Preparing for EC 200x

Texas A&M University

Jeff Froyd, Texas A&M University

Workshop Questions

- How might you prepare a self-study report?
- What are various methods for assessment data collection and reporting?
- How might you choose assessment data for program evaluation and enhancement?
- How might you select and implement assessment processes?
- How might you gather, process, and report assessment results?
- How might you use assessment data to close the loop in a engineering program?

Workshop Facilitator

- **Jeff Froyd**
  - Director for Academic Development, Texas A&M University
  - Project Director, Foundation Coalition (FC)
  - Started curriculum project to integrate circuits and electronics at Rose-Hulman (circa 1985)
  - Started curriculum project that integrated first-year curriculum at Rose-Hulman (circa 1990)
  - Observed curriculum innovations and assessment across the FC and other institutions

Question No. 1

How might you prepare a self-study report?

Jeff Froyd, Texas A&M University

EC 200x General Criteria

- **Criterion 1: Students**
- **Criterion 2: Program Educational Objectives**
- **Criterion 3: Program Outcomes and Assessment**
- **Criterion 4: Professional Component**
- **Criterion 5: Faculty**
- **Criterion 6: Facilities**
- **Criterion 7: Institutional Support and Financial Resources**

Criterion 1: Students

- Program Requirements
  - **Evaluate incoming students**
  - **Advise current students**
  - **Evaluate and enforce program requirements**
  - **Evaluate success in meeting program outcomes (see Criterion 3)**
- Exceptional Cases
  - **Check compliance with policies for the acceptance of transfer students**
  - **Check compliance with validation of courses taken for credit elsewhere.**

Criterion 1. Students

- The quality and performance of the students and graduates are important considerations in the evaluation of an engineering program. The institution must evaluate, advise, and monitor students to determine its success in meeting program objectives.
- The institution must have and enforce policies for the acceptance of transfer students and for the validation of courses taken for credit elsewhere. The institution must also have and enforce procedures to assure that all students meet all program requirements.

Criterion 1: Students

- Describe the processes through which entering students are selected.
- Describe the processes through which student progress is monitored and students are informed about their progress.
- Describe the processes for decisions about course substitutions. Evaluate affect on criterion 4.
- Describe the processes for decisions about transferring credit for courses taken at another school.
- Describe the processes for decisions about transfer students and credit for their courses.
- Make sure transcripts are consistent with process descriptions.

Criterion 2. Program Educational Objectives

- Each engineering program must have:
  - (a) detailed **published** educational objectives
  - (b) a **process** that involves the program's various constituencies to determine and periodically evaluate the educational objectives
  - (c) a curriculum and processes that ensure the achievement of these objectives
  - (d) a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program.

Criterion 2. Program Educational Objectives

- Each engineering program for which an institution seeks accreditation or reaccreditation must have in place:
  - **(a) detailed published educational objectives that are consistent with the mission of the institution and these criteria**
  - **(b) a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated**
  - **(c) a curriculum and processes that ensure the achievement of these objectives**
  - **(d) a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program.**

Criterion 2. Program Educational Objectives

- **State program educational objectives**
- **Indicate where the educational objectives are published**
- **Describe program constituencies**
- **Describe the process through which the educational objectives were developed and how the various constituencies were involved**
- **Describe the process through which the educational objectives will be reviewed.**
- **For each educational objective describe the level of achievement and present a reasoned argument (with data) that supports the conclusion.**

Criterion 3. Program Outcomes and Assessment

- Student Outcomes: a-k
- Assessment Process
  - **Documented results**
- Continuous Improvement
  - **Evidence must be given that the results are applied to the further development and improvement of the program.**

EC 200x Program Outcomes

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs

(d) an ability to function on multi-disciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Criterion 3. Program Outcomes and Assessment

- Engineering programs must demonstrate that their graduates have:
  - **(a) an ability to apply knowledge of mathematics, science, and engineering**
  - **(b) an ability to design and conduct experiments, as well as to analyze and interpret data**
  - **(c) an ability to design a system, component, or process to meet desired needs**
  - **(d) an ability to function on multi-disciplinary teams**
  - **(e) an ability to identify, formulate, and solve engineering problems**
  - **(f) an understanding of professional and ethical responsibility**
  - **(g) an ability to communicate effectively**
  - **(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context**
  - **(i) a recognition of the need for, and an ability to engage in life-long learning**
  - **(j) a knowledge of contemporary issues**
  - **(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.**
- 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.

Criterion 3. Program Outcomes and Assessment

- Describe your program (student) outcomes.
- Describe the process through which the program outcomes were developed. How were your constituencies involved?
- Describe the process through which the program outcomes are reviewed. How are your constituencies involved?

Criterion 3. Program Outcomes and Assessment

- For each program outcome
  - **Indicate which person or group of people is responsible**
  - **Indicate the expected level of achievement**
  - **Describe the process through which the outcome is being evaluated, that is, how do you decide the level to which an outcome is being achieved**
  - **Indicate the level to which the outcome is being achieved**
  - **Present a reasoned argument (with data) the supports your conclusion about the level of achievement**

Criterion 3. Program Outcomes and Assessment

- Continuous Improvement
  - **At a particular point in time how do you identify which program outcomes have the highest priority in terms of improvement?**
  - **In preparing the visit report provide examples of program outcomes that had the highest priority in terms of improvement?**
  - **For each program outcome targeted for improvement, describe the changes which have been made to effect improvement?**
  - **For each program outcome, describe the results of the changes in terms of possible changes in the level of achievement**

Criterion 3. Program Outcomes and Assessment

- Objective-Outcome Matrix
- Outcome-(a-k) Matrix
- Objective-Course Matrix
- Outcome-Course Matrix
- Process Diagrams

Criterion 4. Professional Component

- Major design experience
  - **Based on the knowledge and skills acquired in earlier course work**
  - **Incorporates most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political.**
- Course requirements:
  - **(a) one year of college level mathematics and basic sciences**
  - **(b) one and one-half years of engineering topics, that is, engineering sciences and engineering design**
  - **(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.**

Criterion 4. Professional Component

- The professional component requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The engineering faculty must assure that the program curriculum devotes adequate attention and time to each component, consistent with the objectives of the program and institution. Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political. The professional component must include:
  - **(a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline**
  - **(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study**
  - **(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.**

Criterion 4. Professional Component

- **Major Design Experience**
  - Overall description
  - Describe how most of the factors are incorporated into the major design experience
  - Provide examples of student work that show design process, quality outcomes, and understanding of different factors
- **Course Requirements**
  - Transcript analysis

Criterion 5. Faculty

- Sufficient number
  - **Student-faculty interaction**
  - **Student advising and counseling**
  - **University service**
  - **Professional development**
  - **Interactions with practitioners**
- Breath of competence to cover all of the curricular areas of the program.
  - **Education**
  - **Experience: engineering, Professional Engineers, teaching, professional societies, etc.**
  - **Activity in curricular/pedagogical initiatives**
  - **Research activity**

Criterion 5. Faculty

- The faculty is the heart of any educational program. The faculty must be of sufficient number; and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.
- The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program, its educational objectives and outcomes. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and registration as Professional Engineers.

Criterion 5. Faculty

- Complete the faculty worksheet
- Include a brief paragraph on each faculty member in the self-study.

Criterion 6. Facilities

- Classrooms
  - **Number and size**
- Laboratories
  - **Number and size**
  - **Evidence of continued maintenance and improvement**
- Equipment, including computers
  - **Inventory**
  - **Evidence of continued maintenance and improvement**

Criterion 6. Facilities

- Classrooms, laboratories, and associated equipment must be adequate to accomplish the program objectives and provide an atmosphere conducive to learning. Appropriate facilities must be available to foster faculty-student interaction and to create a climate that encourages professional development and professional activities. Programs must provide opportunities for students to learn the use of modern engineering tools. Computing and information infrastructures must be in place to support the scholarly activities of the students and faculty and the educational objectives of the institution.

Criterion 6. Facilities

- Describe classrooms
- Describe each laboratory and how it has been updated
- Describe equipment and how it has been updated.

Criterion 7. Institutional Support and Financial Resources

- Financial resources
  - **Attract, retain, support well-qualified faculty**
  - **Acquire, maintain, operate facilities and equipment**
- Institutional support
  - **Adequate service personnel**
  - **Adequate institutional services**
- Constructive leadership

Criterion 7. Institutional Support and Financial Resources

- Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program. Resources must be sufficient to attract, retain, and provide for the continued professional development of a well-qualified faculty. Resources also must be sufficient to acquire, maintain, and operate facilities and equipment appropriate for the engineering program. In addition, support personnel and institutional services must be adequate to meet program needs.

Criterion 7. Institutional Support and Financial Resources

- Describe available financial resources and how they have been used
- Describe professional development opportunities
- Describe support personnel
- Describe institutional services
- Describe relationship with larger campus community

Question No. 2

What are various methods for assessment data collection and reporting?

Jeff Froyd, Texas A&M University

Assessment Methods

1. Commercial Norm-Referenced, Standardized Examinations
2. Locally Developed Examinations
3. Oral Examinations
4. Performance Appraisals
5. Simulations
6. Written Surveys and Questionnaires
7. Exit Interviews and Other Interviews
8. Third Party Reports
9. Behavioral Observations
10. External Examiners
11. Archival Records
12. Portfolios
13. Classroom Research
14. "Stone" Courses
15. Focus Groups

Prus, J., Johnson, R., (1994) Assessment & Testing, Myths & Realities, *New Directions for Community Colleges*, No. 88, Winter 1994

Question No. 3

How might you choose assessment data for program evaluation and enhancement?

Jeff Froyd, Texas A&M University

EC 200x Program Outcomes

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs

(d) an ability to function on multi-disciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Outcomes for Graduates

- **Criterion 3:** "Engineering programs must demonstrate that their graduates have …"
- Since the purpose of the assessment is to demonstrate achievement of outcomes by graduates, proximity of the data collected to the time of graduation is important.
- Since time and energy are required to generate assessment data, prudent allocation of resources suggests that most data related to achievement of outcomes be collected near the time of graduation.

Grades

- **Course grades are composite scores. Using course grades as assessment data for one or more outcomes will raise questions.**
- **Course grades may be used as assessment data for outcomes in SPECIFIC cases, but be prepared to make the case why course grades are a relevant indicator for a specific outcome.**

Major Design Experience

- **Extract lots of information from student work during major design experience**
- **Major design experience must address many factors relating to outcomes a-k**
  - Teams, social/global issues, ethical issues, may illustrate ability to perform research/lifelong learning
- **Major design experience is a cumulative learning experience and is well positioned to provide information on graduates**

Cooperative Programs?

- **Design a careful program to collect feedback from employers**

Outcome (a): Apply knowledge

(a) an ability to apply knowledge of mathematics, science, and engineering

- **Potential Sources of Data**
  - Performance in senior courses
  - Comprehensive exams for selected technical stems
  - Scoring data from major design experience work products
  - Student perception and attitude surveys
  - Exit interviews

Outcome (b): Interpret data

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

- **Potential Sources of Data**
  - Performance in senior courses, especially laboratory courses
  - Scoring data from major design experience work products
  - Student perception and attitude surveys
  - Exit interviews

Outcome (c): Design

(c) an ability to design a system, component, or process to meet desired needs

- **Potential Sources of Data**
  - Scoring data from major design experience work products
  - Transferable Integrated Design in Engineering Education (TIDEE) Design Knowledge Instrument
  - Student perception and attitude surveys
  - Exit interviews

Outcome (d): Teams

(d) an ability to function on multi-disciplinary teams

- **Potential Sources of Data**
  - Scoring data from major design experience work products
    - Peer assessments
    - Team Knowledge Test
    - Team Process Checks
  - Soft Skills Assessment Inventory (SSAI)
  - Student perception and attitude surveys
  - Exit interviews

http://www.fcae.umassd.edu/fcteam/teamfacultyguide/frames_index.html

Outcome (e): Solve problems

(e) an ability to identify, formulate, and solve engineering problems

- **Potential Sources of Data**
  - Performance in senior courses
  - Comprehensive exams for selected technical stems
  - Scoring data from major design experience work products
  - Student perception and attitude surveys
  - Exit interviews

Outcome (f): Ethics

(f) an understanding of professional and ethical responsibility

- **Potential Sources of Data**
  - Performance in ENGR 482 Engineering and Ethics
  - Scoring data from major design experience work products
  - Student perception and attitude surveys
  - Exit interviews

Outcome (g): Communications

(g) an ability to communicate effectively

- **Potential Sources of Data**
  - Scoring data from major design experience work products, including team communications and client communications
  - Communications data from other senior courses
  - Student perception and attitude surveys
  - Exit interviews

Outcome (h): Social/global context

(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context

- **Potential Sources of Data**
  - Scoring data from major design experience work products
  - Student perception and attitude surveys
  - Exit interviews

Outcome (i): Lifelong Learning

(i) a recognition of the need for, and an ability to engage in life-long learning

- **Potential Sources of Data**
  - Learning and Study Skills Inventory (LASSI)
  - Study Process Questionnaire (SPQ)
  - Demonstrated research abilities
  - Student perception and attitude surveys
  - Exit interviews

Learning and Study Skills Inventory (LASSI)

- **The Learning and Strategies Inventory (LASSI), is a computer-based program designed as a self-assessment tool.**
- **Students are given questions regarding:**
  - their personal study habits
  - information processing skills
  - time-management
  - various other areas of concern related to attaining academic success
- **The purpose of this self-assessment is to help students recognize their strengths and weaknesses.**

Learning and Study Skills Inventory (LASSI)

http://www.hhpublishing.com/_assessments/LASSI/index.html

- **Skill Component of Strategic Learning**
  - Information Processing
  - Selecting Main Ideas
  - Test Strategies
- **Will Component of Strategic Learning**
  - Attitude
  - Motivation
  - Anxiety
- **Self-regulation Component of Strategic Learning**
  - Concentration
  - Time Management
  - Self-Testing
  - Study Aids

Learning and Study Skills Inventory (LASSI)

Choose the response that most closely matches your feeling about the statement.(SD=Strongly, Disagree, D=Disagree, A=Agree, SA=Strongly Agree)

1. I take rest periods when I study.
2. Roommates, family, or friends distract me while I study.
3. I study for at least an hour without being distracted
4. Listening and staying focused on lectures in my classes is a problem for me.
5. I find it difficult to pay attention in lectures.
6. During a lecture, I doodle in my notebook or sketch pictures unrelated to the course

Study Process Questionnaire

- **The SPQ is a 42-item questionnaire**
- **The SPQ is a diagnostic tool to identify the learning approaches of the students.**
- **The SPQ provides feedback on the learning approaches in the three domains:**
    - the surface approaches
    - the deep approaches
    - the achieving approaches

Surface Approaches

- **Surface motives are extrinsic such as:**
  - fear of failing
- **Surface strategies include:**
  - Reproductive
  - Rote learning
  - “Minimalistic" learning
- **Surface learning is just enough to meet the course demands. Such an approach often leads to poor academic performance.**

Deep Approaches

- **Deep approaches are about:**
  - seeking to understand
  - relate understanding to other subjects and to develop personal meaning for subject material.
- **However, a deep learner may sometimes wander off-track and not follow course syllabi and outlines.**
- **Academic performance, especially in a more structured system, may also be adversely affected.**

Achieving Approaches

- **An achieving approach is about:**
  - maximizing performance while optimizing efforts to achieve it.
- **These are strategic learners who may use surface or deep approaches; whichever that can help them to get high marks.**

Outcome (j): Contemporary Issues

(j) a knowledge of contemporary issues

- **Potential Sources of Data**
  - Scoring data from major design experience work products
  - Student perception and attitude surveys
  - Exit interviews

Outcome (k): Tools

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

- **Potential Sources of Data**
  - Performance in senior courses
  - Comprehensive exams for selected technical stems
  - Scoring data from major design experience work products
  - Student perception and attitude surveys
  - Exit interviews

Question No. 4

How might you select and implement assessment processes?

Jeff Froyd, Texas A&M University

Team Exercise

- **Break into four-persons teams.**
- **Task**
  - Pick a program outcome
  - Select the data sources that you will use
  - Describe when and how you will gather and process the data
  - Describe how you will use the data to reach decisions about the level of achievement with respect to the program outcome.
- **Time: 25 minutes**

Share Plans

- **Assemble into new teams with one representative from each old team.**
- **Each representative will pick one interesting/challenging program outcome and share the potential solution. (3 minutes)**
- **Solicit suggestions to improve (5 minutes)**
- **Total Time: 25 minutes**

Generate Questions

- **Form teams of four.**
- **Each team should generate two questions about selecting and implementing assessment processes**
- **??**


Foundation
Coalition

Question No. 5

How might you gather, process, and report assessment results?

Jeff Froyd, Texas A&M University

Generate Questions

- **Form teams of four.**
- **Each team should generate two questions about processing and reporting assessment processes.**
- **??**


Foundation
Coalition

Question No. 6

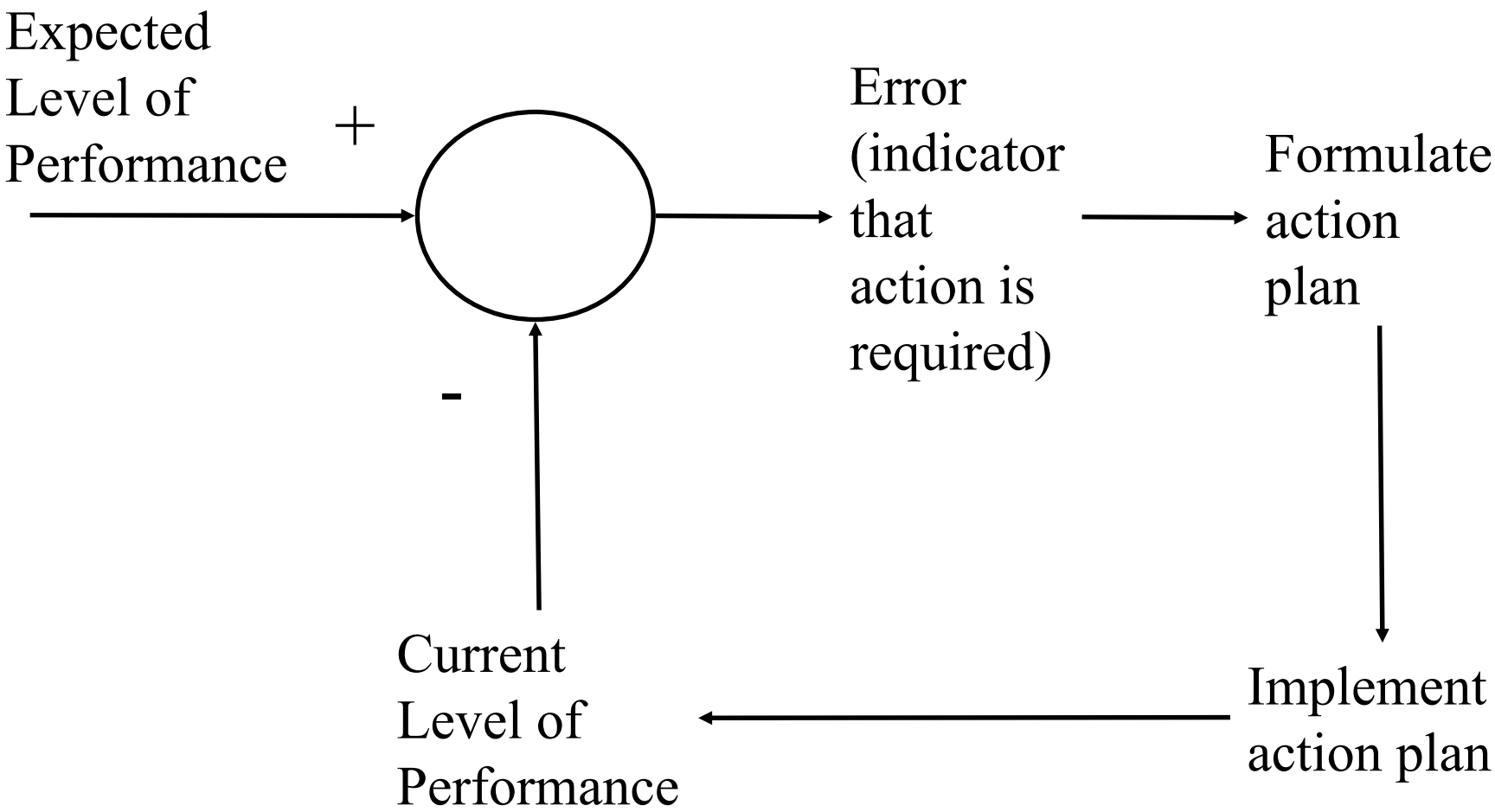
How might you use assessment data to close the loop in a engineering program?

Jeff Froyd, Texas A&M University

General Idea

- **Step 1: In generating each outcome, you will have established an expected level of achievement for the outcome.**
- **Step 2: After processing assessment data for each outcome, you will have constructed a current level of achievement for the outcome.**
- **Step 3: Program committee will review expect and current levels of achievement and decide which outcomes should receive attention.**
- **Step 4: For each outcome slated to receive attention, prepare a plan to improve student performance.**
- **Step 5: Implement plan**
- **Step 6: Use assessment process already in place to observe the effects of the changes.**

General Idea



General Idea

- **Personal Opinion (which has been reiterated by others): Failure to meet expected level of achievement should NOT lead to a weakness or deficiency that would require exceptional accreditation action.**
- **Failure to meet targeted goal should lead to action to improve performance.**

Course Pre-Tests

- **One continuous improvement mechanism that has been used is course pre-tests.**
- **Idea: Almost every engineering course has course prerequisites.**
  - Ideally, students starting the course should have a set of knowledge and skills that raises the likelihood of success to a reasonably high level.
  - Design a local test that indicates the degree to which students starting the course have the required knowledge and skills.
  - Use data from course pre-test to assess the level of knowledge and skills and provide feedback to teachers in prerequisite courses about student performance

Generate Questions

- **Form teams of four.**
- **Each team should generate two questions about closing the loop?**
- **??**


Foundation
Coalition