar next cautioned about jumping to conclusions from data. According to Oscar, high examination scores might suggest the substantial manifestation of student learning, but this wouldn’t be the only possible explanation for such data. And, as such, it would be unwise to initiate a program modification based on this single data point. Oscar commented, “So some discretion must be applied by the instructor to make sense of the various forms of data.”

Stan, who also made an attempt to distinguish between types of data, stated, “There’s always some data, but there isn’t always hard numbers or data sourced from
when somebody actually ran a study and found the data.” In many ways, this response appeared to set the stage for the implementation of program modifications based on intuition, whether personal or collective.

Even among strong supporters of assessment-based program improvement, there existed reservations concerning the process and its perceived utility in promoting program improvement. Some, including the following respondent, acknowledge the difficulties associated with attributing measurable qualities and standards to student populations and the subsequent prescription of generalized program modifications that lead to improvements for entire student populations. Ken provided, “Students are not widgets with specific and known qualities and standards. There is no one-size-fits-all. The stages [involved in assessment-based program improvement] don’t always progress along this [the prescribed] pathway.” It will become clear later in this work that the actual pathway to program-improvement nearly always involves department-specific improvisation rather than strict adherence to the standard assessment-based program-improvement protocols.

In the section that follows, the views of respondents are explored as they address various practicalities associated with assessment-based program-improvement activities.
Data collection, statistical validity, and reliability.

Oscar, with some humor, shed light on the challenges associated with the quality of data that can be collected regarding assessment-based program-improvement efforts.

When we don’t have controls in the process, we don’t have the luxury of saying: let’s take half of the kids and make no change and the other half and make a change; and we’ll use twins separated at birth; and…

Oscar went on to relay his belief that the process, its practices, and its stages lacked most every conceivable resemblance associated with a respectable scientific inquiry. Oscar commented, “ABET does not seem to understand sampling.” Oscar later added, “So at the end of the day, we ask ourselves, are they [the students] learning what we are trying to teach them?”

Frank stated:

It has been difficult to convince the faculty that program change can be implemented in this manner. It is not a controlled environment where you can draw conclusions. You cannot control inputs from teacher to teacher. The data cannot be treated in a rigorous way – there are too many other complications.

Taking the matter to another level, Ken stated, “In manufacturing you can tell if you have a widget if it works or if it doesn’t work, but with students and people in
general – they just aren’t entities that can be assumed to meet particular specifications.” Oscar offered:

If you are in education, you know this. You’ve got principles, but you just have to try stuff. It is not like you’re going to have scientific formulas – if you measure this, if you measure that, to get out of it education results. It is just not like that in our business.

Some brought to light issues associated with the quality of the data that could be collected from student populations and the data’s potential to provide meaningful information that could improve educational programs. Frank counseled:

In the end, our studies of student data do not provide the sort of information that you could publish in a scientific journal. The quality of data is always an issue. There are just too many inconsistencies in the process and in individual classroom applications. It really isn’t a controlled environment where you can draw valid scientific conclusions.

Gail deferred to concern shared by her colleagues regarding the reliability of the data that could be collected by her department from the standpoint of its utility to provide meaningful information. Gail stated, “We have an extremely small sample size. Our sample-size is too small to draw assumptions about any population.”

Even with the large amount of training received by his faculty in advanced assessment-based practices, Ken was quick to point out, “But even the training we received was idealized, but only seldom do practical circumstances conform in any
manner that resembles idealized circumstances. We are very aware of the limitations of the process and its potential outcomes.” Oscar concurred, “You can’t stretch the value of data past its limits.” Perry, whose department sent two faculty members to ABET’s “ridiculously expensive” IDEAL training program, condemned the entire assessment-based practice, stating, “Working through the process and looking at data doesn’t tell us diddly squat.”

Length of the feedback cycle and the assessment cycle.

Baxter stated, “There appears to be a two- or three-year lag in [implementing] these changes [program modifications].” Herb stated, “I believe that the entire process can take from six to ten years to complete, starting from the beginning. The feedback cycle is very long.” Herb supported his claim stating, “One way to measure the success of an engineering school is to survey the employer after the program graduate has worked for a year or two.” Herb continued:

When you talk about a feedback cycle of six to ten years, the faculty who implemented the changes may be gone and retired, or gone to other universities and new faculty come right in the middle – so there is a lack of continuity of this process. A lack of continuity in the thinking process exists when the feedback cycle is long.

Miles added, “A lot of assessments would take years to collect the data. Sometimes we don’t have three years to collect data.” Miles continued, “We want to collect graduate survey data. Of course, there are challenges with collecting data several
years after the student graduates. For example, faculty attrition, changes in program
direction, new ABET focus, et cetera.” Oscar reported similar information, “This
university has always done three- and six-year alumni surveys. We’ve always had
close professional linkages to the companies that hire our students. We keep in touch
with our alums.”

Irv, with apparent bewilderment of the irony regarding Dr. Trudy Banta’s
[Banta, a panel member of the National Institute on Learning Outcomes Assessment
Advisory Board] suggestion that full-deployment of the assessment process could
exceed a six-year time frame, stated, “If that time frame is correct, then the ABET
cycle is completely out-of-whack.”

Quinn stated his belief that the entire assessment process could take more
than fifteen years to fully evaluate. In making his statement, Quinn cited five- and
ten-year alumnus surveys, the law as it relates to course catalogs [“They’re like a
legal contract.”], and lesser concerns. Quinn exhibited great concern as he weighed
the relevance of collected surveys of long-since graduated students with the
curriculum changes implemented without such alumni input, in some sense throwing
his hands up in despair of the complexity of the enormous amount of data to be
separated, sifted, and reorganized, and refined. Quinn, in utter frustration, stated,
“You likely wouldn’t even have the same faculty or educational priorities. I can’t
wait 11, 15, 18 years to determine whether or not to make a change. Instead I have to
look at right now.”
Issues of causality.

Some respondents referenced the difficult nature of associating specific programs outcomes with the factors responsible for their genesis.

Baxter commented:

The process is not clean. The process does not take place in a normal cycle. Collecting data is time consuming and it is difficult to evaluate. When we note increases in student outcomes we find it difficult to say why the increases have occurred.

Herb, who agreed about the difficult nature of determining causality, stated:

It is difficult to correlate data concerning our changes or program modifications. Further complicating matters is the idea of implementing multiple modifications, in such instances it is difficult to say which modification leads to program improvement, or if together one or more of the modifications act in a negative manner that limits the potential good that may have come about from a specific modification.

It should be noted that Herb has served as the chairperson of his department since 2002, the same year that his institution first received accreditation under the criteria associated with EC2000.

The reduction of units factor.

How will departments contend with educational directives exterior to their individual organizations when such movements directly impact the ability a program
has to implement program improvement? Will the movement designed to speed up graduation collide with program-improvement efforts aimed at promoting increases in student learning outcomes? Will the superposition of expedited engineering degrees with changes associated with assessment-based program-improvement cohabitate successfully?

While not a specific focus of the study, five of the twenty-one participants (23.8%) cited concerns they held regarding the effect that unit reduction would impose on their programs.

Neil observed, “Sometimes external forces make changes happen, and not necessarily with the betterment of our program in mind.” Neil stated,

It will get to a point where there will be a conflict between ABET and the drive for unit reduction in our program. This change impacts our educational goals. These changes on the horizon are significant. It may come back where it affects our outcomes and educational goals… Unfortunately, professional schools are small – so we don’t have a strong voice.

In discussing the effects of the graduation unit cap, Oscar explained:

The real driver of it was not dissatisfaction with the current system, it’s just that the current system wasn’t [isn’t] sustainable for several reasons. It is based on data. It is based on dollars. It is based on the number of faculty we have, the number of students we have. It is based on hard data math; we
cannot continue to operate as we do now... We basically need to go to a
smaller number of higher unit courses; that is the easiest way to put it.

Stan commented, “I think that the state realized that students aren’t graduating in
four years and they want to get some economic relief there.” Oscar, with a hint of
optimism, commented, “We would never have done this sort of thing [revamping our
courses], all at once, without the set of [state funding] dynamics.” Stan, who
expressed dismay with the movement advanced in his state to reduce engineering
degree requirements from 132 units to 120 units, stated:

Legislators are making these decisions instead of educators. The other side of
it is, is there is a natural control of the credit hours, because we are still in
competition for students. When we are recruiting students and if your credit
hours are grossly out of line [with competing institutions] you are going to
lose some students on the basis of how long it will take them [students] to get
their degrees.

Stan continued, “It’s the heck with students. We need to deal with the economics of
the matter and graduate students quicker.”

Two respondents took a hard-line stance concerning the movement to reduce
the number of units required for the undergraduate degree. Responding to state
legislation to reduce engineering graduation requirements from 138 units to 120
units, Neil commented, “Obviously in engineering it is not possible to do this. Some
of these units are GE units, but currently some of these are untouchable. Upton, with
defiance, stated, “There is pressure from the chancellor’s office to drop from 132 units. Some believe they want us to go as low as 120 units. The best we can do is 128 units. Period!”

Obstacles to Change: The Process and Its Challenges

The interview instrument’s second set of items requested that the subjects identify the most challenging phase of Dr. Trudy Banta’s three-stage assessment-based program-improvement process. The three phase process outlined by Dr. Banta involved: Stage 1, collecting sufficient data to convince faculty members that change is necessary; Stage 2, crafting and implementing appropriate program modification to enact the desired change; and, Stage 3, collecting data toward the determination of its impact on the selected program modification.

Table 4 summarizes the stages that respondents believed were the most challenging relative to the three stages described by Dr. Banta. See Appendix D.

Table 4: Identification of Most Difficult Stage Data

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<thead>
<tr>
<th>Stage</th>
<th>Number of Respondents</th>
<th>%</th>
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<tbody>
<tr>
<td>1</td>
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<td>61.9</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
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<tr>
<td>Total:</td>
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<td>100.00</td>
</tr>
</tbody>
</table>
Sixty-two percent of the respondents sensed that the most difficult stage of the process was convincing faculty members that change was necessary. This percentage is identical to the percentage of respondents who reported that less than fifty percent of their faculty believed that student data provided data that could be used to improve their programs. While not identical processes, this observation led to an inquiry into the correlation of the two data sets.

The Spearman rho correlation of the data compiled in Table 3 and Table 4 (see Appendix D) was found to be 0.225, indicating that there was not a strong relationship between an institution’s stage classification and its belief quotient. This implies that there is no reason to expect that a faculty believing that the collection of impact data (Stage 3) presents the greatest challenge will necessarily be a faculty with a high-degree of buy-in to the assessment-based program-improvement process. This also implies there is no reason to believe that a Stage 1 faculty, a faculty that holds Stage 1 to present the greatest challenge of the process, will necessarily be a faculty with a low degree of buy-in to the assessment-based process.

It is impossible here to determine if a Stage 1 response reflects a lack of faculty buy-in to the assessment-based process or the difficult nature of obtaining compelling data that is capable of adjusting the mindsets of faculty members.

It is interesting to note that not a single respondent identified Stage 2 of the assessment process as being particularly challenging. That is to say that no respondent thought that Stage 2 rose to a level of challenge that exceeded either of
the other two stages. Apparently, faculty members have no difficulty crafting and implementing a program modification once an agreement is reached that a particular change is in order. Thirty-eight percent of respondents reported that collecting sufficient data to determine the impact of selected program modifications proved to be the most challenging aspect of the three-stage assessment-process. In this study no assumptions are made concerning the quality or quantity of the data collected by a department that may or may not have led to the program modification to be tested by Stage 3.

The majority of the respondents who selected Stage 3 as the most difficult stage offered little in the way of commentary in support of their selection. Ed, who appeared to employ his identification of this stage as a tool to abridge the assessment-based process, stated, “This said [Stage 3 is the most difficult stage of the process], many of the program modifications we make are not accompanied by drawn out analysis of data.” It is interesting to note that Ed reported one of the highest incidences of faculty buy-in of the assessment-based program-improvement process. Ed added, “Some feel that the program modifications we have implemented don’t require detailed data collecting or analysis. Still it is best to justify program modifications with data.” Herb, as reported earlier in this chapter, made reference to the difficulties associated with causality and the length of the feedback cycle relative to the fulfillment of Stage 3 activities. Herb added, “We try to subject every change to data analysis, but you can’t wait six to ten years until the feedback cycle plays
out.” Miles shared Herb’s concern regarding the length of the feedback cycle relative to testing the impact of program modifications. Rose, who was relatively new in her coordination role, stated:

I have only served in this capacity for three years. I haven’t much experience concerning implementing change. Based on the data we have collected, we have implemented some change, but we are just in the process of getting everything modified, and that has taken all of the time.

Assessment-based program modifications versus other pathways to change.

In conjunction with this set of inquiries, respondents were requested to provide information concerning their department’s practice of using assessment data as the driver for program improvement. Respondents were asked to estimate the portion of program modifications that arose from the analysis of student assessment data. The possible sources of such assessment data is addressed in detail below. For the purpose of this section, potential sources of such data were student and alumni surveys, employer surveys, information obtained from industrial partners, course examinations, projects, portfolios, the FE, and departmental examinations.

Participant data was divided into three classifications: Application Quotient 1: assessment data is generally not the driver of program modifications; Application Quotient 2: assessment data is the driver in around half of program modifications; Application Quotient 3: assessment data generally is the driver of program modifications. See Appendix D.
It is important to note that respondents were, for the most part, very decisive concerning this item. When a respondent identified that a minority of the program changes implemented by their department were the result of assessment data, the general statement was “very few…” or “a low percent…” or something there akin. Alternatively, when a respondent identified that a majority of the program changes implemented by their department were the result of assessment data, the general statement was that “all” or “almost all” of the program changes implemented by their department were the result of assessment data. The only respondent position concerning this item that was astraddle was the application quotient 2 response, a response that most frequently announced, “about half…” or “about equal.” Even for the application quotient 2 response, respondents presented no appearance of ambivalence in addressing the inquiry.

Table 5 summarizes the responses of subjects concerning the employment of assessment data as a drive for program change.

Table 5: Changes Attributed to Assessment Data

<table>
<thead>
<tr>
<th>Application Quotient</th>
<th>Number of Respondents</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>47.6</td>
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<td>2</td>
<td>6</td>
<td>76.2</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>
Seventy-six percent of the institutions associated with the study reportedly implement less than or about equal to 50% of their program changes in response to assessment data. This percent is identical to the percentage of respondents who reported that less than or about equal to 50% of their faculty members believed that the assessment of data provided useful information that could improve their programs (see Table 3 and Appendix D). What this suggests is that 76% of institutions involved in the study observe that 50% or less of their faculty believe that the assessment of student data provides information that can be used to improve their programs and that 76% of the institutions involved in the study are reported to use the assessment of student data to drive program change in 50% or less of their program modification applications. This observation led to an inquiry into the correlation of the two data sets.

The Spearman rho correlation of the data compiled in Table 3 and Table 5 (see Appendix D) was found to be 0.347, indicating that there was not a strong relationship between an institution’s application quotient and its belief quotient. This implies that there is no reason to believe that an institution that experiences a high-degree of faculty buy-in (belief quotient 3) to the assessment-based program-improvement process will necessarily experience a high-degree of incidence of assessment (assessment quotient 3) being utilized to direct program change. Alternatively, this implies there is no reason to believe that institutions that experience low faculty buy-in (belief quotient 1) to the process will necessarily
exemplify low incidences of the use of assessment (assessment quotient 1) to direct program change.

Perhaps more revealing is that only 24% of respondents reported that greater than half of the program modifications implemented by their departments occurred as a result of assessment-based program-improvement practices.

The most frequent talking-point for not employing the assessment of student data in the process of implementing program change was that data didn’t inform educators of anything that was not already known to them. Some respondents expressed concern that the process was unduly cumbersome, and that – surely a better process was out there.

Alan stated, “All of the program changes we have made have been the product of assessment data. But really, the process doesn’t really tell you anything you don’t already know.” Curiously, Alan was unable to cite a program modification that resulted from the assessment of student data. Alan did, however, state that 93% of the students in his program pass the FE and that, as such, “There isn’t much more to improve upon.” Baxter claimed that most of the changes implemented by his department were due to assessment data, but qualified his response when he stated, “But most of the changes likely would have occurred without the process.” Short of changes involving student remediation, Baxter did not provide an example that involved a program change that was motivated by assessment data.
Laura, an application quotient 2 respondent, commented, “We do make some changes that are not based on assessment data. But those changes we try to support with data toward assurance that our actions were warranted and that, in fact, led to the desired outcome.” Laura reflected, “In past years our program changes or modifications have not been based on data; however, starting with several months preceding our last review in 2011, there has been a departmental movement to use data to drive program change.” As an assessment-based change, Laura cited a course modification where her department introduced computer programming content into an existing mathematical methods course that resulted from the discovery that students were deficient in their programming skills.

Miles divided program changes into those he termed “large” and those he termed “small.” According to Miles, small changes might come about through mere discussion with his program’s “industrial advisory board.” Miles stated, “We use the industrial advisory board as a sounding board before we move forward – they know what kind of graduates would be most welcome.” For larger changes, Miles stated that his department favored pilot programs or hybrid-courses prior to across-the-board deployment. Miles cited a program change where his department added increased computer programming content into the curriculum. Apparently, this program modification constituted a small program change, as the respondent made no reference to the formation of a new course. Neil, who indicated a preference for using data to drive program change, cited the addition of a professional practices
component in his program’s curriculum. This program modification came about directly from the EC2000 mandate, so it is unclear the role that assessment-based program-improvement practices played in his department’s program modification.

Upton discussed, in detail, a program change implemented by his department that called upon most every available resource. Upton stated:

We use our seven data sources. [Those being] the embedded course assessment, the fundamentals of engineering exam, our graduating senior exit survey, our alumni survey, our employer survey, our professional advisory board, and our accreditation feedback. This is how we came up with our capstone course.

The capstone course that Upton referred to involved working on a “real-life” engineering project where students worked in interdisciplinary teams toward developing team skills and partaking in opportunities where students learn from one another. Upton, an educator with decades of experience, stated, “We worked on this doggone thing for two years.” While the role that assessment played in the organization and refinement of this new course was not clear, it was clear that its origin was a direct offspring of a specific ABET mandate.

Frank, an application quotient 1 respondent who was unable to cite an example of a program modification that was “solely due to student assessment data considerations,” commented, “I don’t think that our data collection has really ever informed us about something we didn’t already know.” Jeff commented, “The
changes we have made have been irrespective of data. Our changes have not largely been driven by data considerations.”

Jeff contributed:

We did make one change in review of FE data. The change was inspired by low FE scores concerning probability and statistics. We addressed the issue by changing the textbook and the course instructor, and this seemed to improve matters.

Jeff went on to point out that he would have reviewed and acted upon the results of the FE – whether or not EC2000 had ever come about. Oscar stated:

I would say that very few changes have been driven primarily by what I might characterize as surprising data, where we had no idea what was going on until the data told us. A lot of our program modifications are based on standard everyday empirical evidence or observation.

Oscar later commented:

We don’t need to put on a dog and pony show to really learn about the strengths, weaknesses, and needs of our students. We, as educators, are surrounded by ample and informative data – it isn’t necessary or desirable to concoct contrived instruments to learn things we are capable of assessing through ordinary means.

Oscar later added, “The vast majority of the changes we implement are the variety of change that is patently obvious, not requiring data to justify.”
Perry, an application quotient 1 respondent, stated, “Most of our changes are intuitively known and don’t require the assessment of student data. One of our greatest resources is – the advice of our advisory board.” Stan commented similarly, “Most of the changes made by our department are based on intuition, with some data. We also base our changes on suggestions from our industrial partners.” Stan went on to comment, “Off the top of my head, I can’t think of a program change that was driven by data.” Stan continued:

I think that most of the changes we make are being driven either by accreditation or institutional requirements and we are in the process of getting into the state requirements [state mandated program unit reductions], which is insane to me, but it is my feeling.

Darla, with direct simplicity, stated, “Zero percent of the program changes we have implemented are the result of assessment data!”

Ed, an application quotient 2 respondent, shared, as his example of a data-driven change, the adoption of a graphics software program. Ed stated, “Basically, the students told us that the program was either not interesting or that it was insufficient toward the completion of their assignments or coursework.” Apparently, there is rather fine line between what differentiates a data-driven decision from a common-sense impulse. In truth, there appears to be an entire class of engineering programs that can claim membership to this minimalist-wing of the assessment-based program-improvement movement. To be fair, Ed did point out that many of
the changes implemented by his department that he deemed “assessment-based” could have come about through other channels of observation.

Early in the interview process of this study it was realized that if data was to be collected regarding specific examples of program modifications from each respondent, it would be necessary, at times, to settle for examples that were removed from assessment-based processes. As an example of a change that did not involve assessment, Herb provided:

We incorporated a component associated with construction and construction trades into our program. This change occurred at the request of our students. This change actually supported content found in other courses, but the change was more important than that as it empowered our students to feel that they could control their academic destiny – this surely increased their confidence and interest in their coursework as a whole.

Irv, who stated that only around 25% of the changes implemented in his department resulted from assessment processes, stated, “We moved two laboratory courses so that they were taught concurrently with the core courses they went with.” Irv went on to relay that the course rescheduling resulted from student feedback, but he quickly added, “We probably could have made the change though, in the absence of feedback from the students.”

Examples such as provided by Irv, serve as a clear reminder that important program modifications needn’t necessarily be subjected to rigorous data collection
prior to their implementation. This seems to be the sort of example that constitutes what Perry referred to as an “intuitively known” change.

Rose commented, “I would say that 90% of our changes have been made without the assessment of student data; however, I would add that of that 90%, 50% of those are tested with data after the fact.” Rose cited a program modification where she placed increased emphasis on building laboratory report writing skills. According to Rose, her efforts worked to “circumvent receiving a series of poor reports the remainder of the semester.” Rose, offering clarification, stated, “But really, this was more of what should be considered empirical rather than a detailed study where data was rigorously collected and analyzed.”

Alan, who placed greater emphasis on assessment data as a tool to gauge the impact of a program modification rather than in its potential value to dictate change, provided:

So the changes that we have made didn’t so much require data toward a conclusion to implement a modification toward meeting a goal, but more that the assessment of our outcomes justified our determination. I’m not so sure this has anything to do with ABET though. I mean, such a process involves very general principles that everybody is familiar with.

Ken, whose assessment-based practice was modeled after the program in place at the West Point Military Academy, brought the true meaning of program-improvement back into focus, “We recognize that whether improvements come
directly or indirectly from application of the ABET EC2000 criteria isn’t of great consequence. What is important is that change comes.”

Eight out of the twenty-one respondents (38.1%) cited what they believed to be examples of program modifications that were the result of assessment-based program-improvement practices.

*Stage classifications and application quotients.*

It was noted earlier that identical percentages (62%) were observed for the number of respondents who provided Stage 1 responses and those respondents who provided belief quotient 1 responses. It was also noted that the incidence of those respondents reporting application quotient responses of 1 or 2 coincided with the incidence of those respondents reporting belief quotients of 1 or 2 (76%).

This section examines the relationship between the assessment stage classification associated with institutions and corresponding application quotients (see Table 4, Table 5, and Appendix D).

The Spearman rho correlation of these two data sets was 0.595, with a \( p \)-value of 0.004. In past practices providing the \( p \)-values associated with Spearman correlation values was avoided due to concerns regarding the unreliable nature of this value associated with the software package employed in this study. Here the \( p \)-value has been provided in virtue of the observation of its similar value to what was provided via a Pearson correlation on the same data sets. The Pearson correlation of the data sets was 0.593, with a \( p \)-value of 0.005. Were the respondent-sample
associated with this study of ample size, it would be reasonable, with some confidence, to report that a moderately strong relationship existed between the stage classification associated with an institution and its application quotient. This would imply that a program that utilized assessment to a high-degree (application quotient 3) to direct program change would, with some likelihood, report stage 3 as being the most challenging of Dr. Banta’s three-step assessment process to overcome. Alternatively, this would imply that a program that utilized assessment to a low-degree (application quotient 1) to direct program change would, with some likelihood, report stage 1 of the assessment process as presenting the greatest challenge or the process.

Program transformation: a perfect storm.

For years, the standard offering to entering freshmen at the military academy, where Ken serves as department chairperson, was a course simply titled: Introduction to Engineering. The course was a real bomb.

From years of student feedback, the faculty knew that the students hated the course. And, from years of faculty dialog, it was clear that the entire faculty hated to teach the course. For years, the faculty tried to improve the course through various means, and the more faculty members tried to improve the course, the worse it became.

Since 95% of the engineers serving in Ken’s branch of the military are the product of the academy and since it requires 50% of the academy’s graduate output
to fill the roles, it was critical that the first engineering course taken by cadets didn’t become a promotional tool for majors other than engineering.

According to Ken, the course was ridiculous; it was too weak for students with strong engineering aptitudes. Ken stated:

It was almost impossible to fail the course, and almost impossible to get an “A.” There were 69 objectives to the course, some as lofty as every forth student will be able to prepare a technical laboratory report. I mean we are lucky if our students can prepare a technical laboratory report when they graduate. It was silly. So the department chairperson at the time said, “We need to fix this – I don’t care if we teach statics – we need to fix this!”

So, this is just what was done.

They took a good look at the existing statics course, retooled it, and bumped the course down to the freshmen year, for service during the 2000/2001 academic year. And, now, more than ten years later, Ken commented excitedly, “They learn engineering design principals and they learn statics – a real engineering course that every student goes through.” Ken continued, “Basically, the faculty loves teaching the course and the students love taking the course. In fact, it has been a recruiting tool for us to get engineering majors at the academy.”

But, there is more. Ken, and his faculty, went on to analyze student learning outcomes after the implementation of the change. Ken, his excitement still unmitigated, commented, “Of the freshmen who ultimately selected engineering as a
major – they did better on those questions [selected examination questions] than the sophomores did.” It should be understood that the sophomore students received exposure to some of the content in the new course that they received as freshmen in the course that was eliminated.

What Ken, and his faculty, learned from their experience, and this was pre-EC2000, is that if a program structure that is in place seems problematic, it may be necessary to completely restructure the existing process.

Favored Sources of Assessment Data

The third section of the interview asked respondents to identify the metrics they believed provided the most useful information relative to their departmental program-improvement efforts. The selections included student portfolios (P), projects (PJ), student surveys (S), departmental examinations (DE), the FE (the Fundamentals of Engineering examination) (FE), other (O), or none apparent (NA).

Respondents were permitted to identify as many as three instruments that they felt provided useful information that could be used to improve their programs. Three respondents in the study provided a single preference; eight respondents provided two preferences; and, ten respondents provided three preferences (See Appendix D).

Table 6 summarizes the preferred assessment instruments responses of the participants in the study.
Table 6: Preferred Sources of Assessment Data

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<tbody>
<tr>
<td>Fundamentals Exam (FE)</td>
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<tr>
<td>Surveys (S)</td>
<td>15</td>
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<tr>
<td>Departmental Exams (DE)</td>
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</tr>
<tr>
<td>Other (O)</td>
<td>5</td>
</tr>
<tr>
<td>Projects (PJ)</td>
<td>5</td>
</tr>
<tr>
<td>Portfolios (P)</td>
<td>1</td>
</tr>
<tr>
<td>None Apparent (NA)</td>
<td>1</td>
</tr>
</tbody>
</table>

The responses that composed the other (O) classification were of themselves of three classes. In three instances, the “O” response resulted from the belief that student grades provided useful data; one respondent suggested that his department’s “course outcomes assessment” [a document prepared by the course instructor, for departmental submission, that reviews course highlights and other notable course attributes] provided useful data, and another respondent referenced “student theses” [a project classification] as providing useful data. Oscar commented:

So at the end of the day, what you really care about is GPA. That is a measure that you can’t fudge. We as faculty assess in a very holistic way. We ask ourselves, “are they learning what we are trying to teach them?”
Cody, the sole respondent who submitted the no instrument preference (NA) response, expressed that neither he nor his colleagues felt comfortable, or skilled, with the practice of assessment-based program improvement. As a result, Cody stated that he felt unqualified to identify a preferential assessment instrument.

In addition to the six respondents who identified departmental examinations (DE) as providing useful information, several mentioned that their departments were giving “serious thought” to developing such instruments toward their use as a standardized means of measuring trends in student learning outcomes over time.

Only one respondent stated a belief that portfolios (P) provided useful information. During the interview process, when I mentioned that some engineering programs employed portfolios to catalog student work, two respondents asked me to explain what a portfolio was. After explaining the concept, both respondents relayed distinct disinterest in adopting the process within their departments. Ken, who found portfolios unhelpful, stated, “Portfolios have been taken completely off of the table.”

Surveys were reported at a comparable level to that of the FE relative to their ability to provide useful information that could be utilized to improve specific program attributes. Twelve of the respondents who placed value in the FE, also made reference to surveys as providing useful data. Four respondents who selected the FE did not state a preference for surveys; and three respondents who selected surveys did not state a preference for the FE.
It is interesting to take note of the apparent marriage of the FE, a very objective instrument, with that of the student survey, arguably, an instrument capable of producing data of a highly subjective nature. Quinn, who identified surveys as providing useful information, stated, “Student surveys aren’t data; that is just the students reporting that they are pleased.” Upton, who placed a greater value on student survey’s, stated, “The students tend to be very blunt, very honest. Those student surveys that come back spell it very nicely.” In making this statement, Upton referenced valuable student input relative to an upgrade that took place in one of his department’s laboratories. Highlighting the value of surveys, Oscar commented, “As a faculty, we believe that students keep us informed regarding our successes and failures.”

Little specific reasoning was supplied by respondents for their belief that the FE provided useful data. Upton, who provided an exception to this rule, commented:

The Fundamentals of Engineering exam gives us a lot of useful data. The breakdown provided to us concerning our student’s strengths and weaknesses provides us with knowledge of where we are successful and where we need to make improvements.

Upton went on to state, “…And, when we see a particular number slip, we know that we need to make changes in the course or changes in the faculty.”

Fifteen respondents reported the student FE participation rates associated with their institutions. Table 7 compiles the mean, median, mode, and standard
deviation associated with those schools that contributed to this data. The reported participation rates contributing to this data table represent the best estimates that respondents could provide.

Table 7: Student FE Participation Rate Data

<table>
<thead>
<tr>
<th>Rate (%)</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Standard Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>76.3</td>
<td>85.0</td>
<td>100.0</td>
<td>25.7</td>
<td></td>
</tr>
</tbody>
</table>

Only three institutions were reported to mandate participation in the FE as a graduation requirement; and, of those institutions, only one was reported to have a procedure in place to enforce the regulation. One respondent, not associated with the aforementioned three institutions, commented that, when funds were less restrictive, his department paid the FE registration fee as an incentive for students to take the examination. In most instances, faculty members had little difficulty in convincing students to participate in the examination. The only respondent who specifically de-emphasized of the examination’s importance was Ken. Ken commented, “We don’t use the FE because 100% of our graduates are NOT going to be engineers upon graduation, but rather they are going to be serving as officers.

It should be noted that those institutions that mandated the FE as a graduation requirement, made no requirement that participating students receive passing scores. It is not known how this relaxed stance affected FE scores or the manner by which respective schools interpreted the resulting FE score reports.
ABET Through the Eyes of Program Coordinators

While not a direct focus of the study, on many occasions throughout the interview process, respondents brought forth concerns that were undeniably conjoined with the ease, or difficulty, of their day-to-day struggles to improve their individual programs and to remain compliant with ABET directives.

One of the most frequent concerns expressed by respondents was the apparent arbitrary nature associated with the accreditation review process. Fourteen of the twenty-one respondents (66.7%) made statements that were critical of either the clarity or consistency of ABET’s administration of the accreditation review process and/or of its associated directives to engineering programs.

Frank and Quinn stated that satisfying ABET “is like trying to hit a moving target.” Frank’s statement was based on his comment, “ABET has lost a lot of respect and trust of the faculty due to the confusing and inconsistent manner associated with the accreditation process.” Quinn’s primary concern involved confusion surrounding ABET’s mandate that engineering schools add an additional science course within their degree requirements. Quinn added, “I’d have to say that ABET has a tendency to develop rules that depend upon who in the organization you ask.” Perry expressed a similar level of distress concerning inconsistencies in ABET requirements. Perry stated:

There seems to be confusion between evaluators as to actual program requirements. Once, we were directed to launch a course in probability and
statistics, where during the next review we were informed that it wasn’t required to provide such a course. This exploit proved to be an embarrassment for our program, and it led to some confusion in our students. The students couldn’t help but feel that we were somehow complicit in the snafu.

Frank commented, “Sometimes we are left to wonder if, even, ABET fully understands the process by which programs are evaluated relative to their accreditation standards and expectations.” In addition, Frank referenced ABET’s subjective nature of rating programs on the softer a-k objectives such as those concerning life-long learning and working on interdisciplinary teams. In fact, coming into compliance with some of these softer objectives was a major theme among some respondents.

Gail, commenting on ABET’s lack of clarity in its mandates and expectations of programs, stated, “Many of our observations and/or changes are dismissed as ad hoc or anecdotal.” Irv stated, “[ABET] is not consistent from one evaluator to another.” Ken, who shared Irv’s observation concerning ABET’s lack of consistency in the program review process, stated, “ABET is at the mercy of the reviewers available to evaluate programs. Not all visitors [accreditation review team members] are highly-qualified, top-notch, reviewers.” Neal, also commenting on the lack of the consistency among program evaluators, commented, “But, I’d have to say, that we as
a program still do not know what to expect during our accreditation visits. There is certainly a lack of consistency in ABET’s process of program evaluation.”

Along another strand of discontent with ABET, Oscar commented:

Part of the problem with the ABET [review] process is that review teams seem to get caught up in their own cleverness to a point where they fail to realize the ridiculous nature of the full-cloth BS they submit us to. They had us do a self-study activity where they had us take part in a drawn-out what-would-you-do-if game. ABET has become an unrestrained, amorphous, multi-headed animal. The process is highly informal, and the overriding theme of ABET accreditation is that programs only improve through the process of continuous accountability. ABET appears to make no effort to make their expectations clear… It is almost as if you can fail because you don’t speak fluent ABET-ese or ABET-speak.

Quinn also commented on the cumbersome nature of the language of ABET, stating, “A lot of the time, we get caught up in the silly vernacular associated with the process and its practice.” Quinn later commented, “A lot of times it seems as though you make a change, and by the time it plays out, the point is either moot or that ABET has changed direction or focus.”

Stan commented, “The [evaluation] process is subjective and, of course, reviewers cannot be experts in all subjects… ABET does not seem even-keeled, it does not make its expectations clear.” Upton extended:
I believe that ABET thinks that they are clear about what is expected from our program, and that they do a pretty good job. But, no, I wouldn’t say that ABET is clear in its expectations. I think that ABET has lost its way, and it has lost its way with recent United States funding sources. They have expectations that are not properly supported by funding sources.

Several respondents expressed dismay of being required to prove their worth to ABET. Oscar Stated, “It seems that ABET takes the guilty-until-proven-innocent approach to accreditation and program improvement.”

Four respondents expressed concern that ABET seems to have an unshakable compulsion to repair an educational system that isn’t and wasn’t broken. Stan commented, “If it isn’t broken – don’t try to fix it!”

Costs versus Benefits: Finding a Proper Balance

The fifth item of the interview instrument requested that respondents provide information concerning the perceived costs and/or benefits associated with their department’s assessment-based program-improvement practice. In the spirit of previous data analyzed within this work, the cost versus benefit responses provided by subjects were categorized via the use of a three tiered ranking system. The three possible cost/benefit profiles were provided with the following nomenclature and description.

Value Profile 1 describes the cost/benefit scheme where the costs associated with the process [the assessment-based program-improvement process] outweigh the
benefits associated with the process. Value Profile 2 describes the cost/benefit scheme where the costs associated with the process are essentially commensurate with the benefits associated with the process. Value Profile 3 describes the cost/benefit scheme where the benefits associated with the process [the assessment-based program-improvement process] outweigh the cost associated with the process.

The majority of respondents provided statements that allowed for direct placement into one of the three value profile categories described above. In the remainder of instances, information provided by respondents was distilled to the degree where each response-set was in best-fit alignment with one of the three value profile characterizations.

Table 8 compiles the value profile data that was collected in the study.

Table 8: Value Profile Data

<table>
<thead>
<tr>
<th>Value Profile</th>
<th>Number of Respondents</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>57.1</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>90.5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

Twelve out of the twenty-one respondents (57%) believed their programs incurred greater costs associated with their individual assessment-based program-improvement efforts than the practice was able to produce in benefits.
More revealing is the observation that only 2 out of 21 respondents (9.5%) reported that their individual programs experienced greater benefits than the costs incurred in result of their assessment-based practices.

Perhaps, what is most interesting about this information comes about through examining the cumulative sum regarding value profile 2 and value profile 3. When combined, these profiles reveal that 43% of respondents believed that the benefits associated with the ABET process are greater than or equal to the costs.

Perceived costs.

Respondents in the study made note of a variety of perceived costs associated with the assessment-based program-improvement process. Some of the more likely costs that would be identified by respondents were recognized from the outset of the study. These more apparent costs associated with the process were suspected, and verified, to be those associated with funding support positions to administrate the process; the consumption of faculty time; faculty training expenses, and, if off-site, departure from other departmental duties; material resources and supplies; and time commitment and associated expenses exterior to the general day-to-day operation of institutions, such as might occur in the attendance to a faculty retreat. The more obscure costs identified in the study were most often by-products of the stresses associated with administration and support of assessment-based program-improvement activities. These costs were particularly evident when such
responsibilities were perceived by respondents as not being subjected to equitable
distribution.

Time.

The general consensus is that the process consumes huge amounts of faculty
time. This issue is absolutely without debate. Whether the process consumes 5% of a
faculty member’s time on an annual basis or 60% of a faculty member’s time during
a three-month period leading up to an accreditation review team visit, the time
commitment was reported as onerous. Rose commented, “During a self-study year, it
takes 50-60% of my time in the three months prior to a review.” Cody stated, “About
10% of my time is spent on accreditation activities, and 15% of another faculty
member’s time is similarly spent.” Frank stated, “There is enough work to have the
core group [six faculty members] meet twice a week, but we meet when we can, not
wishing to compromise the quality of our individual courses.” Irv commented, “I
think that about 10% of my time is associated with ABET accreditation.” Frank
added, “I believe that the process promotes inefficiency. It is a source of
inefficiency.”

It was pointed out by Ken that the time commitment required by the process
has the potential to impart a chilling effect that may deter faculty members from
pursuing other, potentially more fruitful, avenues of program improvement. Ken
commented, “Instead of spending three hours here, and, three hours there, attending
to course review reports, [they say] ‘If I could just spend the time and really get
down into the weeds of this course and finally have the time to really go through the text books and compare sections…’” Ken continued, “I mean faculty members only have so much time, so much energy that they can contribute to their professional duties.”

Perry commented, “It [the process] takes a ridiculous amount of time to prepare and process the report, a report that can be more than 200 pages.” No other respondent made reference to the page-count of the self-assessment document. Quinn commented, “In terms of time, the cost is huge. My contribution to the work of accreditation is large and uncompensated.” Gail commented, “The process consumes far too much faculty time with too little return.”

Benefits.

The most recognized benefit associated with the ABET program-improvement process is the periodic reviews that it forces on engineering programs. Fifteen out of the twenty-one respondents specifically made this claim. Jeff commented, “The benefit of the process is that it forces us to regularly take a look at our program.” Alan stated, “If there is a benefit to the ABET mandate – it is the forced examination of individual programs that results from the process.” Frank, who has at times been critical of the process, provided, “We have a really good program and I think this [the ABET program-improvement process] makes it better. We need to find a way to simplify the process. That is my message.” Irv commented, “The chief benefit of the process is that it provides an opportunity for self-reflection.”
Upton, Ken, and Laura expressed similar viewpoints. Rose stated, “Mainly, the value is in constantly looking at the same sort of thing from year to year, to look at how things are working or how things are changing.”

One respondent referenced improvement in student FE scores, but was hesitant to associate the increases with the ABET process. Baxter stated, “The good is that our FE scores have gone up. But part of our strategy of improving student outcomes involved tightening up on our prerequisite requirements, so it is difficult to say why the increases occurred.” Baxter also provided, “The good part of the process is that we are provided with the opportunity to get together as a group to evaluate our program.” Earlier in the chapter, Ed commented that his program benefited from “a certain synergy” associated with the process. Ed added, “It [the process] provides us with a vision of the bigger picture [concerning our program].” Miles offered, “The process has positive benefits. And, we know that our students can only move on, whether through being hired or becoming graduate students, if our program is accredited.”

Some respondents found it challenging to identify benefits that resulted from the ABET program-improvement process. Gail stated, “One benefit is that the process has pulled the faculty together toward the recognition of a mutual enemy.” Oscar stated, “The process is absolutely worthless.” Perry reported, “ABET has its place in that it holds faculties feet to the proverbial fire.” The closest that Stan came to citing a benefit was his comment, “Some might say that the present approach [the
assessment-based program-improvement model] is a necessary evil, but I would prefer that they [ABET] went back to counting credits."

While short on the specific nature of the benefits realized by his department, Herb stated, “The process is really very little burden. It makes us shine.” Neal offered, “ABET has provided an opportunity for us as educators to be candid with our students about accreditation issues. Accreditation has also allowed us to take firmer stands concerning course prerequisites.” Quinn commented, “The benefits associated with the process are moderate at best.”

The next chapter provides an analysis of the results presented in this chapter.
CHAPTER FIVE

DISCUSSION

Introduction

This study was administered under the premise that the sample-size of participants was below the threshold considered to be necessary and sufficient to draw conclusions about the population of ABET-accredited civil engineering schools from which the sample was drawn. What follows here will be limited in focus to a discussion and analysis of the results of the undertaking exclusive to the respondents and their corresponding home-institutions.

A primary focus of this research effort was to determine the extent to which civil engineering programs observed trends in student learning outcomes in relationship to increased application of assessment-based program-improvement practice. If the recognized trend was one of regular increases in student learning outcomes with increased application time of the ABET process, this would have been reported as a direct-relationship between student learning outcomes and application period. If the recognized trend was one of regular decreases in student learning outcomes with increased application time of ABET process, this would have been reported as an inverse-relationship between student learning outcomes and application period. What the study uncovered was that programs were not organized towards recognizing and measuring trends in student learning outcomes in relationship to the time they have been under the program-improvement mandate.
associated with EC2000. Not a single respondent made any reference to the observation of trends in student learning outcomes in result of their implementation of the ABET program-improvement model.

Approximately a quarter of the respondents in the study questioned whether the process could lead to continuous improvement in student learning outcomes; and those who entertained the idea expressed concerns such as, “how much change?” and/or “how long can program-improvement be sustained?”

This chapter provides an analysis of the results that were presented in the last chapter. It examines the faculty- and program-dynamics that can lead to educational success in civil engineering programs, and in some instances the study examines those dynamics that appear to undermine programs from realizing optimum results from their assessment-based program-improvement efforts.

*Faculty*

The study found that 62% of the institutions taking part in the study experienced faculty climates that were less than receptive to the ABET model as a means of leading to improvements within their programs. This group of educators stated without ambiguity that their faculty colleagues did not believe that student data had provided useful information that could be utilized to improve their programs.

The exact nature of this faculty dissent is complex. In many instances respondents relayed that they felt that their institutions were in very little need of
improvement. Many examples that illustrate this respondent prospective were
presented in the previous chapter. The results of the study also supported the notion
that the quality and robustness of student data was below the value-threshold
necessary to counter faculty resistance to assessment-based processes. Perhaps the
root cause of this lack of appreciation of the process is of a more personal nature. As
several respondents pointed out, faculty members deserve a certain amount of
respect, and they don’t like to feel that the quality of their work is under perpetual
scrutiny.

The data cannot address whether a time may come when entire faculties will
come to embrace the process. The only program that experienced anything close to
universal buy-in to the value of assessment-based practices was still a member of the
class of programs that recognized severe weaknesses in the ABET program-
 improvement model. Several respondents recognized that time and sustainment of
the practice seemed to ease faculty disregard for assessment-based practices.

Programs in the study have been operating under the program improvement
criteria associated with EC2000 for either: eleven years; 2001-2002; nine years,
2003-2004; or, seven years, 2005-2006. There appears to be no correlation, at least
within the small time variations associated with the study’s accreditation-year
classifications, between the number of years a program has been operating under
EC2000 and the degree to which faculties believe that assessment-processes provide
useful information that can be used to improve programs. The maximum difference
in application period that existed between any two programs was four years, a time frame that is markedly less than a full ABET accreditation cycle.

Perhaps, what is most important when undertaking assessment-based program-improvement responsibility is a general faculty agreement to work together toward the achievement of agreed upon departmental goals. Ebersole (2009) maintains that at the heart of a successful assessment practice must be the ability of group members to align and to work together toward a common goal, a sense that the undertaken objectives are important and achievable, and a collective conviction that the pathway taken will lead to the desired outcome.

Never in the course of the research did any respondent indicate a general unwillingness of faculty members to work, at least to some degree, with the process. The vast majority of subjects in the study suggested that most of their colleagues accepted assessment-based processes as a fact of accreditation and looked at participation in the process as a primary duty. Where faculty members fell short was their ability to develop binding relationships with the process. In general, respondents reported that they had not seen evidence that the process was particularly productive.

A moderately strong relationship between the stage classification associated with an institution (Banta’s three-stage assessment process) and its application quotient was observed. This would seem to explain why so few programs report high incidences of the use of assessment data to drive program change. This is to say, if a
particular faculty cannot be convinced of a need for program change from assessment data (belief quotient 1), which is the proxy that was used for low faculty buy-in to the assessment-based process, then it seems reasonable to expect that the program would employ assessment data to a very low degree (application quotient 1) in its program-improvement practice.

The transition of program accreditation from an input-based process to an outcome-based process has been very unsettling for the faculties of many programs. Several respondents made reference to their faculties as having undergone cultural changes in result of the implementation of assessment-based program-improvement practices. The idea of educational programs experiencing improvement via refinements in traditional program inputs has been largely pushed aside for improvements based upon program modifications driven by the analysis of student assessment data. This stark, and seemingly sudden, alteration in the modern-day educational fabric has made for a very difficult transition for many of today’s educators. The difficult nature of this transition is compounded when faculty members sense that they are being coerced into adopting particular practices with unknown records of performance. It is only natural that faculty members would resist such change. The demands made by ABET on institutions has ruffled the feathers of many in the engineering-education community and has prompted some educators to call foul relative to assaults on the professional freedoms and liberties that educators have long enjoyed. In short, educators want to see evidence that their assessment-
based program-improvement efforts lead to enhanced student learning outcomes, as promised. It may have looked good on paper, but now educators want to see data; they want to see evidence that proves that the process is a viable means of achieving program improvement in real-life classroom settings.

In the educational setting, for the most favorable realization of departmental goals, it is a necessary condition that faculty unity exists regarding the selection of objectives and their means of achievement; however, this condition is not sufficient to guarantee optimal benefits from the assessment-based process. It is of critical importance that the responsibilities associated with the effort be distributed in such a manner that doesn’t leave any member of the faculty community feeling overwhelmed or overburdened. If possible, the work should be distributed as equitably as possible, that is, if the work is to become meaningful for the collective faculty community. Haessig and La Potin (2004, p. 45) took the importance of faculty support to the next level:

If institutional assessment is to yield meaningful results and be ongoing, faculty leadership is critical. Faculty must be the central players in academic assessment and, where possible, assume leadership roles as well. If assessment is to succeed, faculty involvement and leadership must be incorporated into the institution’s culture.

This last quote serves as a reminder of the relativity factor associated with leadership roles. A leadership role in program improvement is not so much a post or a position
as it is description of the quality of an effort put forth by a faculty member or faculty members. In some sense, all educators are leaders; however, the following of a leader increases in proportion to the perceived value of his/her work and the value associated with this work has direct connection to the processes that are employed to promote success. The challenge of a leader is to choose the right work and the proper pathway toward its achievement (Marzano, Waters, & McNulty, 2005).

In the course of this effort, it was discovered that some departments concentrate the work of assessment within a core-group of faculty members. Sometimes a vast majority of the work becomes the responsibility of one or two individuals. Only 19% respondents stated that their programs equitably distributed the work associated with the assessment-based process.

One relatively common characteristic associated with certain institutions, particularly those placing a high-priority on research activities, is the notion of shielding. This term refers to an effect where a department head or department chair absorbs the bulk of the assessment-based program-improvement workload to “shield” members of their department from the work associated with assessment-based practices, such that their faculty is not encumbered or distracted from their research-based responsibilities. While this approach to administrating a research engineering program is understandable, the practice is suspect in that it effectively silences faculty members from contributing to the process, potentially leading to missed opportunities for program growth and improvement. Somehow, a
compromise must be reached that encourages more input from the research contingent of engineering schools.

Another critical component of a successful assessment-based program-improvement effort is the level of support extended by program leaders in regard to the utility and value of the process as an agent of program improvement. As pointed out by Banta et al. (2009, p. 12), leaders are in the unique position to, through their words, actions, and talent, “enhance the likelihood that the assessment process will be valued and sustained.” Several program leaders confided reservations they held concerning the value and utility of the process. These conversations were in private, and the information was provided in strict adherence to confidentiality. Where the issue has the potential to become problematic is when program leaders employ their personal feelings to demean the process in public venues. No evidence came to light that suggested program leaders or assessment coordinators were in the habit of promoting negative perceptions regarding the ABET program-improvement model. Since adherence to the ABET mandate is nonnegotiable, accepting the process for what it can provide and not promoting condemnation for what it cannot may be the most pragmatic approach to coexisting with the process.

Above all else, the respondents in the study made it clear that they took their responsibilities as educators very seriously. While individual methods and philosophies within this group of educators often differed, each respondent made it
clear that improving their program and the general student-experience was among their highest priorities.

In closing this section, it should be noted that another possible source of disenchantment with the implementation of assessment-based program-improvement practices may simply be related to the increased workload that the process exacts on faculty members. Many respondents made clear reference to feeling overwhelmed, at times, from responsibilities associated with the ABET program-improvement mandate. Respondents were estranged from valuing the process in response to issues involving the lack of clarity and consistency of ABET in its accreditation expectations of civil engineering programs, a topic that is given further attention later in the chapter.

The ABET commissioned study.

In 2006, ABET commissioned a study conducted by the Penn State Center for the Study of Higher Education. The report that resulted from the effort is titled: *Engineering Change: A Study of the Impact of EC2000*. According to ABET, the study highlighted “[the] findings of *Engineering Change*, a comprehensive study of the impact of ABET's outcomes-based accreditation criteria on engineering programs and their graduates” (ABET, 2012).

The Penn State study (2004) surveyed the views of deans, department chairpersons, faculty members, 1994 graduates, and 2004 graduates of 40 engineering institutes. The Penn State sample included thirty PhD-granting
institutions (75%); six masters’ degree-granting institutions (15%); and four undergraduate institutions (10%). The present study’s sample included fourteen PhD-granting institutions (67%); three masters’ degree-granting institutions (14%); and four undergraduate institutions (19%). Six of the institutions surveyed in the ABET-commissioned study are also participant institutions in the current study.

One of the outcomes of the Penn State study was the finding that “More than 75 percent of the chairs estimate that either more than half or almost all of their faculty supported continuous improvement efforts, and more than 60 percent report moderate to strong support for the assessment of student learning” (Lattuca, et al, 2006, p. 5). While it is difficult to compare the data sets associated with the two studies directly, it is evident that two strands of buy-in data within the ABET commissioned study are in strong disagreement with the results of the current study. Using the proxy of the belief quotient (belief quotient 3) toward comparison with Lattuca’s findings, it is found that 24% of program faculties in the study possess views that are comparable to what was reported by Lattuca. That is, 24% of the programs in this study have faculty composites in which greater than 50% of their membership believe that the ABET assessment-based program-improvement process produces information that can be used to improve their programs. Even if the lower of the two figures provided by the ABET study (60%) were used for comparative purposes with what was found in this study (24%), the difference between the findings is very large.
In the current study it was found that 14% of programs have faculty composites where approximately 50% of their membership believe that the ABET assessment-based program-improvement process produces information that can be used to improve their programs (belief quotient 2). When belief quotient 2 and belief quotient 3 are combined it is found that 38% of the institutions in this study possess faculty composites where 50% or more of their faculties possess tendencies supportive of ABET’s assessment-based process. Even with this augmentation, a large disagreement remains between the adjusted buy-in of 38% and the 60% figure that was reported in the Penn State study.

There are several plausible explanations for the disparity between the two studies. One possibility is that many of the pioneering programs involved in the process were strongly motivated to engage in ABET’s assessment-based process. As evidence of this, it needs to be realized that in the early days of EC2000, adoption of the process was to some degree voluntary. Another possibility is that respondents were aware that the Penn State study was commissioned by ABET, and, as such, respondents may not have reported as candidly as they might have were the study conducted in full-confidentiality by a third-party researcher with no conceivable connection to the ABET organization. Another possibility is that department chairpersons either weren’t aware of faculty feelings concerning the appreciation of the ABET process, as was found in some instances in the current study, or that such
program leaders were overly optimistic in their estimates of faculty regard for the practice of assessment-based program improvement.

Another ABET claim that surfaced in the Penn State report as being somewhat suspect was the statement, “Engineering programs and faculty can be confident that their efforts to improve engineering courses and programs will benefit students and the profession” (Lattuca, et al, 2006, p. 13). While this “conclusion” may amount to a true statement, the current study did not uncover any data that supported the suggested confidence referenced in the ABET commissioned study. The referenced statement appears in the conclusion section of the Penn State study.

Respondents in the current study did not present any evidence that students had experienced gains in their mathematics, science, or engineering skills. This finding is consistent with the Penn State finding, “Math, science, and engineering skills appear unchanged over the past decade…” (Lattuca et al., 2006, p. 11).

The Process

This section examines the application of the assessment-based program-improvement process. The sections looks at issues that might adversely affect the ability of programs to incorporate program improvement using the ABET model.

Program improvement or program accountability?

To many respondents, ABET’s assessment-based program-improvement process looks a lot like a program designed to place the practices and methodologies of engineering educators under perpetual scrutiny. A number of subject in the study
relayed that their programs felt compelled to implement program modifications, in the words of one subject, “just for the sake of satisfying ABET.”

Many educators reported that faculties often found themselves scrambling to complete their documentation in the months leading up to an ABET review team visit. In many ways it appeared that the assessment-based practice occupied the faculty at a level much greater than the faculty was able to manage and/or benefit from the practice. More than half of the respondents indicated that their faculties had less than a full grasp of the process and only 19% of the respondents indicated that one of more members of their faculty had received advanced assessment-based training. While it remained unclear whether this advanced training led to a greater command and appreciation of the process, the need for faculty training in assessment-based program-improvement is a clear outcome of the study. Several respondents made reference to the suggestion by visitation team members that faculty members enroll in ABET’s IDEAL program. Unfortunately, respondents reported that this recommendation was the response when the program leaders requested guidance from review team members regarding specifics associated with accreditation compliance or assessment-based practices. One respondent stated that when he asked advice of a program review team member, the response was, “We don’t like to tell programs what they should or shouldn’t do, but if you attend our training program…” The respondent relayed that he was very disappointed with the
quality of this response and added, “Programs are inventing things to do, since they do not have proper guidance from ABET.”

**Effort sustainment.**

In the previous chapter, the idea of a program’s sustainment quotient was introduced. The idea was that programs were rated on a scale of 1 to 5 relative to their organizational and operational capacity to develop and maintain strategies to sustain their program’s assessment-based program-improvement effort. A sustainment quotient 1 rating implied that a program possessed a weak understanding of the process and very passive approach to its sustainment. Alternatively, a sustainment quotient 5 rating implied that a program possessed a strong understanding of the process and a very active, if not proactive, approach to its sustainment. The sustainment quotient 2 rating indicated minimal understanding of the process and minimal sustainment effort. Sustainment quotient’s 1 and 2 are sustainment classifications that could be described as going-through-the-motions (see Appendix C). The mean sustainment quotient for institutions in the study was 2.38. It is reasonable to believe that a connection might exist between the strength of a program’s sustainment effort and the level of training received by the program’s faculty members. In the current study three of the four institutions that reported that one of more faculty members received advanced assessment-based training had sustainment quotients equal to or greater than sustainment quotient 3. The mean sustainment quotient for members of this group was 3.25. Receiving additional
training in assessment-based program-improvement principles appears to have the potential to support the development of procedures and strategies that can accentuate focus and effort on assessment-based educational objectives.

There appears to be reason to believe that programs with low sustainment quotients possess less than a solid grasp of the process and its application. It is recognized that faculty discord regarding specific educational objectives and/or the means of achieving such goals can undermine program improvement strategies and their intended outcomes. It is also recognized that a disorganized, confused, or ineffectual program-improvement practice may be the product of faculty discord. To some degree it is no wonder that some sustainment efforts appear to be little more than efforts of formality. This is not to suggest that the sustainment efforts of such programs isn’t sincere, but rather that such programs are doing what they can with the available resources and knowledge-sets regarding their assessment-based program-improvement efforts.

*Time, resources, and money.*

Most every respondent made reference to the significant time demands required of the process. In some instances this sense of burden was elevated in result of the inequitable sharing of the assessment-based work and its administration.

It is important to note that base-line compliance with the ABET criteria is required of all engineering programs. All programs need to complete a self-study, keep ongoing records concerning specific aspects of their program-improvement
practice, monitor the assessment-based work of faculty members, and take part in the planning process to sustain assessment-based activities in their departments. It has been mentioned that some of the larger and/or better funded institutions are in a financial position to contract specialists to deal with many mechanics of the process. With this in mind it becomes clear that the implementation and continuance of the practices associated with the ABET program-improvement model places a larger burden on smaller programs or other programs not in a position to equally distribute or farm-out the work associated with the ABET process. This is in fact what respondents in the study reported. Recall the statement, “[the ABET process] is poorly suited for a small department with few faculty members and resources.” These comments suggest that the burden of the workload associated with the ABET process is lessened when shared between more individuals. This observation forms a reasonable argument for distributing the workload among faculty members in as equitable of a manner as is practicable.

There is reason to believe that not enough money is available for some programs to properly respond to the workload associated with ABET’s program-improvement model. It is possible that some of the challenges that programs experience associated with the mandate of EC2000 have root in insufficient funding to support the effort. A number of respondents alluded to this possibility. In fact, one respondent stated, “I don’t really feel that enough money is going into the assessment side.”
According to respondents in the study, there are program modifications that are assessment-based and there are program modifications that are intuition-based. The concern is that there is often a very fine line between the two classifications. Program modifications that are based on assessment have been reported to arise from examination scores, portfolios, the FE, industrial partnerships, surveys, projects, and other contrivances with the capacity to capture data. There appears to be little if any uniformity in the sources or methodology by which institutions gather and process data. This is not meant to imply that each of the named data sources doesn’t have some value in the venue of assessment-based program improvement, but it is clear that departments appear to be left to their own devices when the time comes to collect and analyze data.

In short, there are definite gaps in the language associated with assessment-based program improvement. What was a description of an intuitively oriented program modification from one respondent would have been a data-driven program modification from another respondent. The point is that there is great ambiguity in the use of language associated with assessment-based processes among respondents.

Thirty-eight percent of the respondents provided an example of a program modification that was implemented by their program that they believed was driven by assessment data. One respondent reported that a student survey informed his department of the need to offer a laboratory course during the same term that its
companion lecture course was offered. Another respondent reported that she had implemented a course component designed to improve student laboratory writing skills that came about through the assessment of poor quality reports.

What is the difference between assessment-based program improvement and intuition-based program improvement? While it was not a direct inquiry of the study, many respondents reported that data never informed their programs of “things they didn’t already know” or work to “provide surprising data.” There is good reason to believe that such opinions have been contributory to low application rates of assessment as the drive for program modification. Recall, 48% of programs reported that less (and generally substantially less) than 50% of their program modifications were assessment-based. On the other hand, the faculty viewpoints expressed here also work to explain why only 24% of respondents’ programs report assessment as the primary driver of program change.

To the credit of those educators employing intuition-based program improvement, there surely are changes that programs must make without data. Many respondents waged arguments against waiting for data when a clear need for change was evident. One respondent stated that her department could not, and wouldn’t, wait for the time that data might come along to support a necessary program change.

A number of programs made reference to employing assessment not as the drive for program modification, but as a means of providing validation for implemented program changes. This approach appeared to be the more favored
application of the assessment process. The preference of this secondary application of assessment data may be related to the predisposition of faculty members to believe that the process seldom provides “surprising” student data.

*Practicalities.*

It seems to make a lot of sense that if educators collect and analyze sufficient student assessment data, target appropriate learning outcomes, implement appropriate program modifications, and systematically cycle through the process, repeatedly, that educators should be able to hone in on the educational goals they have selected for their students. Theoretically, the practice should work.

Of course, the previous paragraph does not address the parameters that are generally associated with a respectable scientific study. Respondents pointed out a number of concerns with the process that severely limit its utility. The concerns that were most frequently expressed centered on the ability to extract useful data. Respondents commented frequently that their student populations were too small to provide data that possessed statistical relevance. One respondent commented, “We have an extremely small sample-size. Our sample-size is too small to draw assumptions about any population.”

Concerns were raised about the absence of control populations. One respondent commented that the process lacked nearly every conceivable resemblance to a respectable scientific inquiry. The same respondent commented that ABET appeared to lack an understanding of proper sampling procedure. Another respondent
commented, “It [the process] is not a controlled environment where you can draw conclusions.” This same respondent made reference to the impossible nature of controlling inputs from teacher to teacher. Nearly one-third of the respondents expressed reservation concerning whether collected data could even be subjected to rigorous statistical treatment.

When taking into consideration the totality of the issues that respondents brought forth concerning the gap between idealized application of the assessment process and the real-life version of the process, respondents tended to recognize that the process had merit, but they expressed caution in taking data and analysis past their limits. Recall that one respondent stated, “But even the training we received was idealized, but only seldom do practical circumstances conform in any manner that resembles idealized circumstances. We are very aware of the limitations of the process and its potential outcomes.”

*Feedback cycle.*

A major concern of some respondents involved the length of the feedback cycle associated with the assessment-based program-improvement process. Respondents reported feedback cycle lengths ranging from three to more fifteen years. The chief concerns with the long feedback cycle were issues of faculty attrition, changes in program emphasis, and changes in ABET focus.

While these concerns do not seem to have led programs to divest from their program-improvement practices, they do seem to have destabilized program
confidence in the process. It is clear that taking on a program improvement objective that might take years to work its way through the assessment process is fraught with uncertainty. This consideration, while legitimate, cannot provide justification for not working to implement positive change in result of some unknown factor that might negatively impact such an undertaking. Not one respondent took any stance concerning this issue other than making reference to the long feedback cycle as providing a confounding influence to the practice of assessment-based program-improvement and its outcomes.

**ABET**

ABET is the accreditation organization that provides the seal of approval that engineering programs meet quality standards set by the profession (ABET, 2012). While the vast majority of respondents indicated that a somewhat tense relationship existed between engineering programs and ABET, every respondent relayed the critical importance of having their program sanctioned by ABET.

The most frequent benefit that was reported by respondents concerning the ABET accreditation model was that the process forced programs to periodically review their programs. Seventy-one percent of the respondents shared this observation. One respondent commented, “ABET has its place in that it holds faculties feet to the proverbial fire.” Another respondent stated, “The process has been painful, but it has been good. Raising the awareness of the faculty has proved to be beneficial.”
There is ample evidence that, at times, substantial confusion exists between
ABET review team members and program faculty members. This confusion can
arise from ambiguities in evaluative standards or from inconsistencies between
review teams and/or review team members.

Sixty-seven percent of respondents reported that the ABET process and/or
accreditation review team members lacked clarity and consistency in the
expectations of programs. Two respondents likened the process to “trying to hit a
moving target.” One respondent suggested the process was much like “a dog and
pony show.” Two respondents reported that they were incorrectly advised by review
team members to make changes that were not part of any known ABET directive.
One respondent commented, “Sometimes we are left to wonder if, even, ABET fully
understands the process by which programs are evaluated relative to their
accreditation standards and expectations.” Another respondent commented, “ABET
is at the mercy of the reviewers available to evaluate programs. Not all visitors
[accreditation review team members] are highly-qualified, top-notch,
reviewers.” Another respondent commented, “But, I’d have to say, that we as a
program still do not know what to expect during our accreditation visits. There is
certainly a lack of consistency in ABET’s process of program evaluation.” Some
respondents even used profanity to punctuate their claims.
Costs and Benefits

It is unavoidable that the experiences of respondents color their perceptions of the generalized value of the assessment-based program-improvement process promoted by ABET. Sixty-two percent of respondents reported that their faculties were largely unsupportive of the assessment-based program-improvement process. This figure is comparable to the 57% of respondents who reported that the benefits associated with the assessment-based process were outweighed by the costs. Alternatively, 38% of respondents reported that 50% or more of their faculties were supportive of the assessment-based process. This figure is comparable to the 43% of respondents who reported that the benefits associated with the assessment-based process were at least as great as the costs.

The principal costs associated with the process were reported to be time and resource expenditures. The most frequently reported benefit of the process was that it forced programs to periodically review their programs. One respondent commented, “ABET forces us to ask: why are we here; what are we trying to do; and how are we trying to accomplish it?”

None of the respondents were able to provide concrete examples that demonstrated impacts on the quality of the generalized student experience or that were evidentiary of improvements in student learning outcomes.

In incidences where it was reported that the benefits associated with the assessment-based process were less than the costs, it was found that faculties tend to
resent the assessment-based process. It cannot be determined if one effect is causal to the other. Evidence of this observation lies in examination of those respondents who both reported that the cost associated with the ABET process outweighed the benefits and that the ABET process lacked clarity and/or consistency. It seems reasonable that reporting that the ABET process lacked clarity and/or consistency would be associated with certain resentment on the part of respondents. Ten of the fourteen respondents (71%) who reported that the ABET process lacked clarity and/or consistency also reported that the benefits associated with the process were outweighed by its costs.

Nine of the twenty-one respondents (43%) expressed what would be best described at indignation with ABET and/or the ABET process. Six of these nine respondents (67%) claimed that the ABET process lacked clarity and/or consistency. Several respondents provided clear evidence of strong indignation or resentment associated with the ABET program-improvement model.

It seems that cultural change is necessary to provide proper support to the assessment-based program-improvement process. Faculty members need to take advantage of opportunities to receive advanced training in assessment-based program-improvement practices. Faculty members need to coexist in a beneficial manner with the assessment-based program-improvement process. They need to learn to be able to make sense of the process and the data that the assessment-based process provides. These conclusions are supported by the data in this study and are
supported by earlier work on this subject. “If faculty do not participate in making sense of and interpreting assessment evidence, they are much more likely to focus solely on finding fault with the conclusions than on considering ways that the evidence might be related to their teaching” (Banta & Blaich, 2011, p. 24).

Summary

This study did not reveal any trends in student learning outcomes. It is evident that engineering programs are not currently mobilized to look for trends in student learning outcomes in result of their assessment-based program-improvement practices. This outcome is consistent with Banta’s observations.

An uneasy relationship exists between faculty members, the process, and the ABET organization. This somewhat tense state may lessen as programs reach maturity in their assessment-based program improvement practices. It is fair to assume that many programs are still learning the ropes of becoming assessment-based in their efforts to improve their programs. Banta pointed out that it can take longer than six years to work through each of the stages associated with the assessment-based process. Banta did not comment upon how long it might take programs to become skilled and productive in assessment-based program-improvement practices.

It is likely that programs will develop stronger ties with the process through increased training in assessment-based activities. ABET offers advanced training in assessment-based principles and practices. Only 19% of the programs in the study
reported that one of more of their faculty members had received advanced assessment-based training such as is offered in ABET’s IDEAL program.

It is important that programs work to enlist as many of their faculty as is practicable to assist in the work of assessment-based program improvement. Too frequently it was found that the work of assessment was concentrated in a very small group of faculty members. When this was found to be the case it was generally observed that faculty members felt isolated and overburdened.

Views concerning the value and utility of the assessment-based program-improvement process vary widely. Many more engineering educators are critical of the process and its outcomes than are praiseful of the program-improvement value provided by the process. Critical views of the process have the potential to taint the quality of the work that goes into a department’s program-improvement effort.

Programs often reported that the benefits associated with the assessment-based program-improvement process were outweighed by the associated costs. This finding is a serious issue that is connected with the human component of the process. Such reporting is as much a statement on the quality of the gains made by programs as it is a statement of the dissatisfaction of the educators who administrate the ABET program-improvement model. If educators do not learn to work and accept the process, it should be expected that programs will continue to work with the process albeit without the realization of program gains of a substantive nature.
Compilation of Major Findings

- Engineering programs’ outcomes-assessment processes are not organized towards the recognition and measurement of trends in student learning outcomes.

- Sixty-two percent of participant institutions experienced faculty climates that were less than receptive to the ABET program-improvement model. Respondents stated without ambiguity that their faculty colleagues did not believe that student data provided useful information that could be utilized to improve their programs.

- Fifty-seven percent of respondents reported that the costs associated with the assessment-based program-improvement process outweighed the benefits associated with the process.

- Seventy-one percent of respondents reported that a primary benefit of the assessment-based program-improvement process was that it provided an opportunity to completely review their programs.

- The vast majority of respondents suggested that most of their colleagues accepted assessment-based practices as a fact of accreditation and considered participation in the process as a primary duty.

- Sixty-seven percent of respondents reported that ABET program-improvement requirements and/or accreditation review team members lacked clarity and consistency in their expectations of programs.
The lack of consistency and/or clarity in ABET’s accreditation expectations has estranged many educators from valuing the assessment-based program-improvement process.

Respondents reported that ABET evaluators appeared either unable or disinterested in providing specific guidance to individual programs.

There appears to be little if any uniformity in the sources or methodologies through which institutions gather and process data.

Receiving additional training in assessment-based program-improvement principles appears to have the potential to support the development of procedures and strategies that can accentuate focus and effort on assessment-based educational objectives.

The implementation and continuance of practices associated with the ABET program-improvement model places a larger burden on smaller programs or other programs not in the position to equitably distribute or farm-out the work associated with the ABET process.

Twenty-four percent of programs reported that assessment-based practices were the primary driver of program change. Forty-eight percent of programs reported that less than (and generally substantially less than) 50% of their program modifications were motivated by outcomes assessment-based practices.
• Respondents reported that long feedback cycles hampered their institutions’ assessment-based program-improvement efforts and destabilized program confidence in the ABET model.

• Respondents presented numerous concerns that focused on limitations of the utility and value of the assessment-based program-improvement process. Three such reservations were: (1) Nearly one-third of respondents expressed apprehension concerning whether collected data could be subjected to rigorous statistical treatment; (2) Respondents reported that assessment-based processes seldom provided surprising data; and (3) Respondents expressed concern regarding the disparity between the idealized application of the assessment-based process and the real-life version of the process.
CHAPTER SIX
CONCLUSION

**Introduction**

In the course of this effort, 21 civil engineering educators shared their personal observations and experiences with the assessment-based program-improvement process promoted by ABET. Data revealed a multitude of challenges that can render the ABET program-improvement model ineffective in participant engineering programs.

The success of Continuous Quality Improvement (CQI) practices such as those employed in the ABET program-improvement model are based on a well-defined set of conditions: clear goals, consensus and participation in meeting those goals, measurement sufficiently sensitive to incremental change and reliable enough to base decisions upon, and a reasonable time-frame in which to implement change and to measure its impact on program objectives. Program success also assumes stability of an organization’s goals, minimization of confounding variables that affect the reliability of an outcome measurement, and an iterative process where the benefits of incremental change are consistent within each cohort of students.

The ABET program-improvement model is an adaption of the CQI business model. However, the model is based on a number of assumptions specific to the business domain, some of which prove untenable or without proper comparison in the educational setting. The study found no evidence of systematic increases in
student learning outcomes. The next few sections provide evidence of the ABET model’s incompatibility toward providing a pathway to program-improvement for participant institutions.

*Students*

One frequent issue that was presented by respondents concerning the goodness-of-fit of the process to educational applications had to do with the difficult nature of placing the student in the model as if he/she were a product of knowable specifications. One respondent stated, “Students should not be treated as if they were a commodity.” One respondent observed, “Students are not widgets with specific and known qualities and standards.” Recognizing the variability of inputs raises the question of whether any standardized process as required in a continuous improvement model can be successful in incrementally working to reduce variation in the output. It is clear in the literature that what works for one cohort may not be equally effective for subsequent cohorts (Pauly, 1991).

*Practical Considerations*

Respondents frequently shared their concerns regarding the quality of the data they were able to collect and the statistical validity of making decisions based upon such information. They expressed their concerns about the level of statistical rigor that the data could reliably be subjected to. They questioned whether their mini-studies would pass muster were they to be submitted to respectable scientific journals. Others respondents expressed concern regarding the challenging nature of
controlling inputs from one teacher to the next. One respondent stated that the process “lacked most every conceivable resemblance to a respectable scientific inquiry” and characterized the process as “assessment-theater.”

Overall, there was general agreement that assessment data lacked the rigorous controls required for valid interpretations and therefore truly sustained application.

*Faculty Consensus and Participation in the Program-Improvement Process*

The underlying principle of the CQI business model is that people (employees) are “basically good” and that they want to work together cooperatively toward meeting common goals that benefit the mother organization (Radawski, 1999, p. 13). Another assumption is that an organization’s workers know their work processes better than management (Radawski, 1999). The previous two statements form the basis of the organizational requirement for shared goals and broad participation.

The vast majority of respondents in the study reported that their colleagues were less than receptive to the ABET program-improvement model. Respondents often sensed that their work effort was under perpetual scrutiny. Some respondents expressed concern that low faculty buy-in to the process hindered potential successes in their program-improvement efforts. One respondent commented, “The faculty is now at the point where they are just going through the motions, they just throw their binders together. I’m not convinced that they are putting the thought into it to make it valuable.”
Many respondents indicated certain patience with the process, while others were frustrated with the process. One respondent commented, “I have huge passion for my work, and little patience toward what does not work, and this lack of patience is compounded when continuing to carry out a process that has failed to produce results.” Many respondents commented on the day-to-day challenges associated with the planning and continuance of the program-improvement process. One respondent observed:

It is really challenging keeping the faculty motivated in this area. I mean the faculty wants to see evidence that their work is leading to beneficial outcomes, and the “evidence” can’t just be marginally significant or it can take the appearance that it is merely anecdotal.

Some respondents questioned whether the ABET program-improvement model could work. One respondent pondered, “Does outcome-based education work? It would be good to see some evidence. We want to see patterns of evidence that we are improving our program from year-to-year.”

Concerning the last comment, it is important to note that an outcome of this study was the observation that engineering programs are not currently organized to recognize and measure trends in student learning outcomes. This observation is consistent with the findings of an earlier study. According to Banta (2009):

So far, the emphasis within most colleges and universities has been on specifying outcomes and developing mechanisms for assessing the outcomes, then
taking warranted actions based on the assessment findings. Few have talked about following up to see whether the changes undertaken have produced the desired improvements or whether improvements can be sustained over time. This program outcome could possibly be remedied through increased training in advanced assessment-based practices and principles as addressed in ABET’s IDEAL program. It could also be true that participant programs have not achieved maturation in their ability to manage and administrate the assessment-based program-improvement process. Banta (2009) pointed out that it could take in excess of six years to completely work through the three-stage assessment-based process; she did not, however, address the length of time it might take to become proficient or skilled in the process.

In contrast to the requirements of the CQI model to ensure broad participation in the collective program-improvement effort, a large majority (81%) of the participant engineering programs made no effort to equitably distribute the workload associated with the ABET program-improvement process. Research institutions appear to be particularly vulnerable to this program trait due to what has been described as a “shielding effect,” where faculty members are effectively shielded by a core group of faculty members or program leaders such that their research efforts are not inhibited. Not infrequently, this concentration of the work effort in so few individuals results in personal distress. One respondent commented,
“The process takes an enormous amount of time, at virtually no compensation to the coordinators. Why would I do a good job?”

**Feedback Cycle**

To be successful, CQI models must provide meaningful information within a time frame where the data maintains its relevance. Respondents in the study often referenced the long feedback cycle associated with the process. Respondents cited feedback cycles ranging from three to more than fifteen years. The previous chapter described the assessment-based process as being fraught with uncertainty due to the long feedback cycle. This uncertainty results from a number of factors not limited to faculty attrition, changes in program emphasis, and confounding influences that emerge from implementation of simultaneous or coincident program modifications. Concerning the program-improvement challenges associated with the long feedback cycle, one respondent commented, “We try to subject every change to data analysis, but you can’t wait six to ten years until the feedback cycle plays out.”

**A Tense Partnership**

ABET and engineering institutions have a very complex relationship that at its best is one of mutual respect and at its worse is one steeped in distrust and misunderstanding.

This study only surveyed the views of engineering educators, and as such what follows here is a one-sided account of the relationship that exists between the two groups.
The majority of the respondents did not feel that ABET was consistent in their expectations or that ABET’s expectations of programs were expressed with clarity. Two respondents likened appeasing ABET to “trying to hit a moving target.” Respondent after respondent relayed mistrust in ABET. Several participants expressed dismay at receiving misinformation from ABET evaluators. While others commented on the disparate manner in which ABET review team members relayed program expectations. Respondents expressed concerns about the high-level of rigor associated with the review process, yet they commented that the reviews were insufficient toward fully evaluating a program. One respondent compared ABET to a “massive machine” that didn’t “have to provide evidence to anyone that their methods are productive or that they amount to the best possible approach to program improvement.”

Limitations of the Study

This study utilized the observations of individual faculty members to characterize the assessment-based program-improvement practices of engineering programs. In many instances this amounted to the respondent interpreting the views or observations of their program’s collective faculty, or of specific faculty members.

The respondents in the study presented a range of views that were ultimately classified for analysis in a manner that forced their placement into a rigid coding structure while in reality the data possessed the properties of a continuum. This is to say that potential error exists in attempting to classify continuous phenomenon that
possess similar traits. Classification of respondent data was carried out on a best-fit basis. This could lead to scenarios where the differentiation between adjacent classifications may seem arbitrary to a reviewer. This is a general challenge associated with processing qualitative data. Great effort was taken to maximize the sensitivity of coding responses while working to minimize the potential for classification errors.

The number of respondent programs that participated in the study represented only 8.5% of the population of ABET accredited civil engineering institutions. This observation demands restraint from making generalizations about the population of civil engineering schools from which the sample was drawn.

**Suggestions for Future Research**

This chapter has brought into question the goodness-of-fit of continuous quality improvement protocols in educational applications. Many of the challenges associated with the ABET program-improvement model may work themselves out as engineering programs become more comfortable and skilled in the process of assessment-based program improvement. But it remains unclear if program-improvement efforts will ever lead to improved student learning outcomes under the current formulation of the ABET process.

Engineering schools need to more fully educate and organize their faculty members to look for underlying patterns or extended meaning in student learning data. Subsequent to program adoption of this practice, a comparable study to what
has been presented here should be carried out. Future studies along this lineage should be done on a scale that allows conclusions to be drawn about the general population of ABET accredited engineering programs.

It is hoped that in the near future investigators will gain access to FE Data. Providing this access to researchers is important as the FE is the only nationally recognized standardized engineering exam. The National Council of Examiners for Engineering and Surveying (NCEES) needs to develop a protocol for the release of sanitized student FE score data such that investigators can determine the cumulative effects of sustained application of the assessment-based program-improvement process on student learning outcomes. If a release protocol can be developed, engineering educators might soon be in a better position to take advantage of the program-improvement potentialities offered by CQI models.
REFERENCES


### APPENDIX A

**RESPONDENT INFORMATION**

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APPENDIX B

INTERVIEW INSTRUMENT

30 March 2012

Participant: __________________________

Interview Template

Timothy Regan

Pre-Appointment Script: Date/Time: __________/__________

My name is Timothy Regan and I am a graduate student attending Humboldt State University.

My research involves a study of the cumulative effects of assessment-based program improvement practices on student learning outcomes and the degree to which engineering programs accredited under the ABET EC2000 standards are benefiting from the process. A key goal of the effort is to fill a gap in the literature by examining both the cost and benefits of this process.

If possible, I would like to arrange a 20-30 minute phone interview with Dr. ______________ at a time that he/she would find agreeable at some point during the next two weeks.

Appointment Script: Date/Time: __________/__________

My name is Timothy Regan and I am a graduate student attending Humboldt State University in California.

My research involves a study of the cumulative effects of assessment-based program improvement practices on student learning outcomes and the degree to which engineering programs accredited under the ABET EC2000 standards are benefiting from the process. A key goal of the effort is to evaluate the cost/benefit profiles reported by institutions involved in the study, a process which has not been previously reported. Understanding the relative costs and benefits, actual experiences and faculty perceptions will inform debates about the utility of this mode of
accreditation. Pseudonyms will be used for all participants and the data will be collected, analyzed and presented in a way that preserves the anonymity of participants. The interview will take between twenty and thirty minutes. At any point during the interview process you may ask questions, choose not to address a particular inquiry, or terminate the interview at your discretion. At any time you have questions we will stop and address your concerns.

As we go through the interview, please provide as complete a response as possible. To develop a good understanding it is really critical that I learn about the successes, challenges, and what you see as the opportunities. If after the interview you have any questions or concerns, you can reach me at (707) 485-4419 or my faculty advisor Eric Van Duzer at (707)826-3726.

If you have any questions regarding your rights as a participant, any concerns regarding this project, or any dissatisfaction with any part of the study, you may report them, confidentially, if you wish, to the dean for Research and Sponsored Programs, Dr, Rhea Williamson at Rhea.Williamson@humboldt.edu or (707) 826-4189.

Central Research Question:
What are the cumulative effects of accreditation-driven assessment practices on student learning outcomes?

Questions:

1. Are continuous improvement activities equitably distributed among faculty members in your department?

How is the work of assessment, analysis, and program remediation distributed among faculty members?
2. Dr. Trudy Banta, panel member of the National Institute on Learning Outcomes Assessment Advisory Council, has identified three stages associated with the full deployment of assessment to impact program change. The first stage involves collecting sufficient data to convince faculty that change is necessary; the second stage involves crafting and implementing appropriate program modification to enact the change; and the third stage is the collection of data toward the determination of the impact of the selected program modification. Banta suggests that the complete cycle may take more than six years.

Which stage of the aforementioned process describes progress made by your department?

Again, the choices are (1) convincing faculty that change is necessary; (2) crafting and implementing appropriate program modification, and (3) collecting data toward the determination of the impact on student learning outcomes.

To what extent does your faculty believe that assessment of student data produces useful information that can be applied to improve your program?

To what extent are the program changes that you have implemented, over the last few years, been the result of the analysis of assessment data?

Do you feel that such a determination could have been made by members of your department in the absence of the application of the continuous improvement protocol?
3. A number of different assessment instruments have been proposed to assess the quality of student work; the list of possible metrics includes student portfolios, projects, student surveys, departmental examinations, the FE, and more.

What assessment instruments and/or practices have members of your department found to produce the most useful data? Do you feel that there would be general faculty agreement concerning your response?

4. Certain objectives are more easily met than others.

What measures have been taken by your department to sustain faculty effort and focus concerning the achievement of defined learning objectives?

5. Overall, how would you describe the costs and/or benefits of utilizing the CI process to promote ongoing improvement in student learning?

0. What year was your program accredited under the criteria associated with EC2000? When was your last on-site ABET review?

Have you ever served as a member on an ABET accreditation team?
APPENDIX C

CODING RUBRIC

1: Distribution of Responsibility

1A. No or Yes: 1 or 2: A “Yes” implied the work is equitably distributed

1B. 1 through 5: 1: Indicates that no effort is made to make all faculty members part of the process through assessment-based responsibilities; 2: Indicates that selected members, dependent upon their teaching coursework or lack of seniority, are assigned tasks, such as assessment or analysis of data, though with little evident support or structure; 3: Indicates that some effort is made to include all faculty members in the process in a coordinated manner, but that the distribution is anything other than equitably distributed; 4: Indicates that sincere effort is made to actively include all faculty members in the process, whether such activities are limited to collection and processing data in their individual courses or through service in some form of organizational capacity; 5: Indicates that the process takes place in a faculty community where all members are committed to the process and organizational structures are in place that ensure that all faculty members have well-defined and equitably distributed responsibilities relative to the fulfillment of departmental goals.

2A. This question became: What do you feel that the most difficult stage of the CI process as described by Banta?

2A. 1 through 3: 1: Stage 1; 2: Stage 2; & 3: Stage 3.
2B. 1 through 3: 1: The faculty does not believe that the assessment of student data produces useful information; 2: The faculty is neutral or split concerning whether the assessment of student data produces useful information; 3: The faculty believes that assessment of student data produces useful information.

2C. 1 through 3: 1: Most of our program changes have not been driven by student data; 2: Program changes are roughly equally distributed between those driven by student data and those that are not; 3: Most of our program changes have been driven by student data.

2D. 1 or 2: Ability to cite and example of a program modification that was assessment based (description). For this particular entry to receive a “Yes” the subject must (1) describe a specific program modification; (2) describe the manner in which data was collected; and (3) provide a statement that the educational objective was achieved via the modification. Unless items 1-3 are satisfied, the subject is said to have not been able to cite and example of a program modification that was based on the assessment of student data. In such an instance the response is coded as a “No.” In addition, if a subject satisfies 1-3, but qualifies his/her statement with information that indicates that the program modification and outcome required nothing more than empirical observation, the response is coded as a “No.” Example: “…no hard-data here, just common sense.”

3A. Portfolio ≡ P; Project ≡ PJ; Surveys ≡ S; Examinations ≡ DE; Fundamentals of Engineering Examination ≡ FE; Other ≡ O: NA: Signifies a response that indicates no clear-cut favored instrument(s). Up to three instruments may be reported relative the response of a particular subject.
4A. 1 through 5: 1: Subject expresses frustration and/or resignation in maintaining sustained effort or in motivating faculty members to the point of taking on most of the effort or delegating responsibility to a select few individuals, this coding can also result from a response that indicates lack of faculty buy-in to the process or discussion that reveals that faculty members are disinterested in the process or its outcomes, going-through-the-motions; 2: minimal effort is taken to engage faculty members, taking the form of infrequent and informal discussions in faculty meetings or in rare dedicated meetings; 3: middle of the road attention is provided toward maintaining a sustained faculty program improvement effort, this might include: periodic meetings where program improvement and assessment-based program modification is addressed; 4: The faculty effort appears organized in its attention to program improvement and assessment-based program modification; a response that identified a dedicated faculty retreat can as well qualify for this rating given that the generalized sustainment effort appears organized; 5: The faculty possess a high level of training and dedication to assessment based program improvement, this is marked by one or more members of the faculty being trained in assessment-based program improvement practices or training as an ABET review-team evaluator; this rating suggests that frequent dedicated meeting take place that address assessment-based practices.

5A. 1 through 3: 1: Costs exceed benefits; 2: Costs and benefits are about balanced; 3: Benefits exceed costs.
### APPENDIX D

**RAW DATA FOR TABLES 2-6**

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