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Raising the Utility of Assessment: Developing Evidence Systematically to Satisfy the Institution, ABET and Regional Accreditation*

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We have demonstrated how program-level student learning research can be designed to satisfy institutional expectations along with specialized and regional accreditation criteria without duplication of effort. A centralized university quality management system conserves faculty effort by organizing program level learning research in patterns that satisfy multiple forms of evaluation criteria, such as continuous improvement documentation, peer-review of research planning quality, monitoring of planning currency, faculty participation in assessment, and sharing learning assessment information among university community members and external constituents.

Keywords: accreditation; learning assessment; continuous improvement systems

INTRODUCTION

IN THE UNITED STATES, the momentum for achieving effective student learning assessment in higher education continues to strengthen. As recently as November 2006, education leaders at the 2006 National Symposium on Postsecondary Student Success, such as Derek Bok, advised institutions to engage in a continuous process of self-scrutiny and improvement, and to intensify assessment efforts that identify their priorities and solicit faculty input [1]. In addition, The Reinvention Center at Stony Brook held its conference in November 2006 where the focus was on undergraduate education and assessment at research universities with the National Science Foundation as a sponsor. The U.S. Department of Education Commission on the Future of Higher Education formed the following recommendation in fall 2006: "We recommend that America's colleges and universities embrace a culture of continuous innovation and quality improvement. We urge these institutions to develop new pedagogies, curricula and technologies to improve learning, particularly in the areas of science and mathematics" [2, 3].

Fortunately, the engineering accreditation agency, ABET (Accreditation Board for Engineering and Technology), promulgated new accreditation criteria in 2002 that emphasized the outcomes of student learning [4]. Previous to these criteria, engineering programs met program requirements by illustrating the inclusion of desired components within their curriculum. The model could be characterized as: show us what you do. With the new criteria, programs are required to demonstrate the attainment of stated student learning outcomes through evidence of student learning. This new model may be thought of as: show us what you accomplish. The outcomes-based approach has now extended to multiple levels of quality monitoring with an emphasis on continuous evaluation.

This change of focus has been difficult for engineering faculty to embrace. To overcome faculty apprehension, Colorado State University developed an interactive, web-based system that guides programs through a process designed to address the variations of accreditation requirements. This quality management system helps programs generate planning and evaluation information about student learning at four levels:

1) the program level to inform improvement of faculty's curriculum design and departmental functionality,
2) the university level for meeting strategic planning expectations and state-level accountability,
3) the ABET level to satisfy professional quality criteria,
4) the regional accrediting level to assure institutional effectiveness.

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As more institutions begin designing comprehensive continuous improvement systems that manage learning assessment campus wide, engineering program faculty should involve themselves in the design process so that the central system will generate the planning resources and evidence they need for ABET accreditation and their own program improvement. In turn, programs need to learn what planning and evaluation activity institutions need from them. This article describes how one engineering program uses a research university's centralized quality enhancement system to focus faculty effort and reduce duplication.

ALIGNING EVIDENCE OF LEARNING WITH MULTIPLE ACCREDITATION CRITERIA

What strategy can an engineering department or college use when negotiating the design of a centralized quality management system? When developing Colorado State University's centralized continuous improvement system in 2003, careful attention was paid to the evidence that needs to be consistently generated in the coming years. Using a matrix that aligns institutional expectations, ABET criteria, and regional accreditation criteria was helpful (see Table 1).

An interesting consequence of doing this criteria-to-evidence matching was the identification of gaps in ABET criteria. Although many faculty might insist that the ABET criteria are too comprehensive, when placing the criteria in the larger context of program and institutional evaluation, the comparison of various accountability criteria highlights quality expectations that ABET requirements do not include. The gaps merely signify that ABET functions at only one level of a four-tiered quality monitoring system in the United States. Therefore, when engineering departments plan their evidence development and self-studies for meeting the ABET criteria, they could save their faculty time by also producing evidence that demonstrates compliance with those criteria not found in ABET. Instead of expending effort to periodically research the large number of non-ABET evaluation criteria, engineering faculty at CSU can use online assessment planning and program review self-study templates to satisfy multiple expectations.

For example, Table 1 highlights in gray shading where the requirements of the two main accreditation agencies, ABET and the Higher Learning Commission (HLC) are consistent, along with requirements from other constituents. Both accreditation agencies require that there be a connection between the institutional mission and program activities that are being assessed (row 2). Therefore, programs must show how each learning objective addresses the mission of the college and university. This table also shows the importance both agencies place on having feedback loops as part of a continuous improvement process (Row 6).

Conversely, Table 1 also identifies quality monitoring areas where the accrediting agencies have inconsistent requirements. The HLC requires that student learning assessment results need to be made available to all constituents, including students (row 10). The ABET has no such requirement of public disclosure. On the other hand, ABET includes program content-specific requirements, whereas the HLC does not evaluate this level of detail. The HLC expectation for student learning to be related to workplace diversity is another area of inconsistency (Row 13).

This alignment of criteria or quality expectations helped the university design a campus-wide continuous improvement system for student learning assessment that delivers various kinds of evidence demonstrating quality. To reveal its effectiveness, the ensuing discussion focuses on the interaction between a single engineering program's assessment planning and the much larger university system and its processes.

INTERACTION OF ENGINEERING PROGRAM AND UNIVERSITY IMPROVEMENT SYSTEM

PRISM, Plan for Researching Improvement and Supporting Mission, is a comprehensive planning and evaluation process for degree programs at Colorado State University. Description is presented in greater detail elsewhere [5]. Essentially, it uses university assessment standards, a structured on-line database, and a peer-review process to guide engineering programs along an evidence generation process that satisfies multiple quality monitoring bodies. This discussion focuses on the needs of engineering faculty and how the system can create efficiencies that result in better assessment programs.

Level one: local program improvement

Because improvement is the key reason for any assessment process, faculty interest and expertise are focused at level one (local improvement). The unique assessment content information that faculty members provide is managed by centralized planning templates, reporting protocols, and database functions that organize this local information into displays of evidence that satisfy multiple quality monitoring bodies. What follows is a description of how one engineering program, the BS Engineering Science, developed an assessment plan and interacted with the University's quality management system to satisfy the four levels of quality attainment mentioned above.

The improvement of this program's assessment planning process resulted, in part, through the university system peer review function. The peer review is one of the more powerful aspects of the system. Although individual programs should be

Table 1. Matrix configuration for designing evidence production, 1) criteria of quality monitoring agencies, 2) evidence generation process, 3) evidence resources

HLC CRITERIA: Higher Learning Commission Criteria & Examples of Evidence	**ABET CRITERIA**: Accreditation Board for Engineering Technology	**UNIVERSITY CRITERIA:** Strategic Plan Goals & Metrics	**PROCESS OF GENERATING EVIDENCE:** Planning & Evaluation Processes producing systematic quality enhancement: 1) Annual Assessment, 2) Academic Program Review	**EVIDENCE RESOURCES**: Demonstrations of Evidence Patterns Satisfying Monitoring Bodies 1) Program Level Improvement [ABET] 2) Institutional Level Improvement [HLC] 3) State Accountability [State Performance Contract] 4) Market Forces [Consumer Demand]
1) Criterion 2: Evaluation and planning processes demonstrate capacity to fulfill mission, improve quality of its education, & respond to future challenges.			Self-Study template requires summaries of unit planning effectiveness for improving student learning, research & outreach. Template requires an evaluative overview of programming that includes identification of strengths and weaknesses plus summaries of special accomplishments, program strengths, concerns/challenges. Template requires discussion of future barriers and opportunities for action planning.	On-line PRISM Reports of Planning Characteristics: shows volume and categories of program improvements. The on-line program review Report of Evaluation and Planning shows aggregations of strengths and weaknesses as well as barriers & opportunities to future action plan success.
2) Core Component 2d –All levels of planning align with the organization's mission	Criterion 2 a) Educational objectives are consistent with institutional mission		Assessment planning template requires descriptive links between planning activity and institutional mission.	PRISM program assessment plan cover pages.
3) Organizational environment supportive of innovation and change 2a			Program review main theme encourages change and improvement over quality assurance with a policy statement stating that success is determined more by the program's evidence of effective planning processes and resulting changes than by meeting a specified outcome.	Program Review Policy Guidelines PRISM public transparency Site "Planning for Improvement and Change" communicates change PRISM Reports of Planning Characteristics—on improvements shows rates of change
4) History **of** achieving its planning goals. 2b	Criterion 2 d) a process of ongoing evaluation of the extent to which these objectives are attained		Self-Study template requires description of progress made on previous action plan goals. The template electronically embeds performance findings for annual assessment outcomes. Programs must also provide a mid-cycle report every 3 years on progress made on Action Plan goals.	PRISM Annual Planning Characteristics Report on performance findings and Implemented Improvements. Annual PRISM reports on program participation. On-Line program review self-studies show gaps in programs' annual assessment planning activity.

Page 2 HLC CRITERIA	ABET CRITERIA	UNIVERSITY CRITERIA	PROCESS OF GENERATING EVIDENCE	EVIDENCE RESOURCES:
5) Maintains effective systems for collecting, analyzing, and using organizational information 2c.	OVERALL Criteria are to foster the **systematic** pursuit of improvement. Criterion 3: Outcomes There must be processes to produce these outcomes and an assessment process, with documented results, that demonstrates that these program outcomes are being measured and indicates the degree to which the outcomes are achieved. Guidelines: Criterion 3 Possible evidence for the assessment process can be a schematic drawing of the assessment process with a time line that reflects systematic processes, documentation of how the process is being sustained, and what multiple assessment methods are being used.		Assessment process includes staff classifying each assessment planning component using a planning characteristics taxonomy that helps categorize assessment activity and aggregates activity volume. Self-Study template instructs programs to describe departmental organizational effectiveness and the systematic processes used for planning activities and performance evaluation.	PRISM Institutional Quality Enhancement Plan and Concept Model. (Process Schematics). Assessment plan on-line inventory and process time lines shows current and behind programs plus the annual sequence of assessment planning steps. PRISM Characteristics Report showing process effectiveness, e.g., range of learning research, volume and frequency of measuring, if findings show strengths and weaknesses as well as the categories and volume of improvements. On-Line Program Review self-studies integrate annual assessment planning, demonstrating the systematic use of organizational information.
6) Data and feedback loops are used throughout the organization to support continuous improvement 2c.	Criterion 2-d A process of on-going evaluation of the extent to which these objectives are attained, the results of which shall be used to develop and improve the program outcomes. . . .” Criterion 3: There must be evidence that the results of this assessment process are applied to the further development of the program.	Goal 7—Learning Outcomes Evaluate and assess student learning as a critical measure of teaching quality. Continuous improvement and accountability is expected of departments. Metric e. PRISM system 2010: Assess impact on continuous improvement.	Assessment plan templates require reporting of program improvements based on student learning research. The University assessment peer-review process includes standards that emphasize the link between improvements and research data and its feedback recommends changes when reported improvements are unrelated to the assessment process. The peer-review process also provides written feedback to programs if planning does not effectively produce improvements.	PRISM Characteristics of Planning Reports classifies Implemented Improvements and reports volume by department by archive year. PRISM on-line dialogues between programs and peer-review teams reveal inconsistencies between improvements and assessment data. PRISM Annual Peer-Review monitors and comments on the rates of improvement based on assessment results.

Page 3 **HLC CRITERIA**	**ABET CRITERIA**	**UNIVERSITY CRITERIA**	**PROCESS OF GENERATING EVIDENCE**	**EVIDENCE RESOURCES:**
7) Planning processes involve internal and external constituents 2d.	Criterion 2-b A process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated		Assessment peer-review committee identifies program activity related to use of external constituents or advisory boards as best practices, which are reported in plans and a common pooling area in the database.	PRISM: Best practices report that is categorized by type with volumes given.
8) Criterion Three: Organization provides evidence of student learning & teaching effectiveness.	Criterion 1 Institution must evaluate student performance, advise students (curricular and career matters), monitor student progress in achieving program outcomes GUIDELINES Programs must have in place an appropriate assessment process that produces documented results that demonstrate that students have achieved each and every item listed in (a) through (k). GUIDELINES Documented results include summaries and evaluation of results-—not a data dump.	7. Learning Outcomes. Metric b. Student knowledge of general education content taught in AUCC-approved courses according to CCHE gtPathways Metric f. Quality assessments of learning as part of Academic Program Reviews	Assessment planning templates require reporting of student learning research findings along with a statement of expected learning performance. A university standard for direct assessment requires all programs to use student demonstrations or performances for learning evaluation according to primary trait analysis. Assessment plan standards and peer-review practices encourage evaluative descriptions of data results; programs are notified if plans include data dumps. Staff classifies each student performance described in planning. Staff identifies plans that do not report learning performance findings. Program review on-line self-studies show annual assessment research results on student performance. Templates require information on student advising objectives and their success.	PRISM: Planning Characteristics Report shows the number of programs not reporting learning research findings. PRISM: Characteristics of Planning Report, Demonstrations of Learning (performances) shows categories and volume. PRISM: On-line assessment plans contain evaluative research data results that show evidence of learning with comparisons to benchmarks set by faculty that signify student success. University annual compliance report with state's CCHE requirement is under development. Program review on-line self-studies show summaries of evidence attained on student learning.

Page 4 HLC CRITERIA	ABET CRITERIA	UNIVERSITY CRITERIA	PROCESS OF GENERATING EVIDENCE	EVIDENCE RESOURCES:
9) EXAMPLES OF EVIDENCE —Assessment includes multiple direct and indirect measures of learning. 3a	Criterion 1 Institution must evaluate student performance. . . GUIDELINES Assessment process uses direct assessment measures that provide "convincing" evidence.		University assessment policy requires programs to use direct assessment to evaluate student learning. University Peer-Review process notifies programs if direct assessment is not used. Staff classifies and counts all direct assessment methods.	PRISM on-line assessment plans all have a methodology section where descriptions of direct assessment appear (over 500 outcomes). PRISM: Characteristics of Planning Report provides categorization and volume and frequencies of direct demonstrations of Learning used by faculty campus wide.
10) Assessment results of student learning are available to appropriate constituencies, including students 3a.		Goal 39—Assessment Systems Provide the Board, the campus and the public with transparent measures of accountability.	PRISM system includes a public transparency component that provides students, parents, and employers with online access to assessment information, e.g., student learning outcomes or learning research methods. It links electronically to the assessment and program review databases.	Website: "Planning for Improvement and Change"
11) Faculty are involved in defining the learning outcomes and their evaluation. 3a	Criterion 5 Faculty Faculty . . . must demonstrate sufficient authority to develop and implement processes for the evaluation, assessment , and continuing improvement of the program and outcomes. Guidelines: Encourages faculty participation in the evaluation and improvement of outcomes—faculty non-involvement in the assessment process or decision-making is generally unacceptable.		Assessment on-line plan template requires a description of the departmental administration of assessment, including faculty participation. In addition, the peer-review process has faculty external to a program talking to faculty in a program on how to improve the assessment process. Program review on-line self-study template requires descriptions of faculty participation in the departmental self-evaluation processes.	PRISM Assessment Plan Cover Pages. PRISM Archive of plans showing past dialogues between peer review faculty and program faculty. PRISM Planning Characteristics report: shows number of faculty dialogues (2,580 in 2004). Program Review self-studies.

Page 5 **HLC CRITERIA**	**ABET CRITERIA**	**UNIVERSITY CRITERIA**	**PROCESS OF GENERATING EVIDENCE**	**EVIDENCE RESOURCES**:
12) Periodic reviews of academic subunits contribute to improvement of organization. 2-c Faculty and administrators routinely review the effectiveness and uses of the organization's program to assess student learning. 3-a The organization's systems of quality assurance include regular review of whether its educational strategies and processes enhance student learning. 3-c			PRISM assessment process requires annual peer-review of planning and evaluation effectiveness for student learning. The online interactive dialogues among faculty members about improvement of processes is documented in a database. The online program review process also uses external peer review to evaluate assessment planning and evaluation processes every six years. This produces another layer of faculty dialog on improvement. The on-line program review self-study templates require discussions on a department's planning and evaluation effectiveness, including that for student learning evaluation.	PRISM: Concept Model Plan on process. PRISM: Planning Characteristics Report, number of peer-review comments and program responses. PRISM: Archive of assessment plans showing dialogues and previous history of peer review feedback to programs. Program Review on-line self-studies display embedded annual peer-review assessment comments as well as those provided by the six-year peer-review process.
13) EXAMPLES OF EVIDENCE –Learning outcomes document that graduates have gained the skills and knowledge they need to function in a diverse, local, national, and global societies. 4c Outcomes include skills and professional competence essential to a diverse workforce. 4c		Goal—3 Curriculum Provide institutional support for infusion of multicultural and global perspectives into the curriculum.	Assessment process has university staff classify all learning outcomes that measure learning performance in multicultural or diversity related content.	PRISM: Planning Characteristics Report, Diversity learning outcomes are reported by volume by department.
14)	GUIDELINES Unacceptable for student learning outcomes that have not been defined, e.g., what is "effective communication skills?"		PRISM assessment plan standards require that learning outcomes define multiple characteristics of a learning goal. The characteristics often make up the primary traits of a learning rubric. The peer-review process identifies outcomes that do not meet the requirement and provides feedback.	PRISM: On-line assessment plans display well-defined learning outcomes. Peer-review dialogues document the improvement of week outcome descriptions. The public transparency Web site permits public access to learning outcomes.

the experts on the content of desired learning outcomes, having independent reviewers provide feedback to the system adds a new level of expertise that can lead to program improvements. In addition, the peer review members, each representing one of eight colleges, operate from a common set of university-wide planning evaluation standards that match the multiple accreditation criteria, such as using direct assessment and others appearing in Table 1. They help programs sustain their compliance with the multiple criteria on an annual basis. For example, the BS in Engineering Sciences first developed its assessment plan using the university's planning templates in 2003. The peer review committee informed the program with online feedback embedded in the plan that the student learning outcome was poorly defined. It recommended adding description to the following outcome: "All engineering seniors will have an ability to design a system, component, or process to meet desired needs (ABET 3c)." The program improved the outcome as follows: "Students are expected to show proficiency in critical design methodology and process elements, including:

1) problem definition,
2) scope,
3) analysis,
4) risk assessment,
5) creativity,
6) synthesizing alternatives,
7) iteration,
8) regulations,
9) codes,
10) safety,
11) sustainability,
12) multiple objectives and various perspectives."

The planning outcome appears in Table 2.2.

The dialogue that resulted as the peer review committee and the program talked back and forth online is documented in the comment section of the database. It helps the program and the institution meet several accrediting criteria, such as evidence of continuous improvement, evidence of faculty participation in assessment, and evidence that the institution periodically reviews the quality of its assessment processes (see Table 2.2, Comment and Response).

The university's system encourages program improvement in other ways too. During their review of assessment plans, the peer review committee members identify best practices in learning assessment and enter them into the university's assessment database. The system maintains a database of best practices from across all programs in

Table 2. BS Engineering Science program assessment plan

General Plan Information	
2.1	
Institutional Mission Linkages: **Colorado State University's Mission**	The dual degree in Engineering and Liberal Arts serves the people if Colorado by providing a program of study for students with broad interests that cross disciplinary boundaries. Graduates of the liberal arts-engineering science dual major often move on to professional programs in medicine, law, veterinary medicine or business. Moreover, these graduates are suited for a wide range of occupations in addition to engineering.
Institutional Strategic Planning Linkages: **Colorado State University's Strategic Plan**	This undergraduate major links to Key Strategy One of the University's strategic plan, specifically 1.9, by incorporating |assessment in its Capstone course. The major also links to the University's Key Strategy 5 Enrollment Management, specifically, 5.4 Student Retention. This major provides a curriculum for students who want to combine what are often considered separate, mutually exclusive majors.
College Planning Goals or Mission Statement Linkages: **Engineering 's Mission**	This major contributes to the college's mission of providing high quality undergraduate programs through broad training in the basic fields of engineering that will educate students who can contribute to, and shape future society. The flexibility of these programs allow students to make societal connections to engineering through a curriculum that often includes a balanced emphasis on both engineering and liberal education topics. College Mission as of November 2005: The College of Engineering's mission is to engineer global solutions that contribute to the quality of life by: Educating for tomorrow's needs, Advancing society, Generating and applying new knowledge, and Stimulating economic development.
Program Purpose:	Engineering science is an interdisciplinary major that allows students to acquire a strong base in mathematics, the physical sciences, and engineering fundamentals while pursuing a broad background in the liberal arts and other areas of interest in preparation for specialized careers or graduate studies. The major provides comprehensive undergraduate engineering education in selected fields which are not served by traditional engineering programs available in the College of Engineering.
Program Administration of Assessment Process:	The assessment process is administered by the Associate Dean for Academic Affairs for the College of Engineering. The assessment committee consists of the Associate Dean and the Engineering Science Committee. The assessment activities will occur during the senior design capstone courses provided by engineering.

2.2

Outcome 1
Student Learning/Development

Description & Methodology

Outcome
All engineering seniors will have an ability to design a system, component, or process to meet desired needs. (ABET 3c)

Students are expected to show proficiency in critical design methodology and process elements, including: problem definition, scope, analysis, risk assessment, creativity, synthesizing alternatives, iteration, regulations, codes, safety, sustainability, and multiple objectives and various perspectives.

Process Used to Develop the Outcome Performance (Strategy)
The engineering science curricula include a series of courses that focus on design projects. This starts with the first year courses and culminated in a two course senior design sequence. The senior design experiences are structured to be fairly comprehensive, and require teams of students to work together to complete the design assignments.

Assessment Method(s)
All engineering students are required to participate in a capstone design project that synthesizes their engineering knowledge. The projects are documented through a series of reports including, project proposals, oral presentations, and final project reports. Faculty members serve as mentors for these projects. The design project work will be evaluated by engineers separate from the design mentors -typically the Engineering Science Faculty Committee and/or external advisory board members. Due to the small number of students in this program, all senior reports will be collected. Each of these reports will be evaluated for matching of the design solutions with the design requirements. Additionally, the reports will be evaluated for the demonstration of the elements of design identified in the above outcome description. The results of these reviews will be made available to the department faculty, and external advisory boards for comment. Note: These reports are generated during the spring semester so results will be available after the Spring 2005 semester.

Expected Performance Level
The goal is for ninety percent of the design objectives to be met by both the proposed and final design solutions in student senior design projects.

Additionally, it is expected that the design projects will demonstration a majority of the design elements listed in the outcome above. It is unrealistic to expect every project to cover every design element but a majority of these items need to be present. Each project will be ranked on a scale of High, medium, and low for the demonstration of these design elements: problem definition, scope, analysis, risk assessment, creativity, synthesizing alternatives, iteration, regulations, codes, safety, sustainability, and multiple objectives and various perspectives. If any element is consistently ranked low across the projects, curricular modifications will be implemented.

Comment 1 Feb 17, 2005	Outcome: Define the learning characteristics of effective design so that students can recognize the learning they are to develop. This will also provide the program with multiple aspects to measure for determining strengths and weaknesses. Make the outcome more student active and measurable with statements, such as ''students will demonstrate design learning characteristics A, B, C, and D in a defined learning demonstration'' rather than ''seniors will have an ability to design.''
Response to Comment 1 Mar 29, 200 by SILLER, THOMAS	The outcome has been expanded to include typical design elements that should be part of the student learning experience.
Comment 2 Feb 17, 2005	Criterion: Please expand the performance expectation (90%) to include each of the design learning characteristics that will be listed in the outcome so that reported results will indicate a range of scores showing strengths and weaknesses.
Response to Comment 2 Mar 29, 2005 by SILLER, THOMAS	This has been added to the criterion in the plan.

Supporting Materials

Symposium VII Group *Student Self Assessment*

Symposium VII Individual *Student Self Assessment*

Best Practice 2/17/2005 12:57 PM	Plan Component *Assessment Method: Student Learning* Outcome 2 Best Practice Student involvement– results

During the senior design projects, all students are required to make oral presentations. These presentations may be to the class, design teams, clients, etc. A group of faculty separate from the design mentors -typically the Engineering Science Faculty Committee, will observe these student presentations. The presentations will be graded on a rubric classifying the presentation into the categories of excellent, proficient, adequate, and inadequate. This rubric will be given to the students before the presentation. A sample of student presentations representing at least fifty percent of the number of students in the class will be collected. The results of these reviews will be made available to the students, department faculty, and external advisory boards for comment. When appropriate, external reviewers from industry will also be asked to help in the review process.

Best Practice 4/6/2005	Plan Component *Assessment Method: Student Learning* Outcome 1 Best Practice External advisory persons used All engineering students are required to participate in a capstone design project that synthesizes their engineering knowledge. The projects are documented through a series of reports including, project proposals, oral presentations, and final project reports. Faculty members serve as mentors for these projects. The design project work will be evaluated by engineers separate from the design mentors -typically the Engineering Science Faculty Committee and/or external advisory board members. Due to the small number of students in this program, all senior reports will be collected. Each of these reports will be evaluated for matching of the design solutions with the design requirements. Additionally, the reports will be evaluated for the demonstration of the elements of design identified in the above outcome description. The results of these reviews will be made available to the department faculty, and external advisory boards for comment. Note: These reports are generated during the spring semester so results will be available after the Spring 2005 semester.

the university that emphasize successes in meeting accrediting criteria or strategic planning expectations. Programs can access this database for alternative assessment approaches being used in other colleges. This places the assessment activities into a broader context where improvement cycles exist beyond the particular engineering program. The BS Engineering Science has contributed to this pool of best practices by involving external advisory boards in the assessment process and sharing learning rubrics with students before their demonstrations of learning take place (Table 2.2, Best Practice).

Because university faculty now upload learning evaluation instruments into several of their 500 plus learning outcomes, the database enables the campus community to browse the thousands of instruments by type, e.g. graduate committee evaluation forms for dissertations and rubrics for undergraduate oral presentations. After the BS program had improved its learning outcome definitions, assessment rubrics could be more easily formulated. The BS program improved its use of learning rubrics by using the system's database collection of learning research instruments. Now, there is a rubric associated with the program's communication skills outcome with characteristics such as the use of good graphics and presentations that are well organized.

Table 2.2 also contains an improved definition of student success that resulted from the peer review process. Performance expectations must be associated with each outcome characteristic or the reported research findings will not distinguish the strong performance areas from the weaker ones.

Level two: university monitoring

For level two, university criteria, the BS program leverages the university assessment system to satisfy the institution's expectation for departments to provide the Board of Governors, the campus, and the public with transparent measures of accountability (Table 1, Goal 39, Row 10). Even though this is not an ABET standard, the program still contributes to the university's needs just by agreeing to use the online database and its standard planning templates, so information can be distributed to the non-ABET quality monitoring levels.

Level three: ABET monitoring

ABET's criteria for assessment were used as a foundation for PRISM's development. Specifically, the following program requirements are addressed:

1) Links program learning research to the institutional mission and planning.
2) Uses systematic process for collecting, analyzing, and using data.
3) Practices rigorous program assessment using a high level of direct assessment.
4) Implements an appropriate assessment process that produces documented results demonstrating that students have achieved each and every item listed in (a) through (k).
5) Develops feedback loops that produce improvements.
6) Demonstrates ongoing improvement in planning and evaluation.
7) Administers an assessment process based on

Table 3. PRISM Assessment planning timeline

	Sep 2005–Oct 2005	**Nov 2005–Dec 2005**	**Jan 2006–Oct 2006**	**Sep 2006–Oct 2006**	**Nov 2006–Dec 2006**	**Jan 2007–Oct 2007**	**After Oct 2007**
BS Engineering Science 2005–2007	Revised plan for new cycle	APAIC comments on plan	Respond to APAIC comments	Report results	APAIC comments on results	Respond to APAIC comments	Plan complete
BS Engineering Science 2006–2008	Revised plan for new cycle	Peer-review comments on plan	Respond to peer-review feedback	Report results	Peer-review comments on results	Respond to peer-review feedback	Plan complete

the needs of the program's various constituencies in which the objectives are determined and periodically evaluated.
8) Encourages faculty participation in the evaluation and improvement of student learning.

As indicated in Table 1, the PRISM system generates documented evidence patterns for all ABET criteria. For example, Table 2.1 shows how the university system's template helps a program demonstrate that its assessment plan links to both the institutional mission and the college mission. Mission statements should provide focus to college activities; therefore the learning outcomes should support that mission.

Clearly the engineering program's engagement of PRISM demonstrates its compliance with the ABET criteria to use a systematic process for collecting, analyzing, and using data (Table 1, Row 5). With this online system, programs have a consistent structure for implementation of assessment plans. Sequential PRISM timelines manage the annual assessment process, guiding programs through a series of developmental planning steps on an academic year basis (see Table 3). After the design of a new plan undergoes a peer review by the university committee, the plan is implemented. Using the interactive, online database, the program annually reports student learning research results, program improvements and revises planning outcomes for the upcoming year. It also uses the database to respond to the online feedback comments of the peer review committee, forming dialogues of improvement among faculty members that help satisfy ABET's Requirement 8 above.

Because the engineering plan is in a database, functionality includes the ability to move the plan backward and forward in time, allowing external viewers to realize the evolutionary changes in planning and improvement. The program uses this functionality to demonstrate to ABET site teams that it practices ongoing evaluation with resulting improvements over time.

In addition, the program uses the online template to communicate its engagement of external advisory boards to affect its assessment process. Assessment method of Table 2.2 specifies that outside constituents will be a part of program evaluation. This section also illustrates the program's use of direct assessment.

Reinforcing this use of external advisers, PRISM provides the BS program with transparency of assessment information so that it can communicate its learning research effort and improvements to students, parents and employers. For example, employers can access the engineering college's learning demonstrations, such as internships or design projects to see if they apply to their workplace needs. The US Department of Education's Commission on the Future of Higher Education 2006 recently emphasized the need for greater public transparency in the reporting of learning assessment results [6].

The online database system applies a structure onto the planning process that holds programs accountable on a regular basis. Without this, programs often get actively engaged in assessment procedures only when accreditation nears, and neglect it during other times. With ABET, a typical cycle is six years—a long time for plans to grow old and abstract.

Level four: regional accreditation monitoring

The BS Engineering Science has not engaged the university system's functionality as effectively at this level. The program has not provided evidence in its assessment planning that it is evaluating learning related to participation in a diverse workforce (Table 1 Row 13). It has not described how program assessment results are routinely shared with students (Table 1, Row 10). The research findings or data results on student learning are not fully developed (Table 1, Row 8). However, the program does participate in the system's process for periodic review of assessment planning effectiveness (Table 1, Row 12). While the program satisfies many of the regional HLC criteria by meeting ABET standards, faculty members need to be aware of those quality monitoring areas where their evidence production is insufficient. At least with this quality management system, programs do not have to wait until a regional accrediting team arrives to learn their gaps in evidence production.

SAVING FACULTY TIME

A final point worth discussing about PRISM is the efficiency provided in terms of faculty time and effort required for assessment. The annual cycle of assessment documented by PRISM does require faculty and staff time for plan development, data collection and summary, and implementing program improvements. This cycle is required by ABET, so there is little opportunity for reducing faculty efforts at this stage. But the other quality-monitoring levels identified in Table 1 require similar assessment plans, often at different times from ABET. One way PRISM reduces faculty effort is by using ABET requirements to also satisfy these other constituents. Also, the development of assessment plans requires expertise often not germane to engineering faculty. By providing both peer review and access to plans from across the university, engineering faculty have quick access to expertise and instructional strategies that can lead to better assessment plans and instruction with minimal faculty effort. Ultimately, faculty members are more likely to embrace a system that reduces their assessment efforts, but maintains and improves program quality.

If faculty effort can be reduced by not spending time on data storage, quality peer review, monitoring of program participation, transparency for constituents, or documentation of evidence

required to satisfy multiple accreditation and accountability criteria, then authentic student learning assessment may be more readily embraced. The university's recent integration of the assessment database and the on-line program review's self-study development means that the work faculty members do annually on assessment is automatically embedded into their six-year self-studies, relieving them of this evidence preparation task. Ultimately, the goal of any improvement system should lead to changes at the local level of faculty-student interaction, i.e. pedagogy and curriculum.

SUMMARY AND CONCLUSIONS

The value of direct assessment of learning outcomes for engineering can be the improvement of undergraduate programs. Assessment should be used to assist in the construction of a broad picture of program quality. Unfortunately, assessment is too often seen as an end in itself and is not integrated into other activities. Assessment for the benefit of assessment becomes just another bureaucratic constraint on faculty and engineering programs. To realize the value through planning integration, Colorado State University has designed and implemented a comprehensive university-wide database system that situates learning outcomes assessment into the broader picture of program evaluation. This system provides a planning and evaluation context that comprises not only engineering accreditation, but also university accreditation, along with other internal constituents. The program's goal is to encourage well planned assessment programs that fulfill the needs and requirements of multiple constituents and lead to measurable improvements in student performance and learning. These goals are consistent with the purpose and desires of ABET. More importantly, they should be congruent with the desire of all engineering faculty—better undergraduate programs.

In support of our goals we have demonstrated two main points:

1) Assessment requirements for specialty accreditation for engineering education in the United State can be systematically managed to provide a transparent improvement cycle,
2) there are great advantages to centralizing assessment programs to leverage their common reqirements for specialty and regional accreditation requirements.

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