

LOOKING AHEAD: CHALLENGES FOR PETROLEUM ENGINEERING EDUCATION

Cunha, J. C., Cunha, L. B.
University of Alberta, Edmonton, AB, Canada

Abstract

This article indicates some basic knowledge and skills that should be present on the education of today's petroleum engineering students. Concurrently it presents some thoughts and points out directions for petroleum engineering education in the next few decades.

The importance of interaction between petroleum engineering schools and the oil industry is analyzed and some directions to improvement of this relationship are given.

The challenge and importance of attracting better and brightest students are commented and some suggestions related to how schools and industry should jointly participate in the efforts to keenly achieve this goal are listed.

Introduction

"Petroleum engineers make the world run." This proud quote, extracted from a Petroleum Engineering Society's website indicates how highly we regard our career and, at the same time, indicates how important it should be the educational process that prepares the next generation of engineers to fulfill the industry needs.

Petroleum engineering, as a formal academic course, is about to complete its first century¹. Obviously, educational methods, as well as industry technology, have undergone tremendous changes that are somehow reflected in current courses. Basic skills for a petroleum engineer, besides mastering fundamentals of mathematics, physics and chemistry, will include:

- Geology;
- Well drilling technology;
- Formation evaluation;
- Oil and gas production technology;
- Properties of reservoir rocks;
- Properties of reservoir fluids;
- Fluid flow in porous media;
- Reservoir analysis and management.

There is evidence² that, regarding basic technical knowledge, the majority of newly petroleum engineering graduates are well prepared. On the other hand, apparently this is not true with regard to the fast-changing requirements of the oil industry, where there is an expectancy that young professionals will be prepared to exercise leadership, deal with business issues and implement policies that will contribute to corporate success and profitability.

It is probably unrealistic to expect to find the aforementioned set of skills on a recently graduate. However, as a goal, petroleum engineering education should provide the students with the means to use their technical background and personal qualification to acquire those skills after a short period of time subsequent to graduation.

Clearly, achievement of that goal will depend not only on university infrastructure, laboratory facilities and well prepared professors. Fundamental importance should also be given to recruitment of students. Two recent panels^{3, 4} have reached similar conclusions regarding the fact that attracting the “best and the brightest” students is essential and somewhat is an objective that is not being completely fulfilled by petroleum engineering schools.

Importance of Industry-University Interaction

Over the last twenty years the field of Petroleum Engineering has undergone major changes. The evolution of technology as well as the increasing presence of computerized tools in nearly all stages of the exploration-production process has generated new needs in the educational system. One frequent comment is that Academia not always has evolved fast enough in order to meet those needs.

The perception that universities do not follow, with the necessary fast pace, the trends of the industry (the real world) is present in almost every discipline. Most of the times this perception does not represent a completely fair view of Academia. Universities do not have to concentrate only on the development of mere technical skills. Knowledge of fundamentals of the exact sciences is still very important for engineers and the efforts dedicated to master those concepts should not be influenced by new developments and the immediateness of the industry. On the other hand, it must be recognized that academic courses should somehow be influenced and reflect changes undergone by the industry. For that matter, a close collaboration between Industry and Academia will certainly contribute to better prepare future professionals.

This interaction should go beyond scholarship programs and research funding. Industry leaders interested in improvement of Petroleum Engineering courses should actively participate on Industry-Academia seminars clearly pointing out problems detected and aspects in need of enhancement. At the same time they should also be willing to participate in the efforts for improvement of the courses with suggestions, constructive analysis, talks as guest speakers and sharing of field data that may be used to provide, for certain courses, a more exciting and industry-related environment⁵. Sharing of actual field data sets is considered one of the most efficient ways³ for Industry to contribute to the enhancement of university education. However, this kind of contribution is relatively rare either due to absence of mechanisms allowing this action or due to confidentiality matters.

Moreover, as mentioned in Ref. 3, a continuous feedback from Industry to Academia relating how junior professionals are performing and how they are meeting (or not) Industry expectations in terms of technical skills and general knowledge of the Industry and its business must be provided. Note that this is easier said than done since not always there are appropriate channels allowing free communication between Industry leaders and Academia. Actually, establishment of such channels is one the main challenges to be faced and should be tackled as priority for both Industry and Academia organizations. This is a task that must be embarked upon by Academia and Industry professionals as well.

Enhancing Preparedness for Professional Life

As mentioned before, knowledge of the fundamentals of exact sciences is of utmost importance for engineers. However, this does not mean that students must have their entire petroleum engineering course devoted to traditional academic disciplines. There are a number of practical measures that may play an important role on preparing students for the challenges that will be faced after graduation.

Modern courses should include comprehensive laboratory training involving such fundamental areas as properties of reservoir fluids, fluid flow in pipes and porous media, drilling fluids, rock mechanics and hydraulics. Theoretical concepts explained in classroom will be better comprehended after practical related applications are performed in laboratory classes. In addition, correlation between theory, laboratory experiments and actual industry applications will be further enhanced if at the same time an extensive field trip program can be implemented as an auxiliary tool to academic education. Note that this tool, although not mentioned on the previous section, also represents a powerful means of Industry-Academia interaction. Visits to operation sites, production plants and industrial laboratories will certainly give to students a much better perspective about the Industry.

Current industry trends ask for professionals whose skills supersede traditional academic training. Our Industry demands from our possible future leaders and managers a basic understanding of the oil business, the global market, its trends, risks and economical implications. Knowledge about major oil and service companies and their markets and geographic areas of operation is also necessary since, as it is well known, professional development and promotions often come with reallocation to a different region or country.

In addition, modern professionals will be asked to be well-informed about legal and ethics issues and have an awareness of matters related to health, safety and environment.

Besides that, even from junior professionals, it will be asked good presentation skills and ability to communicate ideas either orally or with written reports in a logical and clear way. A good academic program (see Fig. 1) will have a profusion of assignments related to critical paper reading, report writing and technical presentations. Also students should be encouraged, whenever possible, to attend conferences, seminars and technical presentations since examples from well established professionals are still one of the best incentives to self improvement.

Challenges on Attracting Students

As mentioned before, not always we have been successful in attracting high level students to petroleum engineering courses. Besides that, there are also concerns, at least in North America³, related to the under-representation of women and minorities in the petroleum engineering career.

One of the reasons often mentioned⁴ for a career in the oil business not to be considered attractive enough for young bright minds is related to the somewhat tarnished image of the industry. This image, as unjust as it may be, clearly is present in many segments of our society. Moreover, there is also the fact that exploration and production of oil and gas is frequently seemed as an un-charmed, dull activity. We may be failing to publicize the impressive degree of advanced technologies used to find and produce oil and the excitement and challenges present in the career.

Many universities promote open career days, when students can come to the universities, visit laboratories and attend presentations. This is a good measure although, apparently, a tradition that is only common in North America.

Companies and professional societies should also participate in this effort. Information is the key to have more young men and women interested in the career. Besides that, students should be informed about the diversified employment opportunities for petroleum engineers. The number of schools (see Table 1) and consequently the number of graduates every year is relatively small when compared with other engineering disciplines, which contributes for constant availability of good job opportunities.

Another point that is always mentioned by prospective students, and even by petroleum engineering students, is related to the long term subsistence of the Industry. Even though there are serious studies⁶ indicating that the oil industry will be the major producer of energy for decades to come, the much more publicized studies indicating the end of the oil era for the next few years has obviously created an understandable fear that there is no future for a career in petroleum engineering.

Continuing Education Programs

This is a tool that is not well utilized by professionals after concluding their BSc programs. Probably one of the reasons for that, as mentioned in Ref. 3, is the fact that programs offered by petroleum engineering schools are fragmented, not always attending specific professional needs and, most of the times, not efficiently publicized. However, this could be one of the most efficient ways to proficiently promote communication between Industry and Academia.

Often these programs are considered uneconomic but certainly this would not be an issue if there were more participation. On the other hand, obviously, increase in attendance will only occur if such programs become regarded by engineers as true tools for professional development and career advancement.

Universities, on the other hand, will benefit from the feedback that can be provided by experienced engineers attending the programs. This is a real and tangible benefit and also an indication that analysis of these programs by educational institutions should go beyond the mere economic point of view.

Conclusions

- Effort should be made towards the goal of attracting more and better prepared students to petroleum engineering schools. The oil industry as well as universities must make every effort in order to better communicate to society the importance of the business for society, its high-tech environment and its numerous possibilities for a rewarding career.
- Sharing field data and thus allowing more realistic examples and field cases to be presented to students, besides contributing to the increase of the overall quality of petroleum engineering courses, will also better prepare the students for the oil business environment.
- Without compromising traditional science education, regarded as fundamental for engineering students, emphasis should also be placed on a broad range of information related to the oil business and the global economy.
- A well prepared professional will have to be able to analyze projects not only from a technical standpoint, but also from the perspective of risk and economic analysis. Notions related to ethics, health, safety and environment are also essential.
- Establishment of channels, allowing free communication between Industry and Academia, must be a priority in order to achieve efficient and up to date courses. Industry feedback is important and certainly petroleum engineering education for the next 20 years will be closely related to the future reserved to the industry.

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TABLE 1
 Number of Petroleum Engineering and
 Technology Schools per Region*

Region	Number of Schools
Africa	9
Asia-Pacific	10
Central and South America	20
Europe/Central Asia	22
Middle East/India	10
North America	36
Total	107

*Source: Society of Petroleum Engineers

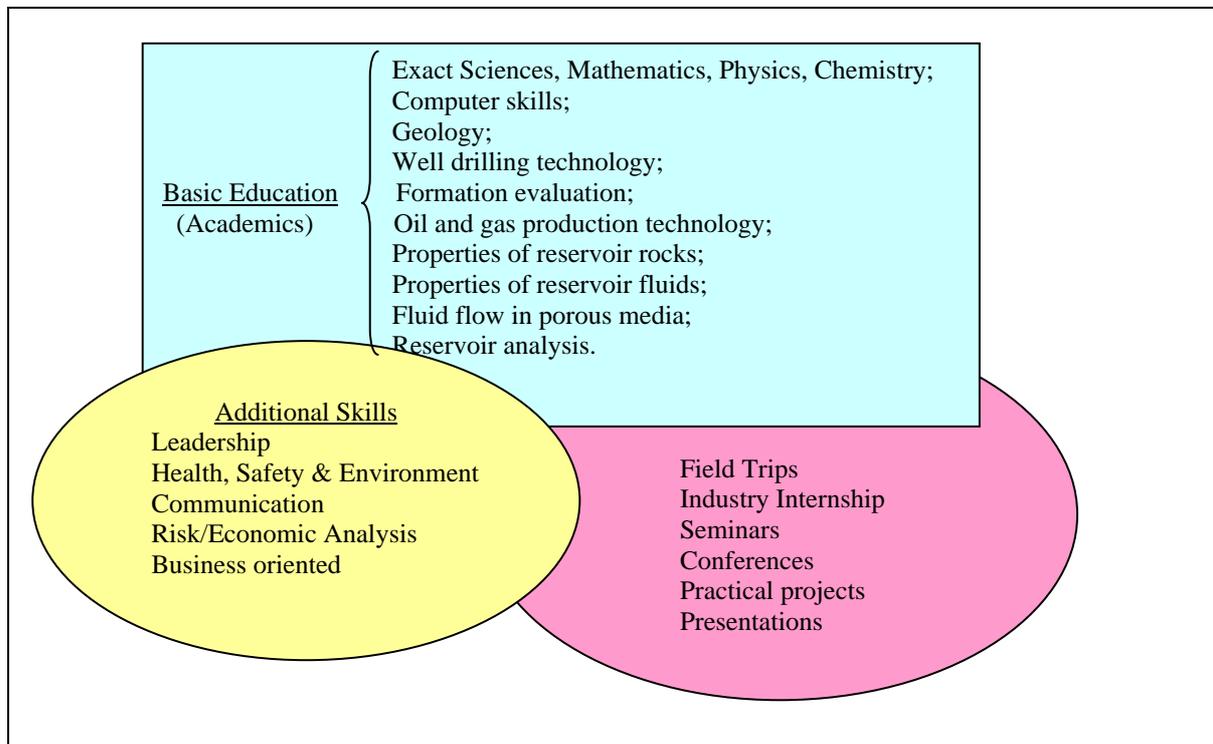


Figure 1
 Graphical Presentation for Petroleum Engineering Curriculum and Addition