Petroleum Engineering Education: The Road Ahead
A Summary of Major Actions at CPEE 2000

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Introduction
The Fifth SPE Colloquium on Petroleum Engineering Education (CPEE), held 23-28 July 2000, focused on partnership among industry, education, and government. Attendees determined how each partner can develop the people and technology that the industry will need in the 21st century.

Significantly, the group suggested ways of enhancing interaction between universities and industry by encouraging greater cooperation in identifying and funding research projects that will benefit both. Proposed collaborative efforts among universities, possibly working with government laboratories, could meet some of the growing need as research programs move away from industry settings.

Universities requested assistance from industry in identifying competencies that will serve students leaving academic programs. Included in the continuous feedback industry could provide the schools might be identification of needs for continuing education or distance degree programs, including coursework that would better prepare geoscientists to work in the petroleum industry. In addition, industry could provide data sets from real fields for students to use in capstone design courses. Educators agreed to seek a means for systematic sharing of those data.

Educators also identified a growing need to attract capable high-school students into university programs. Because they recognize the value of diversity among programs, they plan to catalog the kinds of programs offered by the various schools so students can make more intelligent choices.

The findings, conclusions, and recommendations of the attendees were summarized in the form of “action items” at the concluding session of the colloquium. The reconstituted steering committee (the co-authors of this paper less John Lee, the steering committee chair for CPEE 2000, who will be replaced by Hossein Kazemi of Marathon Oil as the incoming committee chair) is accountable for these action items. Individual steering committee members and selected SPE committees will be responsible for completion of the individual action items, and the steering committee will follow up on progress.

A companion paper by Kazemi et al. discusses some of the conclusions of the CPEE, but with a focus on the industry perspective and with a further focus on research and technology development within the industry/education/government partnership. This paper focuses more broadly on the action items that the CPEE selected. These action items are discussed in the sections that follow.

Enhancing University/Industry Research
The CPEE concluded that university research can be enhanced by adopting one or more of three strategies: (1) “Road shows,” in which representatives of one or more schools visit interested industry or government technology centers and listen to the research needs of the company or government body. Following this review of needs, the university representatives would then, in another face-to-face meeting, propose a plan to meet the needs. (2) An SPE-organized “Research Conference,” in which representatives from industry and government present their research needs and universities discuss their capabilities. (3) Conventional consortia, which continue to work well for some universities.
but not others because of the decreased number of funding entities in industry and government.

The “Road Show” concept generated considerable debate. It offers the advantage that experts and decision makers from industry can meet in person with the most knowledgeable representatives of universities and identify real needs and practical responses to those needs with the effective give-and-take of face-to-face meetings. Disadvantages are that few companies would be willing to expend this level of effort to talk to a significant number of university teams, and many universities do not have sufficient staff size for many such meetings. Thus, this approach could be limited to the larger universities, but the visiting teams could also include representatives of smaller universities, including their skilled specialists. There was a consensus that most companies would prefer to present their research needs alone; i.e., not including any other companies.

The proposed SPE research conferences would be expedited if the first offering were in the format of an Advanced Technology Workshop.

Chuck Bowman of Texas A&M U. and Ron Robinson of Texaco were charged to implement these ideas, with the possible assistance of David Montague of Shell.

At the colloquium and shortly after, several meetings of this sort between university teams and industry and government groups were scheduled and have been held.

Collaborative Research Among Universities

Research consortia have proved to be efficient mechanisms for funding research of wide interest in the petroleum industry. Another, less-widely used method to leverage resources, is collaborative research between universities or universities and government laboratories. The attendees at the Colloquium recognized that we have little information on collaborative research programs and their effectiveness. Therefore, before recommending specific action to enhance collaborative research, the steering committee will initiate a fact-gathering first step of determining the extent of current programs and their apparent effectiveness. Incoming steering committee chair Hossein Kazemi will appoint a steering committee member to take the initiative in this fact-gathering effort.

Continuous Feedback from Industry to Academia

There are needs in several areas for continuous feedback from industry to academia. Needs include (1) determining how appropriate a continuing education program offered by a university or petroleum engineering department is; (2) determining whether the research product and student qualifications from graduate schools meet industry’s needs; and (3) determining the quality of undergraduate student preparation to meet ABET accreditation requirements (a particular focus of the SPE Education and Accreditation Committee).

Because of the vastly diminished level of research in industrial laboratories in the last decade, there is a particular need to determine whether the PhD product of universities is meeting current needs in industry. Feedback from industry will be particularly helpful to resolve this issue. Academics disagree on whether the traditional educational program with a strong emphasis on research (necessary for the economic survival of universities and individual professors) is optimal preparation for PhD students who will more likely become technical service specialists in their initial assignments in industry.

The steering committee requested that the Association of Heads of U.S. Petroleum Engineering Schools and the SPE Education and Accreditation (E&A) Committee work with Hossein Kazemi to develop a systematic mechanism for this feedback.

Distance Learning and Continuing Education

Continuing education programs offered by petroleum engineering departments are fragmented and, at many universities, uneconomic. Just as efficiency can result from collaborative research, it may be useful for universities to collaborate in their continuing education and distance learning efforts.

Independent operators in the industry have a particular need for continuing education and technology transfer. Close coordination with the PTTC would be helpful.

In addition, we have seen a recent proliferation of graduate courses for credit and degrees in petroleum engineering offered via distance learning. Courses offered by distance learning can be much more expensive to develop and maintain than courses offered live on campus, and collaboration may be the key to more efficient use of human and financial resources.

Lloyd Heinze of Texas Tech U. will work with the SPE Continuing Education Committee to determine possible ways for universities and SPE to collaborate. Possibilities include minimizing overlap as much as possible and “one-stop” shopping for continued education offerings at a central site, such as the SPE Web page with links to descriptions of continuing education courses offered by universities.

Competency Matrix

The Colloquium concluded that the competency matrix that SPE has developed will be of great value in designing or updating undergraduate and graduate curricula and in designing continuing education programs (in addition to its primary function of determining proper qualifications for registration as a professional engineer). Use of this competency matrix has not reached its full potential, however. The steering committee will ask Cindy Reece of ExxonMobil, a major architect of the matrix, to have her SPE standing committee publish a one-page article in JPT describing the matrix and its potential applications in petroleum engineering education.

Field Data Set Sharing Between Industry/Universities

Complete data sets from real fields are of considerable value in university curricula, especially in capstone courses in integrated reservoir studies. However, these data sets are relatively rare and fail to achieve their full potential when they reside only in the files of a single university. Therefore, there
is a need to establish a mechanism for systematic sharing of these field data sets. Don Green of the U. of Kansas will request that the Association of Heads of U.S. Petroleum Engineering Schools establish that mechanism. The association could benefit from the extensive network of contacts that Susan Howes of Anadarko has developed.

**Petroleum Engineering Courses for Geoscientists**

Collaboration between geoscience and petroleum engineering departments for the benefit of petroleum engineers is very much in vogue currently. But in the interest of the petroleum industry broadly, there should be equal focus on satisfying the needs of geoscience students. One need identified at the colloquium is to identify a subset of petroleum engineering curricula (developed to satisfy ABET criteria) that will serve as minimum competency criteria for geoscientists who plan to enter the petroleum industry. Bill Eustes of the Colorado School of Mines will pursue developing such a program with the SPE E&A Committee.

**Attracting Students to Petroleum Engineering**

We concluded that we are failing to attract sufficient numbers of “the best and the brightest” high-school graduates to petroleum engineering as a major, with special problems in attracting women and minorities. Retention of good students is a significant problem (sometimes because good students accept scholarships in petroleum engineering and later switch to another major of greater interest). The solution to this problem may include mentor and buddy systems (faculty and upper classmates working closely with freshmen and sophomores).

To attract more women and minorities, little good is likely to result from a relatively small group such as ours trying to develop an ambitious new program. Better results are likely if we cooperate with other groups already making efforts to make petroleum engineering more diverse and inclusive; such groups include the Society of Women Engineers, the Association of Women in Science and Engineering, the Society of Black Engineers, the Society of Mexican American Engineers and Scientists, the Society of Hispanic Professional Engineers, and American Indians in Science and Engineering. Susan Howes’ extensive network of contacts could provide us with an important start in this effort.

There are also opportunities to retrain women who are returning to the petroleum engineering workforce following extensive leaves. Again, a cooperative effort is more likely to be successful than a new initiative by a small group.

These conclusions are hardly new, but the problem needs to be worked, and talk is not sufficient. Therefore, we requested that Chuck Bowman take this issue to the Association of Heads of U.S. Petroleum Engineering Schools for action.

**Identifying Diversity Among Programs**

There was a consensus that a “one-size-fits-all” core curriculum for graduate studies is infeasible. However, many were interested in obtaining and studying individual university graduate degree core requirements. Therefore, a team of Lloyd Heinze and Akanni Lawal of Texas Tech U. was formed to gather information on core curricula from universities throughout the world. The results of this survey will then be reported to all universities to use as they wish.

The same Texas Tech team will also collect mission statements for both undergraduate and graduate petroleum engineering programs throughout the world. This information will be useful in determining how individual program objectives are similar and how they differ. Colloquium attendees expressed no interest in achieving uniformity in programs; indeed, they regard program differences as healthy.

**Other Issues**

Although we did not develop action plans to deal with the issues listed below, we do need to mention these issues as a matter of potential interest to petroleum engineering educators throughout the world.

- We need to enhance professional society cooperation (e.g., SPE, AAPG, SEG) at the university level. Such cooperation can enhance efforts in curriculum development, joint meetings and publications, and collaborative research and training projects.
- Intellectual property ownership issues inhibit effective university/industry partnering in research. The consensus was that many university policies are archaic, but exist because of state laws. Individual faculty efforts to change state laws will ultimately benefit the faculty member, the university, and the industry/government/university partnership.
- More funding for oil and gas research in the U.S. DOE budget will obviously benefit the partnership and the universities. More funding will, however, depend partly on the efforts of university and industry people to make the case for additional funding to the U.S. congress.
- Undergraduate programs in petroleum engineering need to continue the recent trend of emphasizing fundamentals (mathematics, science, basic engineering sciences), possibly at the expense of instruction in technology used in industry today. We would also benefit from ensuring that the geosciences, business fundamentals, and soft skills (e.g., communications, teaming) are integrated into the curriculum and are not treated on a stand-alone basis.
- We need to investigate the benefits of course-sharing between universities to make more effective use of limited resources. This becomes increasingly possible as remote communication technology improves.
- An improved communication system within SPE linking universities in different countries in inexpensive ways would be in the interest of SPE’s globalization effort. Again, advances in remote communication technology offer possibilities that were once available only through prohibitively expensive visits of significant numbers of students in foreign countries. A program linking universities could enhance information sharing, papers,
and best practices and provide the basis for a “sister school” program that has been attempted in the past with little success.

- Whether the SPE local section scholarship program is truly bringing the best and brightest students to the petroleum industry (with appropriate numbers of women and minorities) is a question that we must raise. The local section scholarship program is a source of great pride to most sections, and changes dictated by a central authority would most likely be unwelcome. But a focused vision and recommendations from an appropriate committee might still be persuasive and might help solve the problem.

- Graduate programs in the United States are dominated by foreign students, a situation that is in the interest of foreign countries, the global petroleum industry, and U.S. universities (and totally consistent with current market forces). Many international graduate students have very limited skills in English, the international language of the petroleum industry. Systematic efforts to solve this problem and a sharing of experiences in problem solution would be helpful to universities, to the students, and to the industry.

**Additional Information**

Additional information about the deliberations at the CPEE can be found the website [http://www.pe.ttu.edu/CPEE](http://www.pe.ttu.edu/CPEE). This file, located on the Texas Tech U. Department of Petroleum Engineering website and compiled by Heinze, contains a wealth of information. Many of the PowerPoint files used by speakers at the colloquium are posted here. Notes taken by designated note takers for each session are here. The steering committee and SPE members interested in details of the deliberations at the colloquium owe Heinze a vigorous “thank you” for his efforts in making this material available.

**Acknowledgements**

The steering committee of CPEE (the co-authors of this paper) gratefully acknowledges the major contributions by the invited speakers and participants in the Colloquium. The presentations were concise and effective; the discussions were to the point and led to specific actions that SPE can now pursue. The SPE staff, particularly Reneé Breazeale who was on site during the colloquium, were outstanding in their attention to detail. The financial backers of the colloquium from industry and, particularly, the U.S. Department of Energy, were very helpful in containing the cost of the colloquium for individual attendees.

**References**