



ISEE
2010

OUTCOMES ASSESSMENT IN CHEMICAL AND PETROLEUM ENGINEERING PROGRAMS

Basim Abu-Jdayil, Hazim Al-Attar, Mohamed Al-Marzouqi

Chemical & Petroleum Engineering Department, UAE University

Al-Ain, UAE

Introduction

- The chemical and petroleum engineering department at the United Arab Emirates University was established in 1980.
- The mission of the Chemical and Petroleum Engineering programs is to meet the educational, research, and service needs of UAE society by providing programs and services of the highest quality.

ABET Accreditation

- The Chemical (CHME) and Petroleum (PETE) Engineering programs at the UAEU are designed to fulfill the ABET (A-K) EC2000 criteria.
- The Department has established a well-defined process for outcomes assessment for the Chemical and Petroleum Engineering Programs in order to ensure that their graduates achieve the program educational outcomes.
- **Three direct tools** are implemented in the assessment process, namely; **course / curriculum assessment**, **exit exam**, and **capstone courses**.
- The proposed **indirect tools** include **internship advisor survey**, **course assessment by students**, **alumni survey**, **employer survey**, **students exit interview**, and **industrial advisory board**.

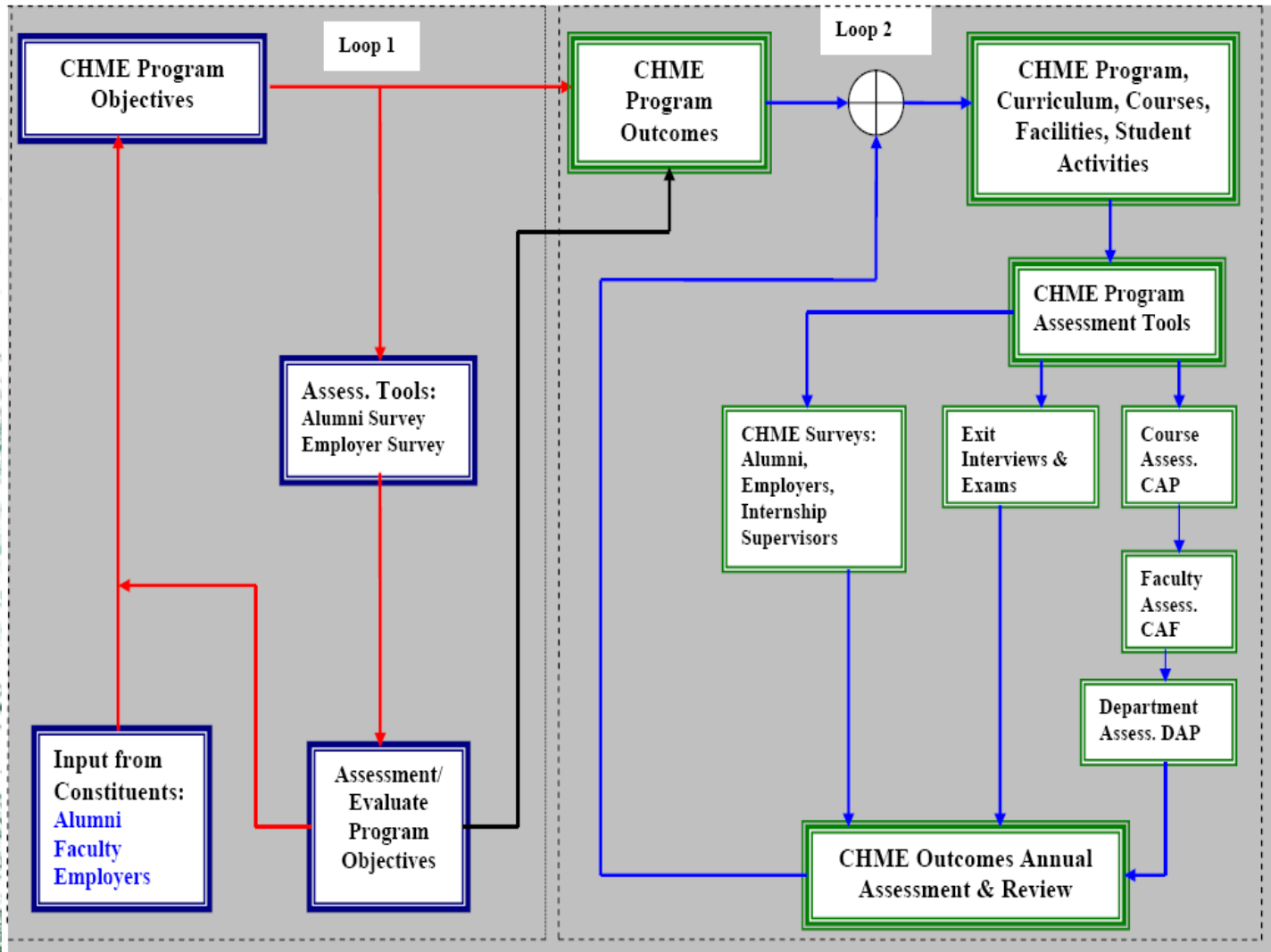
Objective

- This paper aims to describe the establishment, revision and assessment process for educational outcomes of chemical and petroleum engineering programs.
- The proposed approach could be implemented by other engineering disciplines and subdisciplines.

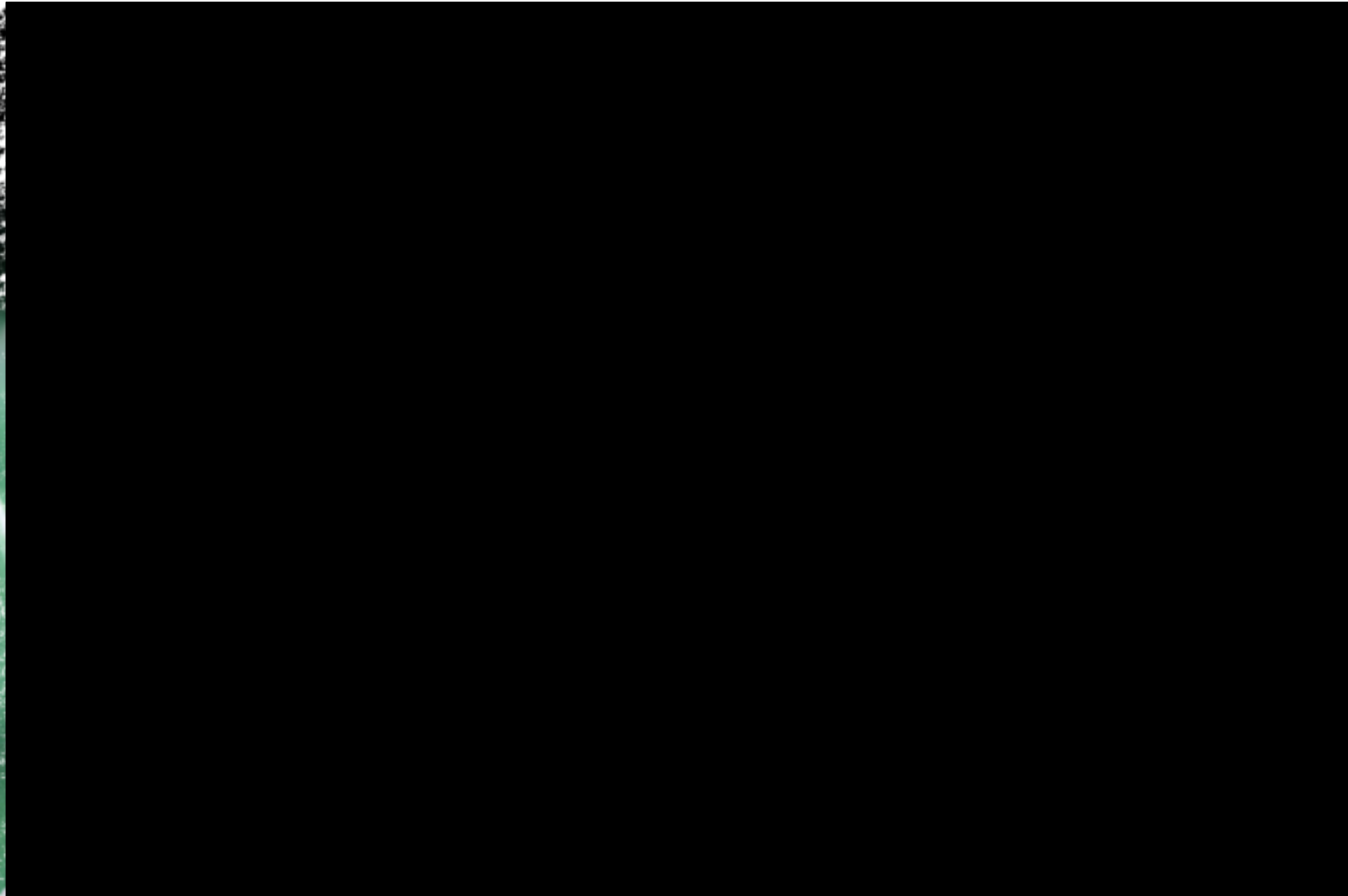
PRPROGRAM OUTCOMES

Outcome	Chemical Engineering Program
A	Thorough grounding in chemistry, physics, biology, math and engineering subjects such as fluid mechanics, thermodynamics, heat transfer, mass transfer, and reaction kinetics; and the ability to apply knowledge of these subjects in chemical engineering practice.
B	An ability to design and conduct different chemical engineering experiments, as well as to analyze and interpret data.
C	An ability to analyze, design, and control a system, component and/or process dealing with fluids handling, separation, and chemical/biochemical reactions to meet desired needs
D	An ability to work and interact effectively in groups/teams which have diverse personalities, cultures, and backgrounds.
E	Ability to identify, formulate, and solve chemical engineering problems
F	An understanding of professional and ethical responsibility
G	Ability to develop effective oral, written, and interpersonal communication skills.
H	Ability to evaluate the potential risks, i.e. consequences and probabilities of engineering solutions which may affect society and the environment.
I	A recognition of the need for and an ability to engage in independent-learning and life-long learning
J	A knowledge of contemporary issues
K	An ability to use of computer software such as spreadsheets, mathematics packages, word processors, and design packages in solution of chemical engineering problems.

Achievement of Program Outcomes



Quantitative Assessment of the Course



Quantitative Assessment of the Course

CHME 330

Fill in **Blue** areas only

Homework 10 %

A2K relevance

GRADES

Weight of questions contribution to A2K+ or Objectives should be relative.
 If weights are similar: Enter 1;
 Else: Enter appropriate weights below

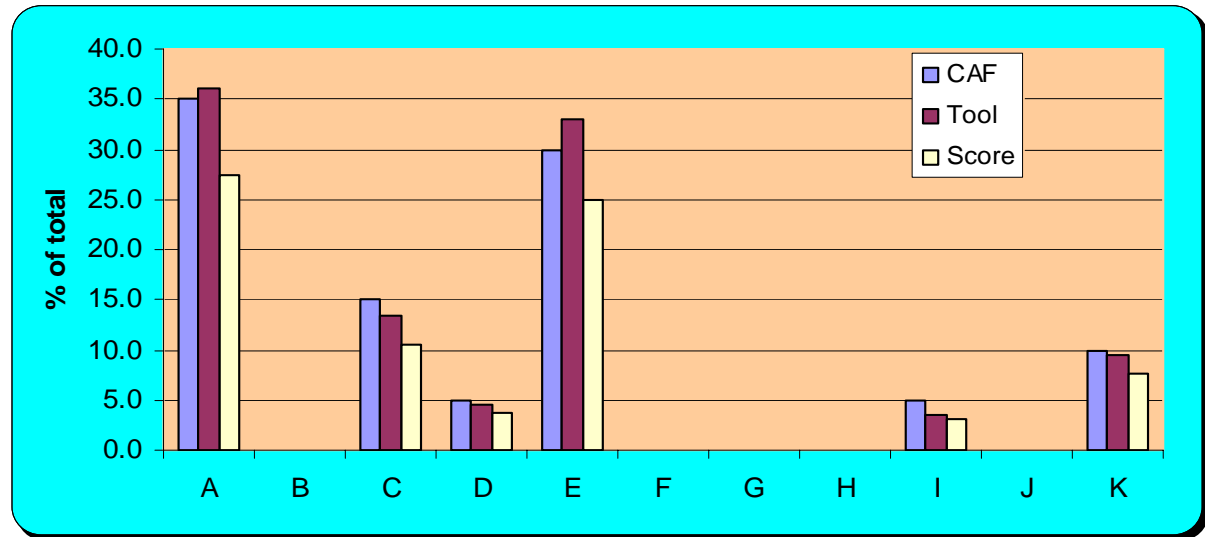
HW #	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
HW1	20		15	25	10				5		25				
HW2															
HW3															
HW4															
HW5															
HW6															
HW7															
HW8															
HW9															
HW10															

Sum-weights

HW #	Max Points	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7	Student 8
HW1	10	8.0	9.5	10.0	10.0	9.5	8.0	8.0	8.0
HW2									
HW3									
HW4									
HW5									
HW6									
HW7									
HW8									
HW9									
HW10									
Sum HW	10	8	9.5	10	10	9.5	8	8	8
# HW	1								

Quantitative Assessment of the Course

	A	B	C	D	E	F	G	H	I	J	K	Sum
CAF	35	0	15	5	30	0	0	0	5	0	10	100
Tool	36	0	13.5	4.5	33	0	0	0	3.5	0	9.5	100
Score	27.5	0	10.53	3.74	24.9	0	0	0	3.04	0	7.63	77.34
	OK	N/A	OK	OK	OK	N/A	N/A	N/A	Warn	N/A	OK	



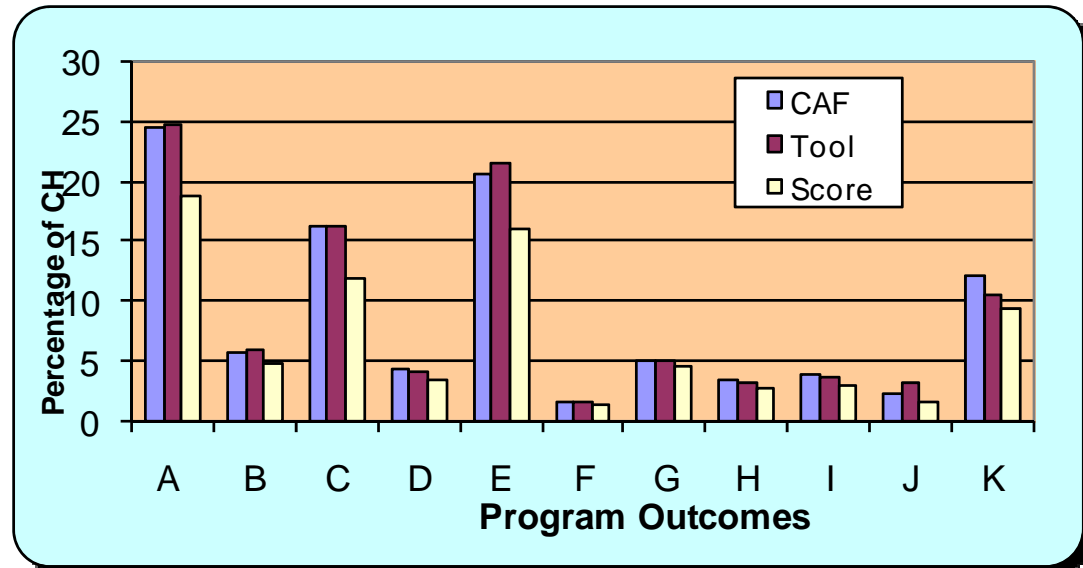
The Comparison of A2K in CAF, TOOLS, and SCORE

Assessments of Curriculum Outcomes

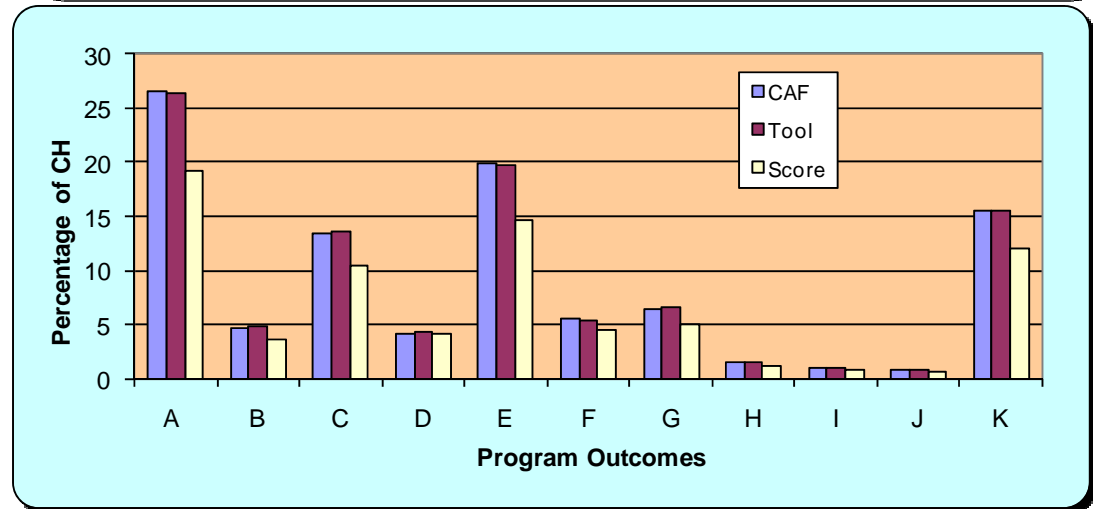
		Program Outcomes										
		A	B	C	D	E	F	G	H	I	J	K
1 st Semester	Fluid Mechanics	√		√	√	√				√		√
	Heat Transfer	√	√	√		√		√	√	√		√
	Mass Transfer Operations	√		√		√						√
	Process and Plant Design	√		√	√	√	√	√	√		√	√
	Chem. Eng. Lab II	√	√		√		√	√	√	√		√
2 nd Semester	Chem. Eng. Thermodynamics	√		√	√	√		√				√
	Chem. Eng. Lab I	√	√		√		√	√	√	√		√
	Kinetics and Reactor Design	√	√	√		√						√
	Process Control	√	√	√	√	√		√			√	√
	Mass Transfer	√		√		√						√

Assessments of Curriculum Outcomes

- CHME



- PE



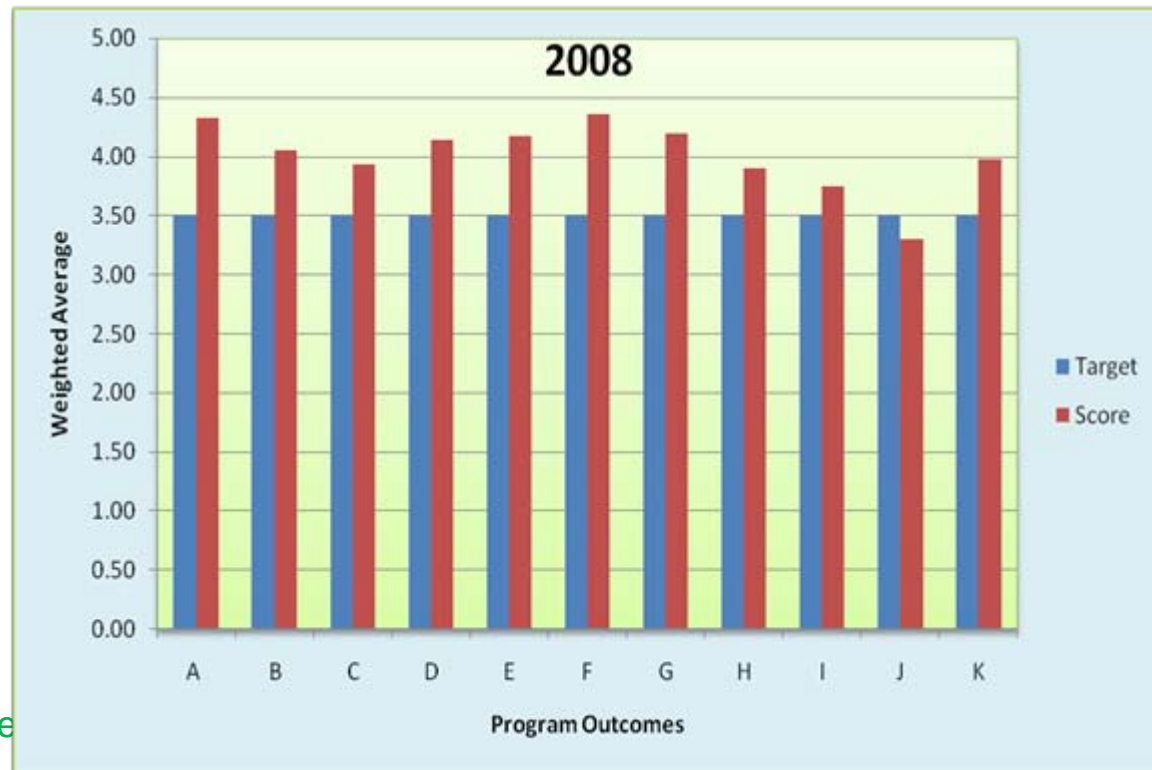
Assessments of Curriculum Outcomes

Curriculum Assessment of 2008

Program	Outcomes											Average
	A	B	C	D	E	F	G	H	I	J	K	
CHME	3.9	4.1	3.8	4.4	3.8	4.7	4.7	4.5	4.5	3.4	4.5	4.2
PETE	3.7	3.5	3.8	4.2	3.7	4.4	3.7	4.6	5.0	3.9	3.8	4.0

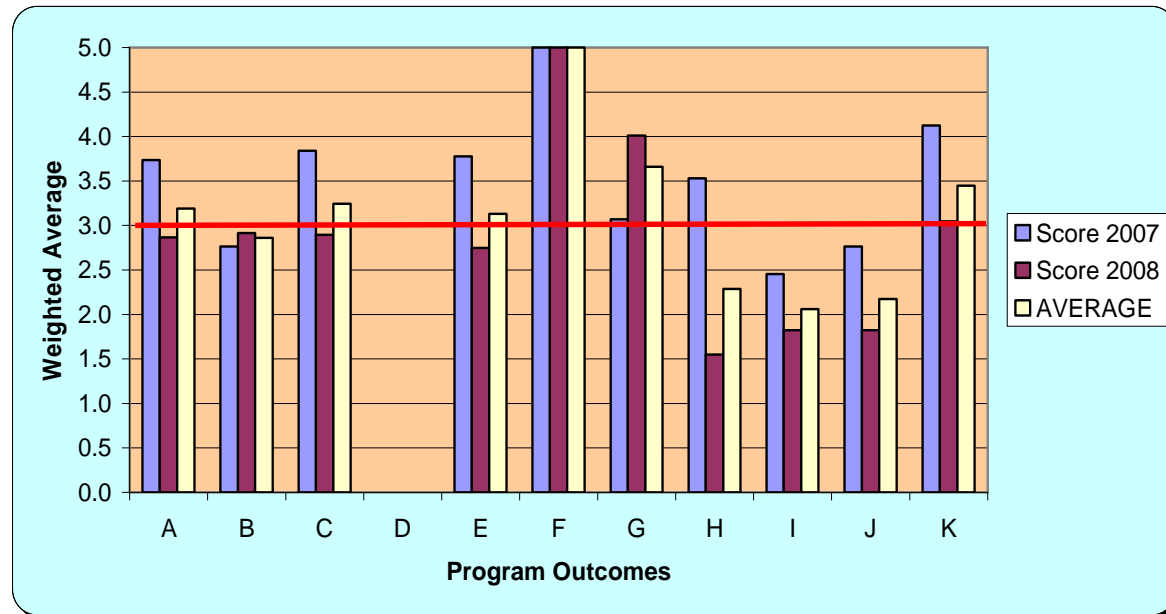
Course Assessment by Students (CAS):

At the end of each semester, students evaluate the course using the CAS Survey Forms. The survey lists the course outcomes as presented in the course syllabus. The survey asks students to evaluate each course outcome based on a 1-5 scale, where 1 is poor and 5 is excellent. The basis of evaluation should be on student's feeling of how the class has helped him/ her to achieve the abilities, attributes, and skills as described in the outcomes.



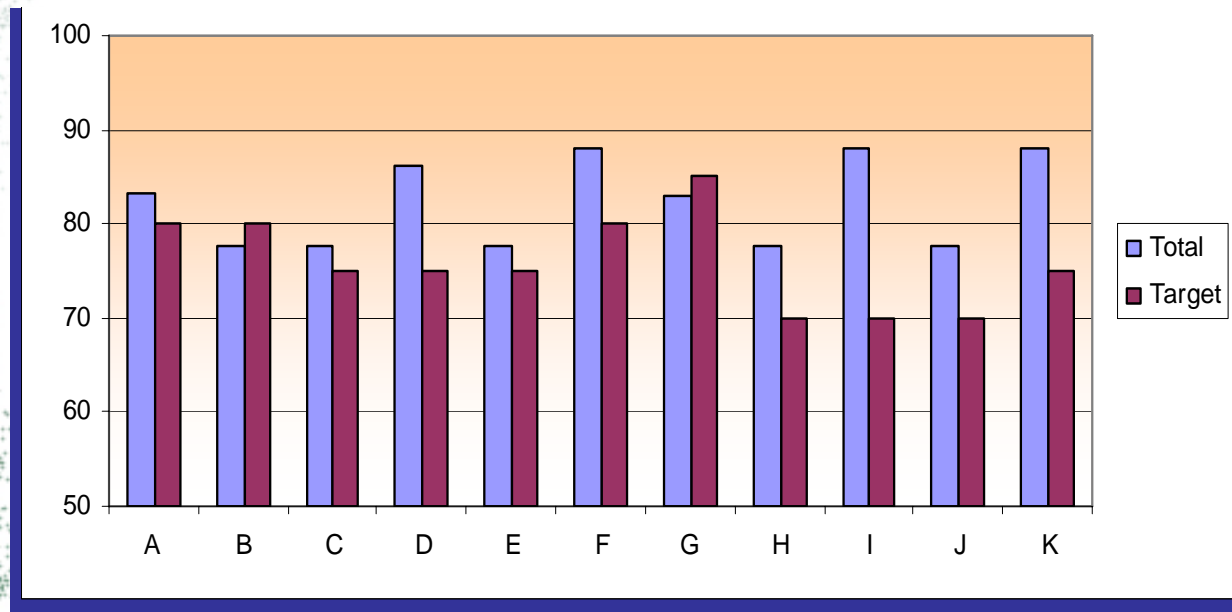
Exit Exam

An exit exam encompassing all the core courses in the Chemical and Petroleum Engineering Programs with 50 questions was designed in order to assess the students in their final semester. This exam is conducted during the last portion of Graduation Project II course. Exit exam questions were also mapped to ABET criteria and assessment of the exam is included in the overall assessment.



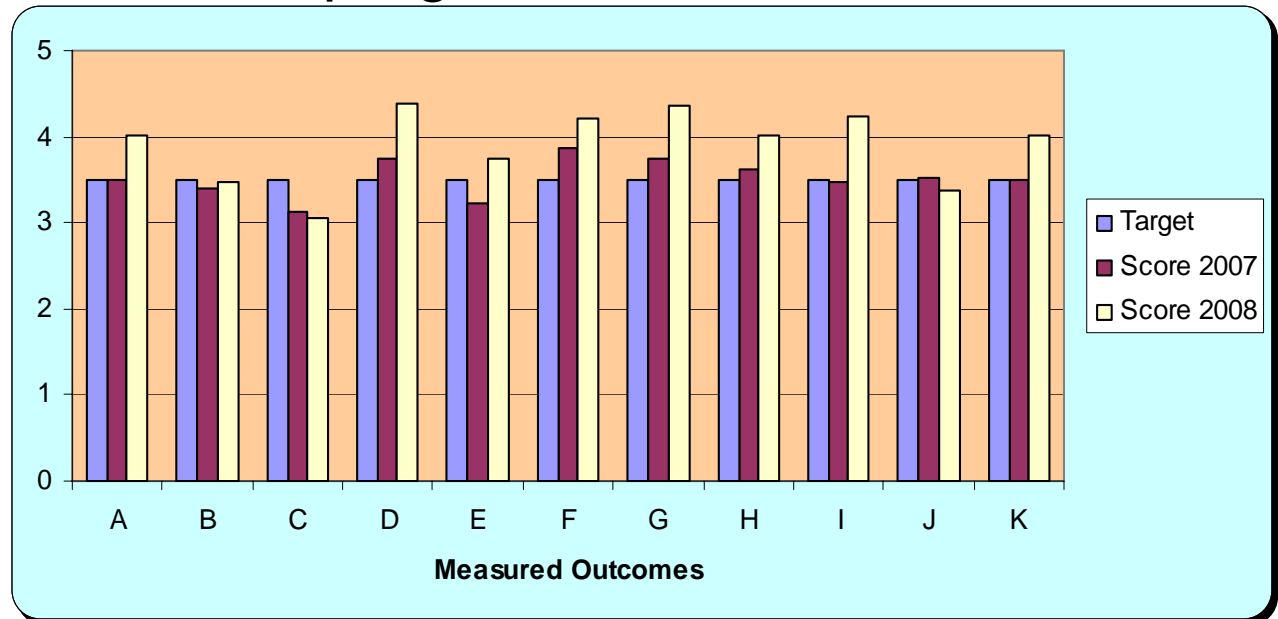
Capstone Course

The capstone design course is spread over two semesters as Graduation Project I and Graduation Project II. The CHME and PETE programs use the results of the GP II (bulk of design work) only in the assessment process. It was found that students performed quite well in achieving the program intended outcomes.



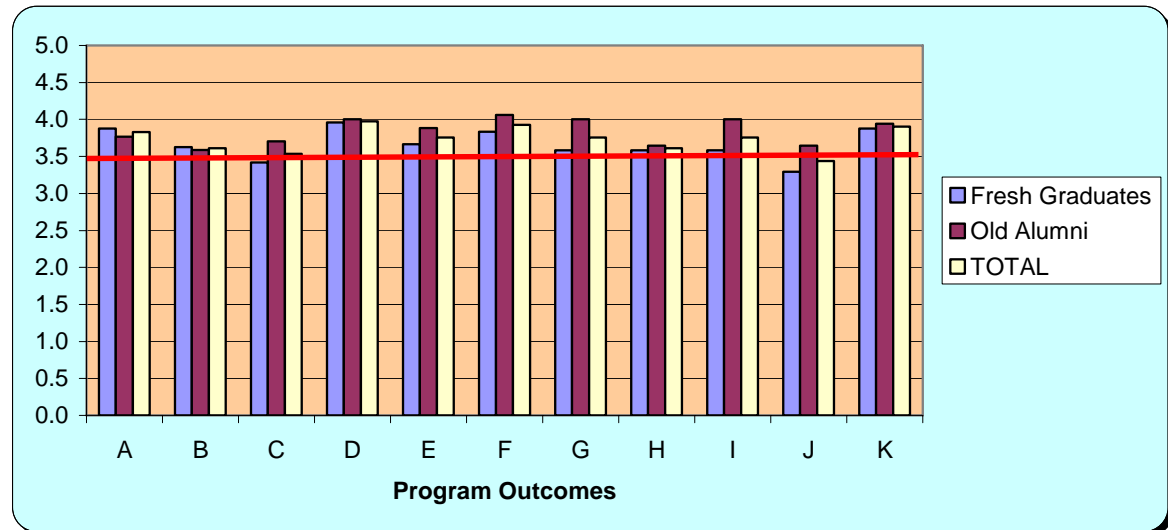
Internship Advisor Survey

All CHME and PETE students are required to join the industrial training program after they complete at least 114 credit hours. Each trainee spends a full semester (about four months) in an industrial setting. The industrial supervisor is asked to complete a survey to assess the trainee's abilities, attitudes and skills relevant to the educational outcomes of the CHME and PETE programs.



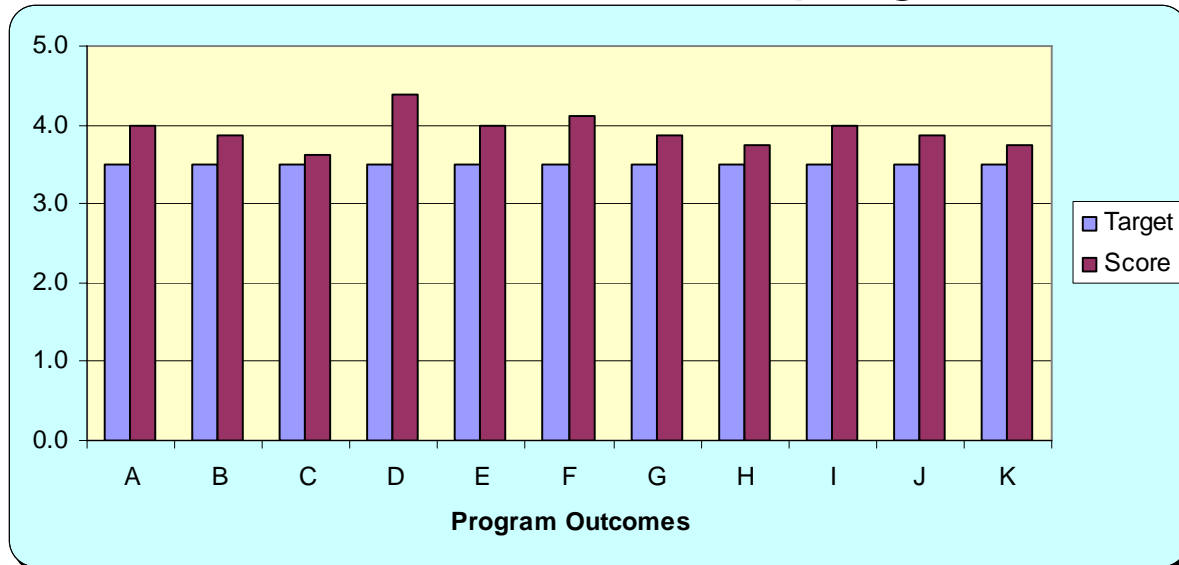
Alumni Survey

- The alumni survey was designed to provide the information needed by the CPE Department to measure the intended outcomes for the CHME and PETE programs.
- The survey was analyzed to determine the "strength" level for each of the stated items. The Alumni were asked to evaluate all items as "Very Weak", "Weak", "Average", "Strong", or "Very Strong".



Employer Survey

The survey was conducted to assess how well CHME / PETE graduates meet the program outcome criteria as judged by their employers. This survey is considered to be one of the important feedback tools from the program constituencies. The Employer Survey contains two sets of questions; the first set includes 5 questions that conform to the program educational objectives and the second set includes 11 questions that conform to the program outcomes.



Overall Assessment of Achievement of Program Outcomes

Assessment Tool	Strength level	Weight %
Curriculum	High, encompasses all the courses	30
Employer survey	Medium-High; external evaluators	25
Internship	Low; involves external evaluator of our junior students	5
Capstone course	Low; includes application of all learned material	10
Alumni Survey	Medium-High; two categories of engineers are involved in the assessment process	20
Exit Exam	Low; covers limited outcomes	5
Student Assessment of Course	Low; students don't take the survey seriously	5

Overall Assessment of Achievement of Program Outcomes

Outcomes	Assessment Tools CHME Program								Assessment Tools PETE Program							
	Curriculum	Capstone	Exit Exam	Internship	CAS	Alumni S.	Employer S.	Total	Curriculum	Capstone	Exit Exam	Internship	CAS	Alumni S.	Employer S.	Total
Wt %	30%	10%	5%	5%	5%	20%	25%		30%	10%	5%	5%	5%	20%	25%	
A	3.9	4.2	3.2	3.7	4.3	3.8	4.0	3.9	3.7	4.3	3.2	2.9	4.4	4.2	3.7	3.8
B	4.1	3.9	2.9	3.4	4.1	3.6	3.9	3.8	3.5	4.2	2.4	2.5	3.6	4.3	3.4	3.6
C	3.9	3.9	3.2	3.1	4.0	3.5	3.6	3.7	3.8	4.2	3.3	1.0	4.0	4.1	3.4	3.6
D	4.4	4.4	NA	4.0	4.3	4.0	4.4	4.3	4.2	4.3	NA	3.3	4.1	4.4	4.4	4.3
E	3.9	3.9	3.1	3.5	4.2	3.8	4.0	3.9	3.7	4.2	2.9	1.8	4.1	4.4	3.7	3.8
F	4.6	4.4	5.0	4.0	4.3	3.9	4.1	4.3	4.0	4.5	2.7	3.3	3.1	4.1	4.3	4.0
G	4.5	4.2	3.7	4.0	4.1	3.8	3.9	4.1	3.7	4.3	2.6	3.3	3.3	4.2	3.9	3.8
H	4.3	3.9	2.3	3.8	4.0	3.6	3.8	3.9	3.9	4.2	3.0	2.4	3.6	4.0	3.7	3.8
I	4.4	4.4	2.1	3.8	3.8	3.8	4.0	4.0	3.8	4.5	4.2	2.9	3.6	4.1	3.7	3.9
J	3.4	3.9	2.2	3.5	3.6	3.4	3.9	3.5	3.8	4.2	3.2	2.8	3.4	4.1	3.7	3.8
K	4.5	4.4	3.4	3.7	4.1	3.9	3.8	4.1	3.8	4.5	2.9	2.9	3.9	4.3	3.9	3.9

CONTINUOUS IMPROVEMENT

- ❖ Further improvement in the program outcomes can be achieved by some combination of the following; (a) implementation of focus groups recommendations, (b) upgrading of course materials, (c) introducing new software packages to solve engineering problems, (d) emphasizing team work, (e) shifting to industry-oriented design problems in capstone courses, and (f) introducing new courses if necessary.
- ❖ The results of the overall outcome assessment for year 2008 indicate that all A-K program outcomes have been met. However, more work seems to be needed to improve outcome J in chemical engineering program and outcomes B and C in petroleum engineering program.

CONCLUSIONS

- A systematic approach is proposed in this study for the assessment of CHME and PETE programs' educational outcomes. Direct and indirect assessment tools were recommended and implemented to achieve this purpose.
- The results of the proposed outcomes assessment process can lead to identification of points of weaknesses and strengths in the program which could then be translated into actions for the improvement of the CHME and PETE programs.
- The evaluation process developed in this work for the CHME and PETE programs at UAEU is recommended for implantation in other engineering disciplines and subdisciplines.