IOWA STATE UNIVERSITY
Department of Electrical and Computer Engineering

Implementation and Results of a Revised ABET Assessment Process

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Background

- All engineering programs in the college were reviewed during fall 2012.
- The ECE Department has 3 programs:
  - Computer engineering
  - Electrical engineering
  - Software engineering (co-administered with CS)
- Motivation to revise the process for assessing student outcomes:
  - Current engineering accreditation criteria
  - Efficiency
  - Sustainability

Outline

- Current criteria and principles of assessing student learning at the program level
- Faculty involvement in the assessment process
- Multilevel assessment approach
  - Efficient data collection
  - Sufficient data to make decisions
- Assessment examples
- Evaluation of assessment results
- Conclusions

Criteria for Accrediting Engineering Programs

1. STUDENTS
2. PROGRAM EDUCATIONAL OBJECTIVES
3. **STUDENT OUTCOMES**
4. **CONTINUOUS IMPROVEMENT**
5. CURRICULUM
6. **FACULTY**
7. FACILITIES
8. INSTITUTIONAL SUPPORT

PROGRAM CRITERIA

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

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

c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d) an ability to function on multidisciplinary teams

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

f) an 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, economic, environmental, and societal context

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

j) a knowledge of contemporary issues

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

Criteria (continued)

- Criterion 6. Faculty: … 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**.

Okay, wait. What were we studying again?

ABET Training Materials

http://www.abet.org/pev-refresher-training-module4/

Student Learning Outcomes: Criteria 3 and 4

The focus of the data collection is to answer the question:

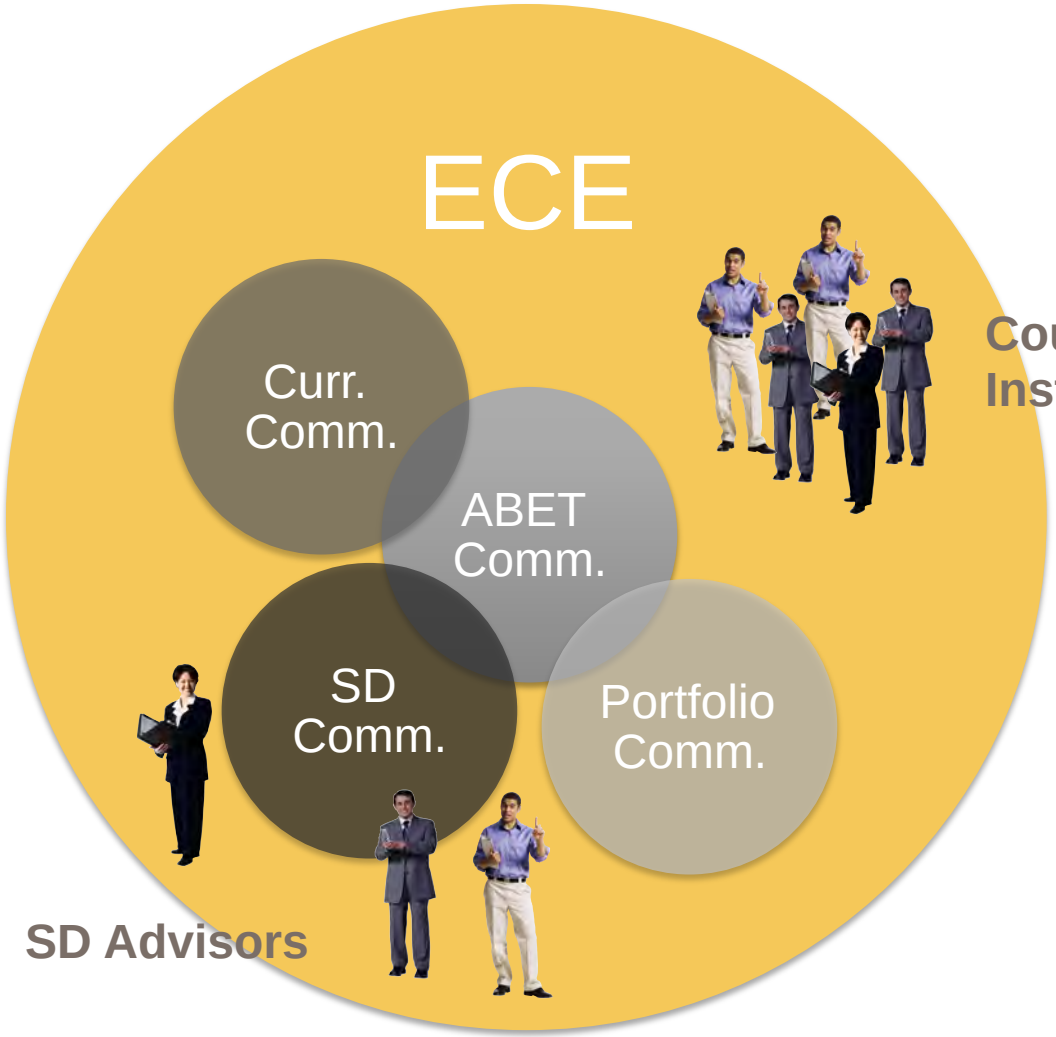
Can the program demonstrate the level to which students have attained the student outcomes?

Principles of Assessing Student Learning at the Program Level

- Focus of Criterion 4 is on:
  - Assessment of the *program*, not individual students.
  - *Cumulative learning* of students, not assessment of individual courses.
  - Information for decision making.
- A program does not have to:
  - Collect data on every student in every course.
  - Collect more than one data point on each student in the program cohort.
  - Assess every outcome every year.
- Student outcomes should be defined.

If I'd known they wanted me to use all this info, I would never have asked for it!

Faculty Involvement



Faculty Involvement (continued)

- Faculty committees and groups involved over 40% of the faculty in targeted ways in student outcomes assessment.
  - 55 faculty members in the department at tenured, tenure-track, and lecturer ranks
  - Curriculum committee: 7
  - ABET committee: 7
  - Senior design committee: 7
  - Portfolio review committee: 8
  - With some overlap, more than 20 faculty members participated in these committees.

Faculty Involvement (continued)

- Spreads the workload among the faculty
- Division of responsibility aligns well with the scope of each committee
- Creates a community of practice around student outcomes assessment
  - Supports instructors who conduct course-level outcomes assessment
  - Shares responsibility for program improvement
  - Creates greater awareness of how to assess student learning
- Challenge: consistency and uniformity in reviewing and scoring student work using rubrics

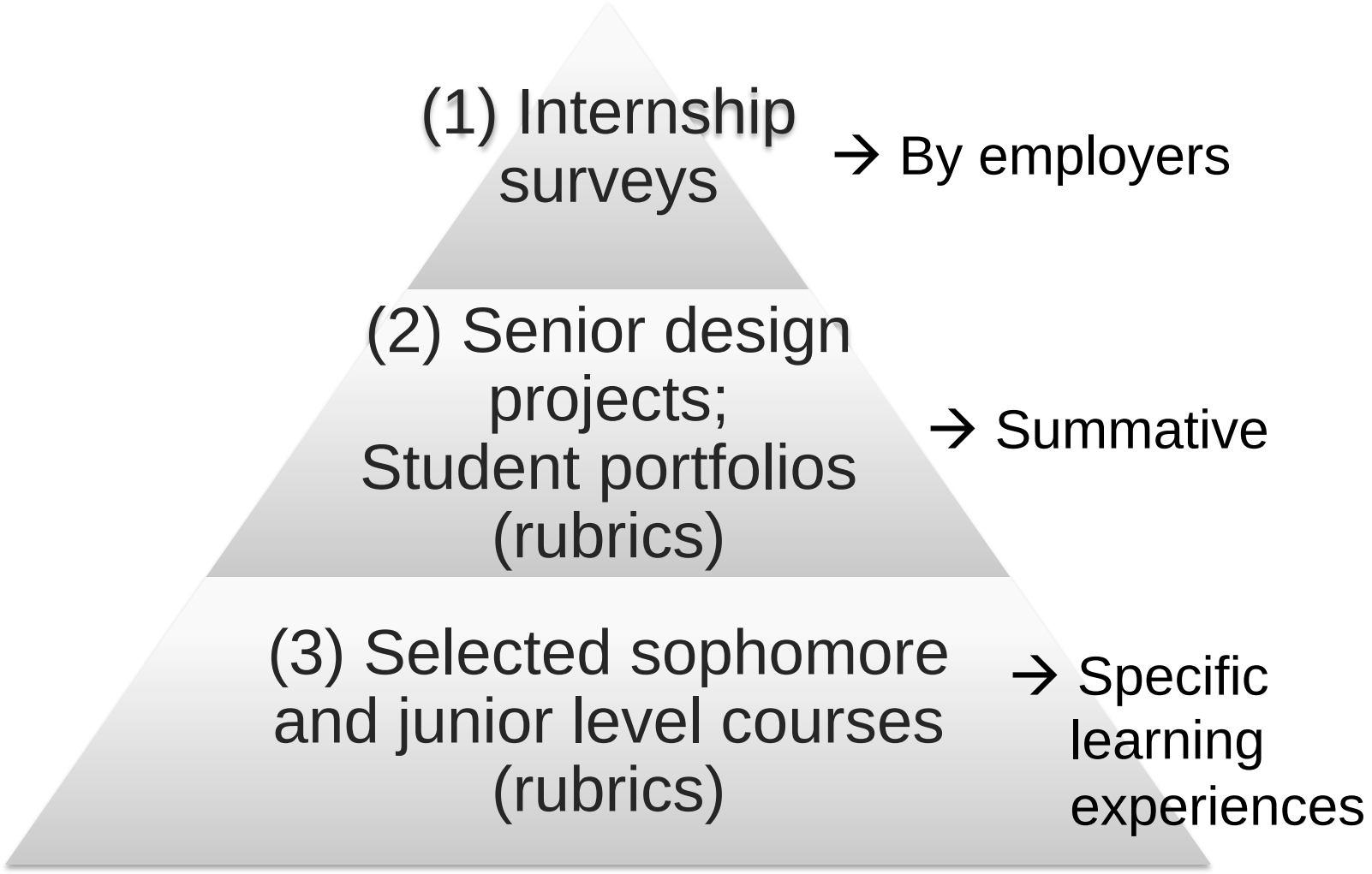
Multilevel Assessment Approach

- Involves various faculty
- Incorporates various proven assessment tools and practices

→ Integrated and coordinated use of tools/ practices by the faculty committees represents a creative approach to department-wide student outcomes assessment across multiple programs.

- Related approaches: Auburn University (ASEE 2011), U.S. Military Academy (ASEE 2007)

Multilevel Assessment (continued)



Student Outcomes Assessment Tools for the Computer Engineering Program

Direct Assessment Tool	ABET Student Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
Level 1: Employer survey from internships	√	√	√	√	√	√	√	√	√	√	√
Level 2: Senior design scoring by industry panel			√		√		√				√
Level 2: Senior design rubric scoring by faculty advisor	√		√	√	√	√	√				√
Level 2: Senior design rubric scoring by instructor			√			√	√				
Level 2: Portfolio rubric scoring by faculty								√	√	√	√
Level 3: Course-based rubric scoring by instructor											
CPRE 281: Digital Logic		√									
EE 230: Electronic Circuits and Systems		√			√						
CPRE 288: Embedded Systems			√								
CPRE 381: Computer Organization					√						√
CPRE 310: Theoretical Foundations of Comp. Eng.	√										
CPRE 394: Program Exploration						√					

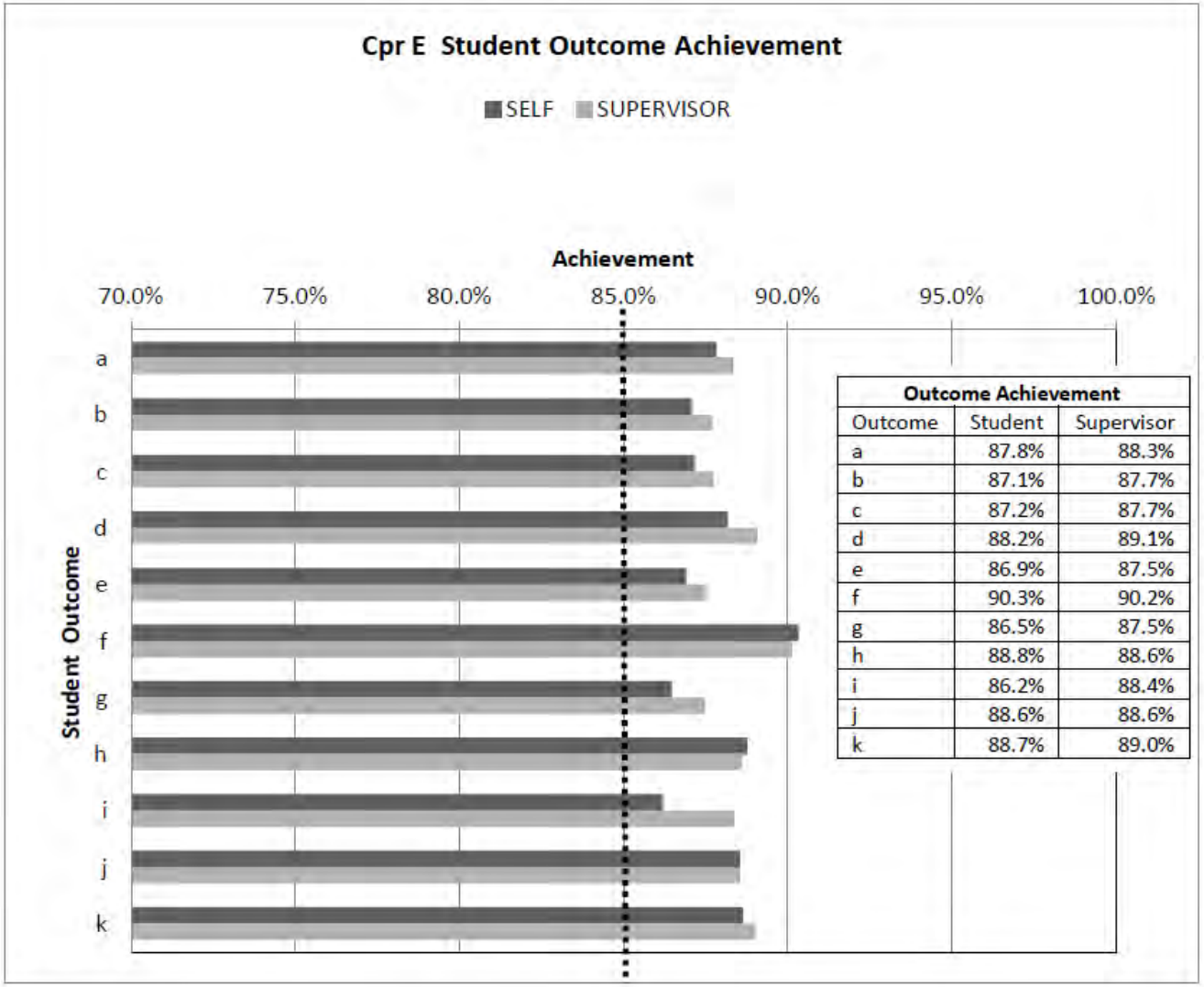
Assessment Example: Level 1

Table 1. Core competencies in engineering at Iowa State.

Analysis and Judgment	Engineering Knowledge	Planning
Communication	General Knowledge	Professional Impact
Continuous Learning	Initiative	Quality Orientation
Cultural Adaptability	Innovation	Safety Awareness
Customer Focus	Integrity	Teamwork

- Workplace competencies are associated with the practice of engineering at the professional level.
- There is a mapping of the competencies to the ABET (a-k) student outcomes.
- Supervisors respond to this question: “When given the opportunity, how often does the student perform the key action?” (5) always/almost always; (4) often; (3) usually; (2) sometimes; and (1) never or almost never

Assessment Example: Level 1



Outcome Achievement		
Outcome	Student	Supervisor
a	87.8%	88.3%
b	87.1%	87.7%
c	87.2%	87.7%
d	88.2%	89.1%
e	86.9%	87.5%
f	90.3%	90.2%
g	86.5%	87.5%
h	88.8%	88.6%
i	86.2%	88.4%
j	88.6%	88.6%
k	88.7%	89.0%

Four-point Performance Scale Used in the Level 2 and 3 Rubrics

1

- Beginning
- Unsatisfactory

2

- Developing
- Partly Satisfactory

3 ← 75% achievement threshold

- Accomplished
- Competent
- Satisfactory

4

- Exemplary
- Exceptional
- Beyond Satisfactory

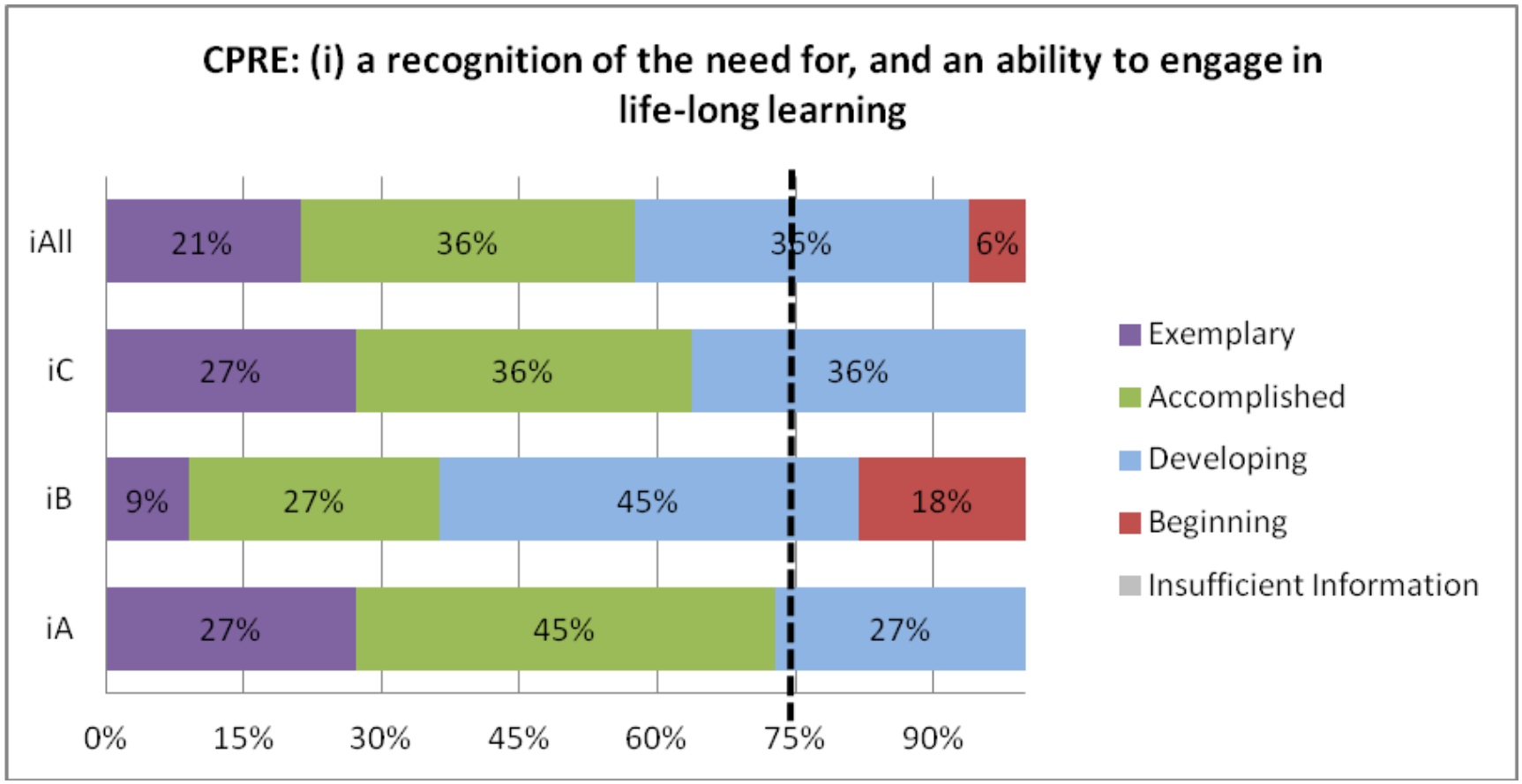
Assessment Example: Level 2 - Portfolios

- Main elements of a portfolio used for assessment:
  - Career objective and resume
  - General education component and reflection
  - Examples of prior work
  - Technical work experience
  - Senior design project
  - Cumulative reflection
- The general education reflection and cumulative reflection elements include specific questions to gather information relevant to particular student outcomes.

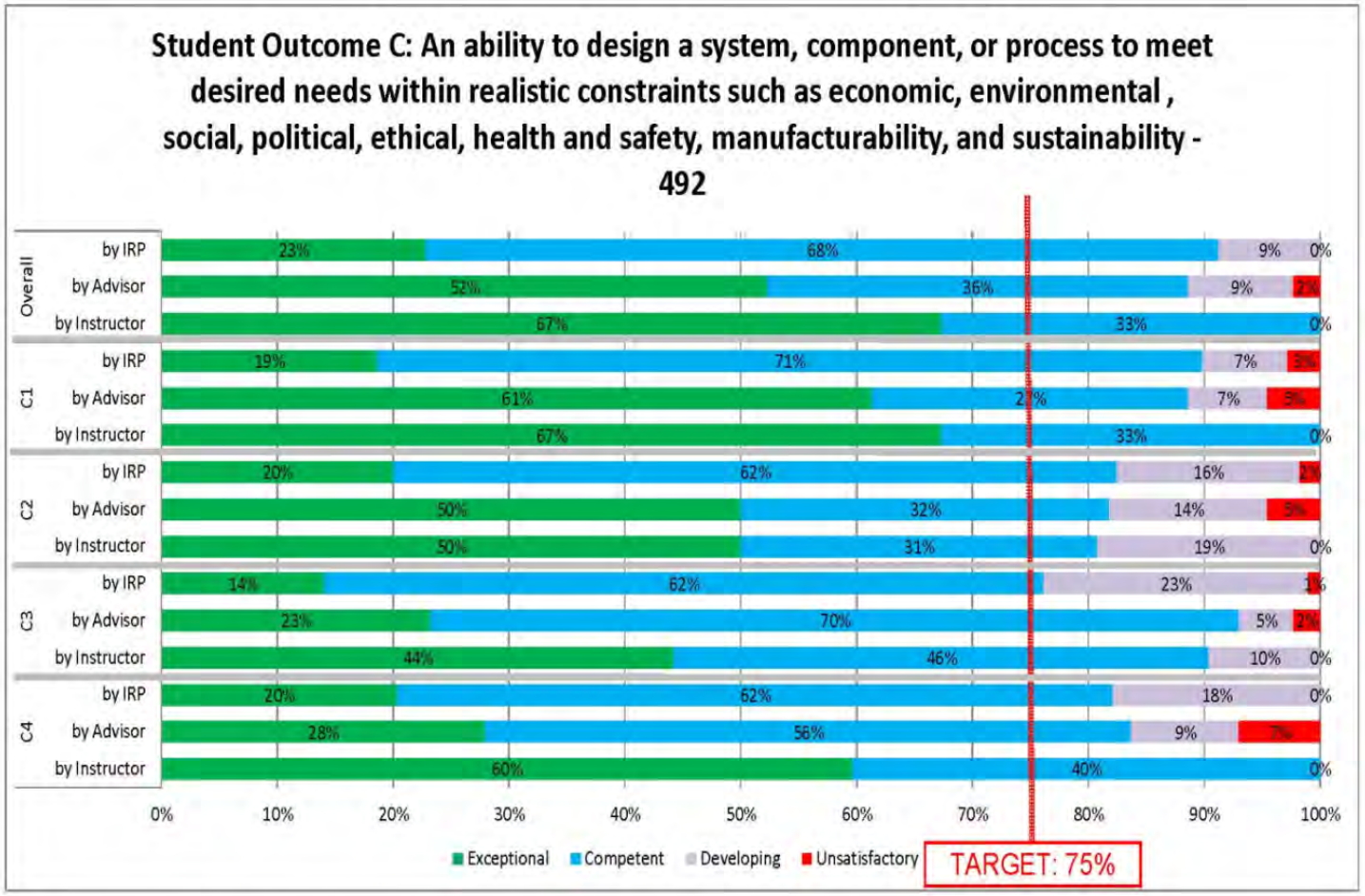
Assessment Example: Level 2 - Portfolios

Student outcome (i): a recognition of the need for, and an ability to engage in life-long learning				
Performance Indicators	**Proficiency/Performance Scale**			
	1: Beginning	**2: Developing**	**3: Accomplished**	**4: Exemplary**
(i.A) Description / discussion of use of external sources of information to complete class projects and other problem-solving tasks	Cannot use materials outside of what is explained in class. Assumes that all learning takes place within the confines of the classroom.	Seldom brings information from outside sources to assignments. Completes only what is required.	Multiple examples of use of external sources of information, including library resources, professional journals, experts in field, and other students.	Demonstrates ability to learn independently – goes beyond what is required in completing an assignment.
(i.B) Awareness of learning activities outside of the classroom, including participation in professional and technical societies, learning communities, industry experiences, etc.	Shows little or no interest in outside learning resources, including professional and/or technical societies, learning communities, internships, etc.	Co-curricular and/or extra-curricular learning experience. Occasionally participates in the activities of local learning opportunities.	Multiple co-curricular and/or extra-curricular learning experiences. Active participation in local learning activities.	Participates and takes a leadership role in learning opportunities available to the student body.
(i.C) Acknowledgement of how the college experience contributes to understanding the need to continuously update professional skills to solve new problems	Has difficulty in recognizing own shortcomings.	Acknowledges the need to take responsibility for own learning.	Demonstrates connection between short/long term goals and life-long learning.	Demonstrates responsibility for creating one's own learning opportunities.

Assessment Example: Level 2 - Portfolios



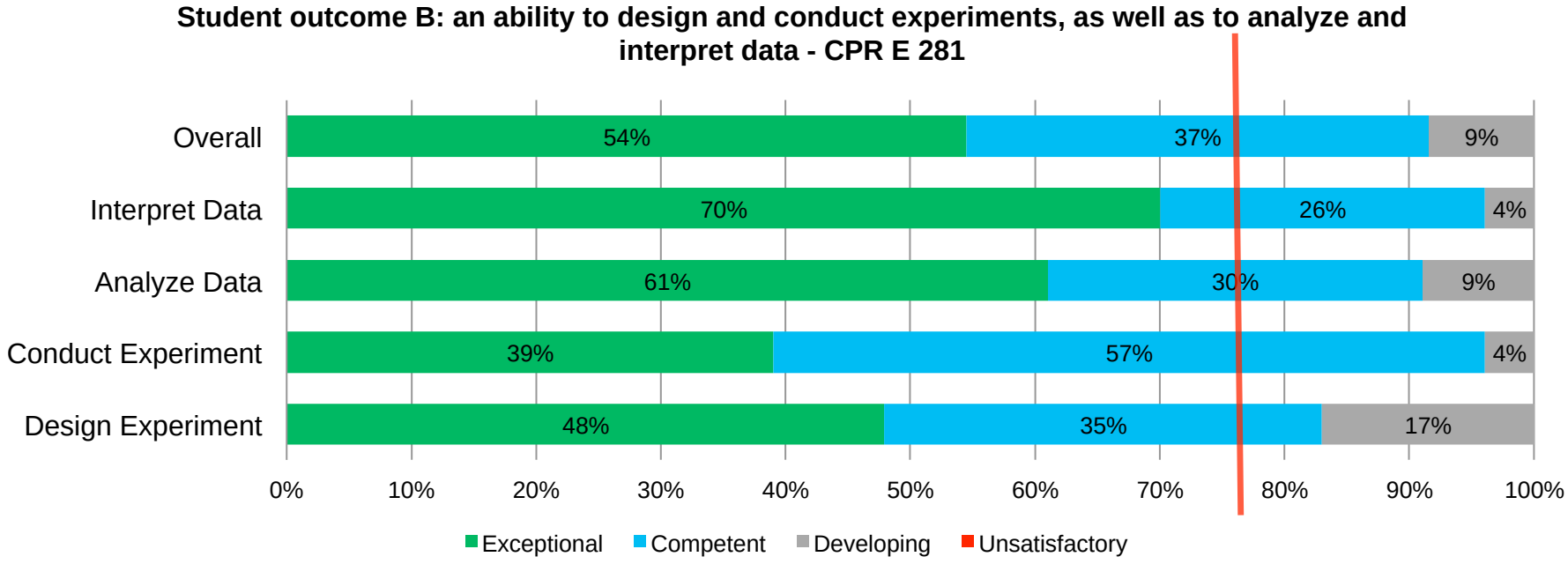
Assessment Example: Level 2 – Sr. Des.



C1 - Develops a design strategy based on project and client needs and constraints.
C2 - Thinks holistically: sees the whole as well as the parts
C3 - Supports design procedure with documentation and references
C4 - Considers all the relevant technical, nontechnical constraints and design tradeoffs.

Assessment Example: Level 3

- Assessment results for student outcome (b) in CPRE 281:
  - Specific lab experiment: programming the DE2 board to perform binary addition
  - Focuses on experimenting with the board, and collecting and analyzing data



Assessment Example: Level 3

- Course-based outcomes assessment is implemented as orthogonal to the primary grading assessment in a course.
  - An outcome rubric score is focused on specific aspects of student learning.
  - A course grade reflects comprehensive learning in a course.

Evaluation of Assessment Results

ABET committee evaluation of student outcomes for each assessment method.

Assessment Method	Student Outcomes X: Student outcome does not meet expectations based on assessment results.										
	a	b	c	d	e	f	g	h	i	j	k
Survey of Interns/Employers											
Senior Design Rubrics											
Portfolio Rubrics								X	X		
Course-based Rubrics					X						

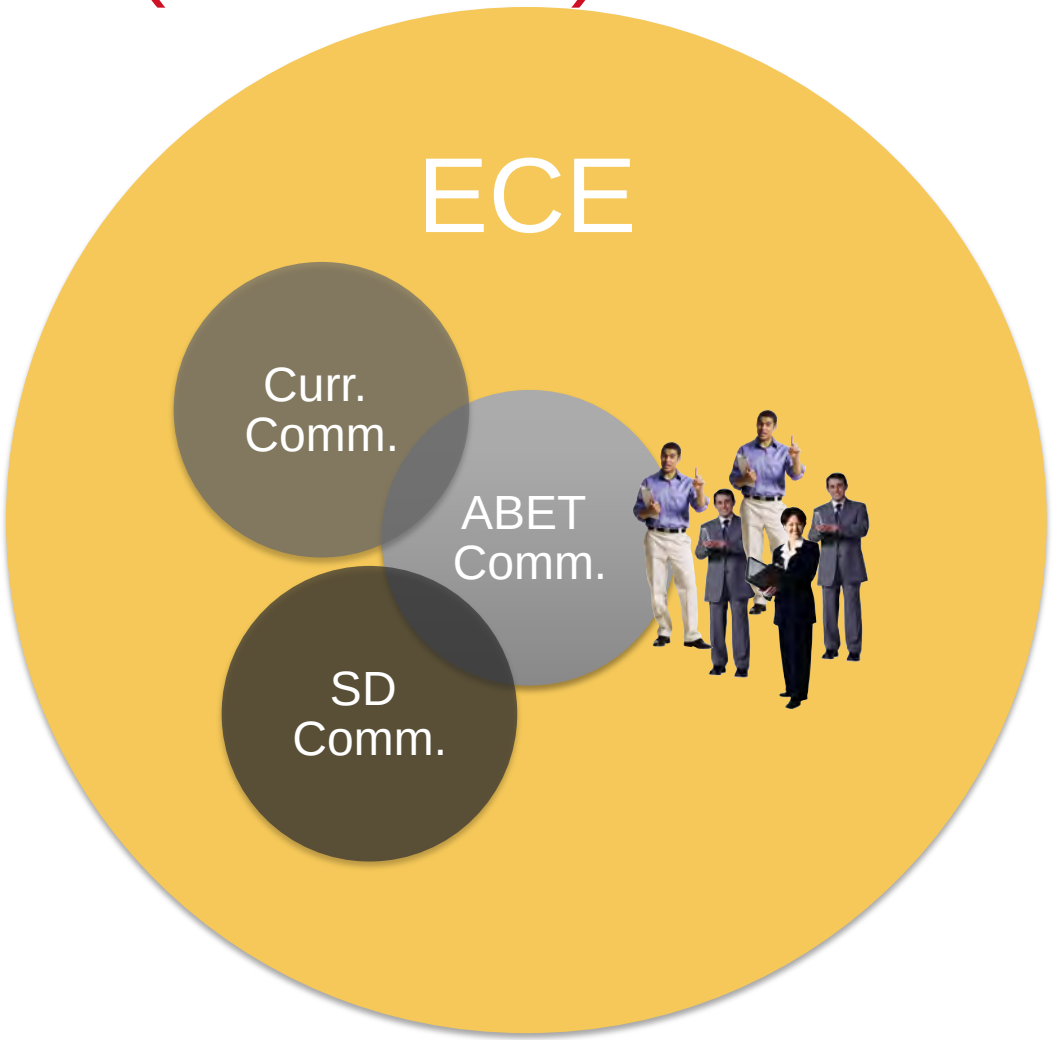
Evaluation (continued)

Summary of performance areas that need attention.

Assessment Method	Student Outcomes Non-blank: Specified performance indicator does not meet expectations.										
	a	b	c	d	e	f	g	h	i	j	k
Survey of Interns/Employers											
Senior Design Rubrics				d1			g1 g6				
Portfolio Rubrics								hB	iA iB iC	jB2 jC	kB
Course-based Rubrics											
CPRE 281: Digital Logic											
EE 230: Electronic Circuits and Systems		b4			e1 e2 e3						

etc.

Evaluation (continued)



Conclusions Related to Efficiency and Faculty Involvement

- Having a small committee of faculty knowledgeable about the accreditation process adds significantly to the quality of assessment results.
- Using knowledgeable committee members as shepherds is an important and efficient way to involve other faculty.
- Faculty engaged in meaningful discussions about teaching and learning.
- Faculty generally perceived the process as reasonable in terms of time and effort.