

Industrial Advisory Board Function in TU's Chemical Engineering Assessment Processes

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Abstract

The University of Tulsa's Chemical Engineering Department's most recent accreditation visit was October 2006. As a result of that visit, the department formalized many of its previous informal assessment processes. The department now has a two-year cycle of review of the Program Objectives, Courses, Curriculum, and Program Outcomes. The Industrial Advisory Board (IAB) is involved in reviewing and approving changes to the goals as well as the measurement of how well we are achieving the Program Outcomes. The IAB is viewed as providing input from both alumni and employer constituencies.

IAB surveys for the Program Objectives, Courses, Curriculum, and Program Outcomes will be presented. We have completed only the first year of this two-year cycle, so only the Program Objectives and the Course Objectives will be discussed.

Assessment Processes

The assessment processes of the department are described in the flowcharts of Figure 1, in the Appendix. The Program Objectives, Course Objectives, Curriculum, and Program Outcomes are reviewed in turn over a two-year period. Each review process includes the measurement of how well the students are meeting each item and the consideration of those results by the faculty and the Industrial Advisory Board (IAB), as highlighted on the flowcharts. The IAB and faculty can both suggest changes, but the faculty has the final approval at a faculty meeting after the IAB meeting. This assessment process is modeled on the assessment process of the Petroleum Engineering Department at the University of Tulsa.

Industrial Advisory Board

The IAB for the University of Tulsa's Department of Chemical Engineering consists mainly of alumni who are in upper management, including many who own their own companies. Some of them have hired our more recent graduates. Current board members and their employers or companies are listed in Table 1.

Table 1. Industrial Advisory Board members and employers.

Name	Employer	Name	Employer
Ken Agee	Syntroleum	Calvin McKee	Retired
Mark Agee	Excel Energy	Reed Melton	Therma Tran, Inc.
Jim Beer	Hartwell Environmental	Bob Purington	Tulsa Heaters, Inc.
Darla Coghill	Tulsa School of Arts & Sciences	Chris Raffensperger	Nalco
Chris Collins	Dresser-Rand	Wayne Rumley	R&R Engineering
Jon Edmonson	Shell Exploration	Thomas Russell	Thomas Russell Co.
Rak Gupta	Retired	Tom Steiner	Steiner Engineering
John Hottovy	Chevron Phillips Chemical	Greg West	BP
Dan Lansdown	Domain Engineering	W. Wayne Wilson	Cononco, Inc.
Bob McCay	Retired	Stephen Yeretski	Retired

The Industrial Advisory Board meets twice a year for two half-days. A typical schedule is given in Table 2. The number of board members attending is usually around 8. The short meeting time requires that the members come to the meeting prepared to discuss the assigned topic.

Table 2. Typical Schedule for an Industrial Advisory Board Meeting

Friday		Saturday	
Event	Duration	Event	Duration
Lunch with students (without faculty)	2 hours	Breakfast, IAB only	1 hour
Dean's report	¼ hour	Discussion, IAB only	1 hour
Faculty Reports	1 hour	Discussion with faculty	1 hour
Discussion, sometimes with campus guests	1 ¼ hour	Discussion with IAB and Chair only	1 hour
Reception	2 hours		

Measurement Instruments

For many years we used an informal feedback process with our IAB. They would receive complaints from the students, filter those complaints through their experience, and make recommendations to us. This process worked, but it was viewed as “ad-hoc” by our ABET visitor. In response, we have developed a series of surveys for their input. We are only one year into the two-year cycle of review, so it is likely that there will be minor changes as we work through our process.

Each survey is sent to the IAB members before the meeting, and they are asked to come prepared to discuss. For some surveys we ask for a consensus report of the IAB; for others we ask for collected individual responses, which the IAB Chair provides.

The IAB reviews other data as they consider making recommendations. We collect senior exit interviews, alumni surveys, student surveys over the Program Objectives, student course objective surveys, faculty course objective surveys and course reports, and Fundamentals of Engineering Exam results. All but the course objective surveys and faculty course reports will be made available to the IAB to avoid overwhelming them with information.

The first IAB survey, given in Figure 2 in the Appendix, is for the Program Objectives and is done in fall of even years. This survey simply asks the board if the Program Objectives are appropriate for the program. The members may also suggest changes. For this survey we ask for a consensus report of the IAB.

The second IAB survey, done in spring of odd years, is much more detailed. The IAB is given a listing of the course objectives for every course in our department that counts toward a BS chemical engineering degree, as well as the engineering science classes that we offer. For each objective, they are asked how important it is to the course: essential, keep, drop, or modify. There is space for them to describe the modification when “modify” is checked. They are asked to identify the ABET Criterion 3a-k that are addressed by each course objective. There is also space for additional comments, such as added objectives. An example of the survey for one course is given in Figure 3 in the Appendix. The report for this survey includes the number of check marks in each box with all comments.

The third survey is over the entire curriculum and is done in the fall of odd years. This survey is given in Figure 4 a and b in the appendix. The board is asked to rate how important our courses, both non-engineering and engineering, are for attaining the Program Objectives. The page for non-engineering courses is shown in Figure 4a; the similar page for engineering courses is not given here. The board members are given space to recommend other courses. They are also asked to rate how well our students who graduated in the last 3 – 5 years are able to perform the ABET 3a-k and chemical engineering program outcomes in the workplace (Figure 4b). For this survey, the board is asked to produce one consensus report.

The fourth review, done in spring of even years, covers our Program Outcomes. There is no IAB survey for this review, but the board considers the other material that we collect for ABET review.

Effectiveness

The effectiveness of our new process is yet to be determined, as we are only one year into the first cycle of our two-year cycle. Several rounds of experience with the process, with likely tweaking, will be needed to determine that it does what we need.

Our IAB has given us useful recommendations on our curriculum for many years, and we expect that to continue. For example, information from the IAB led to removing the computer science programming requirement and replacing those three hours with an hour of VisualBasic and two additional hours of process controls. This gives our students an advantage in controls over students from other universities and better prepares them for the programming that they will be doing on the job. This process that we have developed is an effort to formalize this kind of input from the IAB and to maintain a record of it.

The first year of formalized input from the IAB has not led to any formal changes in our Program Objectives. We do not expect to make changes often in the Program Objectives. The Program Objectives had already been updated in Spring 2006, with approval from the IAB, in preparation for our ABET visit. The IAB recommended no changes in the Program Objectives last fall.

The first IAB survey on Course Objectives did lead to some changes, mostly in spring semester courses. Use of the survey was weakened by the low response rate. Not all board members were ready to step up to this higher commitment, and not all members received their surveys before the meeting. Only two board members responded. Improved communication of the importance of the survey and of the materials themselves will help the response rate. The IAB survey on Course Objectives was over the entire year, but our faculty meeting on Course Objectives focused on the fall semester courses since we had all of their assessment data. The faculty did consider the IAB comments on fall semester course objectives but chose not to incorporate those changes at this time. One of the recommendations included removing all references to HYSYS, the process simulation package that we use, in favor of hand calculations. We chose to keep the HYSYS references since we do think it is important for the students to be introduced to this software package after they have done hand calculations. Another recommendation was to require a college-wide handbook on technical reports for the lab. Although we could make our own departmental handbook for the labs, a college handbook would need to be developed at a higher university level. The changes that we did make to fall courses were mainly from objectives of “have an understanding of...” to objectives that are assessable.

Faculty have made changes to some spring semester course objectives in response to the IAB comments, but those were not formally part of the IAB Course Objectives review since they were approved at a different meeting. As one example, the objectives for Plant Design were completely rewritten after the IAB comment that “this class could be taught in the Business College or the College of Education...”. Similarly, the objectives for Lab II were rewritten after the IAB comment that “These objectives are stated rather lackadaisically and without impressing the reader with any urgency in the need to accomplish any of them.”

Conclusion

The Chemical Engineering Department has developed an assessment process which includes its Industrial Advisory Board. The board acts as both alumni and employer constituencies. Over a two-year cycle, the board is surveyed for suggested changes to our Program Objectives, Course Objectives, Curriculum, and Program Outcomes. They also rate how well our recent graduates achieve the Program Outcomes. Data from other measurements of student achievement are also given to the board. They evaluate the data and recommend changes, but the faculty has the final decision on any changes.

Biographical Information

CHRISTI PATTON LUKS

Dr. Patton is Applied Associate Professor of Chemical Engineering at The University of Tulsa. She received her B.S. in Chemical Engineering from Texas A&M University and her M.S. in Applied Mathematics and her Ph.D. in Chemical Engineering from The University of Tulsa. She is currently involved in applying fuel cells and reformers to hybrid-electric vehicles.

LAURA P. FORD

Dr. Ford is an Associate Professor of Chemical Engineering at the University of Tulsa. She earned chemical engineering degrees from Oklahoma State University (BS) and the University of Illinois at Urbana-Champaign (MS and PhD). Her research is in dry etching of metals and metal alloys. She is involved in outreach activities and the American Institute of Chemical Engineers.

Appendix

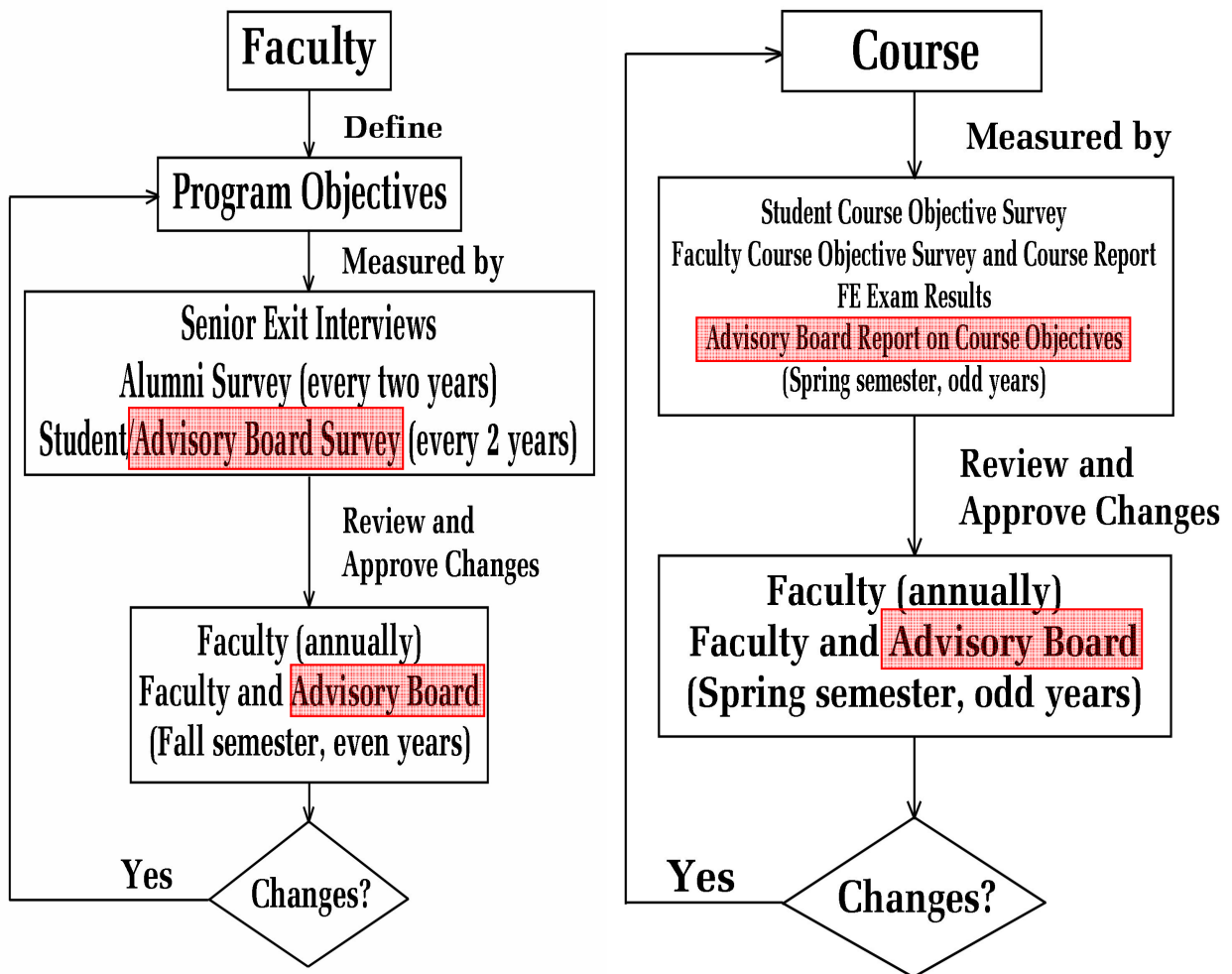


Figure 1 a. Assessment flowcharts for the first year of the two-year cycle.

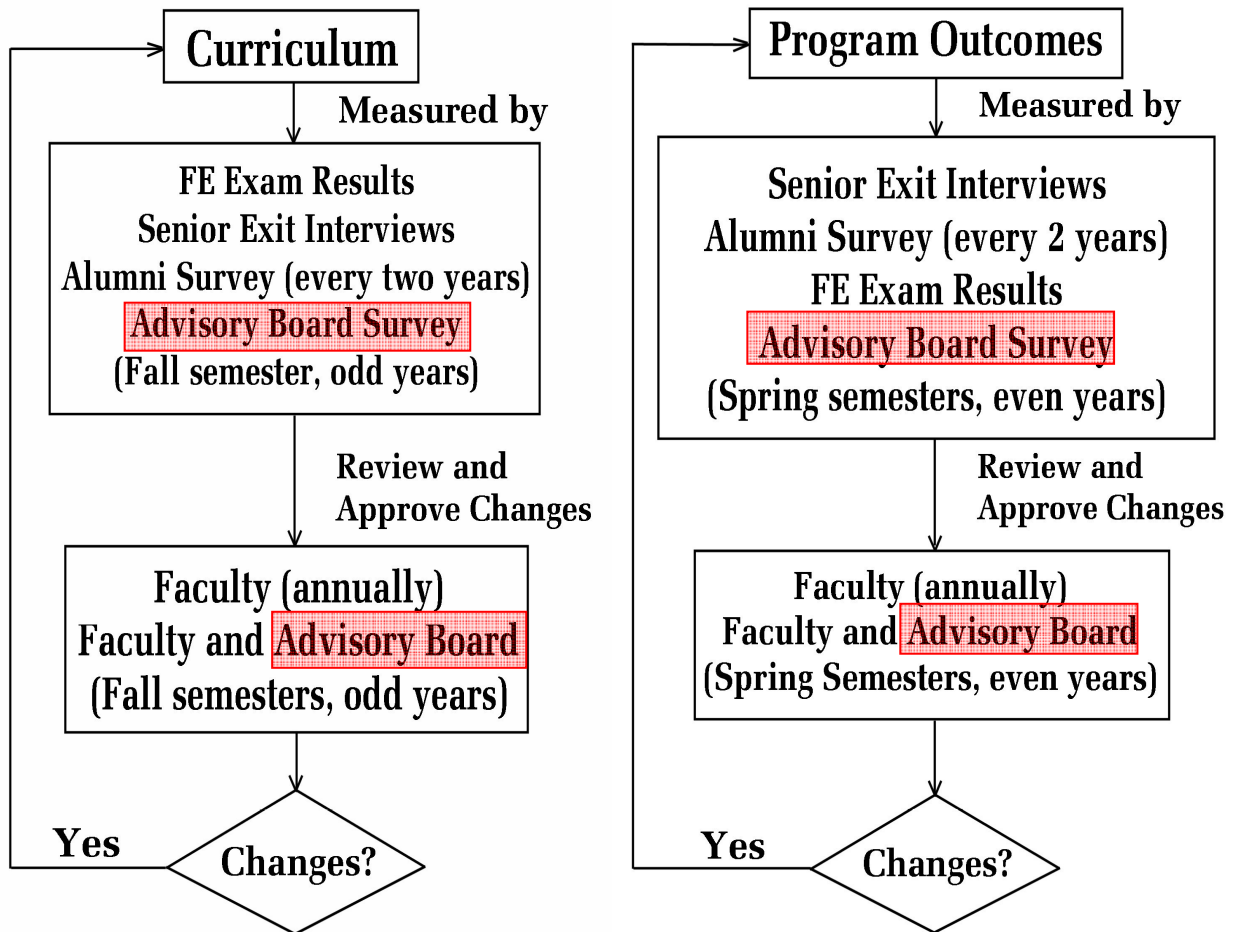


Figure 1b. Assessment flowcharts for the second year of the two-year cycle.

**Department of Chemical Engineering Survey
Fall 2006
Advisory Board/Student Luncheon**

Our educational objectives are to prepare our students, through a high-quality course of instruction involving classroom, laboratory, and professional activities, for successful employment in the chemical process industries, including energy-related industries, environmental, materials, or biotechnology, for graduate studies in chemical engineering; or for graduate studies in other fields such as medicine, law and business administration.

For the purposes of ABET accreditation, and to help keep our program current by responding to changes in the global economy and society, please give us your comments on our objectives.

Are these objectives consistent with your expectations for the BS program in chemical engineering at TU? If no, please explain.

Do you feel that we should modify these objectives or adopt further objectives? If yes, please specify.

Are there ways that we could improve the quality or effectiveness of the chemical engineering program at TU? Please be as specific as possible.

Figure 2. IAB survey for Program Objectives

ChE 4063 Chemical Reactor Design															
	How important do you feel this objective is to this course?				Check any ABET criteria you feel this objective addresses										
Objective	essential	keep	drop	modify ¹	a	b	c	d	e	f	g	h	i	j	k
Design ideal isothermal reactors, including cases with pressure and density changes															
Analyze laboratory kinetic data for concentration and temperature dependence															
Have an understanding of non-isothermal reactor design and be able to solve simple cases by hand															
Design reactors using HYSYS software for complex situations, including multiple reactions in non-isothermal reactors															
Have an understanding of catalysis and catalytic reactor design, including mass transfer effects															
Have some knowledge of non-ideal reactors															
¹ Recommended modifications:															
Recommended additions to objectives (Also, check off ABET criteria you think additions would address):															
Additional comments:															

Figure 3. The portion of the IAB Course Objectives Survey that covers ChE 4063 Chemical Reactor Design.

Chemical Engineering Advisory Board Survey
Fall Semesters of Even Years

Please discuss these questions and provide ONE CONSENSUS RESPONSE to the department. Discussions can also be with the faculty and department chairman if necessary.

How important do you think these non-engineering courses are for a chemical engineering student to have in order to fulfill the department's Educational Objectives?

1 = worthless to 5 = extremely valuable

	1	2	3	4	5
Calculus I					
Calculus II					
Calculus III					
Differential Equations					
Statistics					
Physics I (Introductory)					
Physics II					
General Chemistry I					
General Chemistry II					
Organic Chemistry					
Physical Chemistry					
Instrumental Analysis (Quantitative Chem)					
English Composition					
English - Writing for the Professions					
Humanities and social sciences					

Are there other non-engineering courses that you feel are important for students to take to be able to fulfill the department's educational objectives? If yes, please specify:

Figure 4a. IAB Curriculum survey, non-engineering courses.

According to your knowledge of TU ChE graduates who have graduated in the last 3 - 5 years, how well are they able to apply the following topics in the workplace?

1 = poorly to 5 = extremely well

	1	2	3	4	5
(a) an ability to apply knowledge of math, 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 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, 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					
ChE 1) a thorough grounding in chemistry and a working knowledge of advanced chemistry					
ChE 2) a working knowledge, including safety and environmental aspects, of material and energy balances applied to chemical processes					
ChE 3) a working knowledge of thermodynamics of physical and chemical equilibria					
ChE 4) a working knowledge of heat, mass, and momentum transfer					
ChE 5) a working knowledge of chemical reaction engineering					
ChE 6) a working knowledge of continuous and stage-wise separation operations					
ChE 7) a working knowledge of process dynamics and control					
ChE 8) a working knowledge of process design					
ChE 9) a working knowledge of appropriate modern experimental and computing techniques					

Are there any other skills a chemical engineering needs to be able to fulfill the department's educational objectives? If so, please specify.

Figure 4b. IAB Curriculum survey, program outcomes.