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CHANGING PETROLEUM ENGINEERING EDUCATION TO MEET INDUSTRY DEMAND

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ABSTRACT

The Department of Petroleum Engineering at Curtin University had its inception in 1998. For the last 10 years, it lectured the Masters in petroleum engineering course to local Australian and international students, graduating more than 200 students. The rapid increase in the price of oil during 2006/7 saw a sudden and substantial growth in industry employment opportunities, which resulted in the department losing over half of its staff to industry. At the same time, the supply of local students reduced to less than 10% of those taking the course. This loss in both student numbers and staff at the same time threatened the department's future, and resulted in the need for a new focus to return the department to stability.

A number of new initiatives were introduced, which included: bringing industry into the decision-making processes; introducing a new two-year Masters program to assist high quality migrant students obtain Australian permanent residency; increasing the advertising of petroleum engineering as a career option to schools and industry; linking with UNSW, UWA and Adelaide universities to establish a joint Masters program; introducing a new Bachelor's degree in petroleum engineering; changing the block form of teaching to a semester-based form; and having the Commonwealth recognise the new Masters program for Commonwealth funding of Australian students as a priority pathway to a career as a petroleum engineer while the Bachelors program gathered momentum.

This paper maps the positive changes made during 2008/9, which led to a 100% increase in student numbers, a 50% increase in staff to stabilise teaching, a 400% increase in active PhD students, and industry projects to deliver an increasing stream of high quality, industry-ready, graduate petroleum engineers over the next 10–20 years into the current ageing population where the average age of a petroleum engineer is 51.

KEYWORDS

Education, training, PEA, petroleum engineering Australia, research, advisory committee, industry, learning, students, MBA, oil and gas, geomechanics, Curtin, core flooding.

INTRODUCTION

Since the 1960s and initially in the US, one approach to the education of petroleum engineers has been to take practicing engineers and have them lecture a class of graduate chemical or mechanical engineers, or geologists in an educational program that was based on short courses. This allowed the practicing petroleum engineer to disseminate an area of expertise or knowledge over a short period of time, allowing the engineer to return to the workforce when the information transfer was complete. Since becoming a professional (or chartered) petroleum engineer was an important pre-requisite to joining the industry in some countries, it was necessary to formalise these courses into Masters degrees (MEng), effectively becoming conversion courses for engineers in other disciplines to switch into petroleum engineering.

The short course format of these Masters was not necessarily good for all students, and it is argued that lectures in block form do not provide the rigour offered by the semester form of teaching because of inadequate time to absorb complex material, lack of time for assignments or comprehensive examinations and laboratory work (if any), not to mention the pressure on academic staff of teaching in this tight time frame.

Where the oil and gas industry was expanding (for example in the US and North Sea) and the demand for petroleum engineers exceeded the numbers being generated through such conversion short-course style Masters degrees, it became necessary to establish undergraduate Bachelor of Engineering (BEng) degree programs. Consequently, major teaching centres were set up in an increasing number of locations such as the US, Canada and countries peripheral to the North Sea where there was also a linking interest in expanding petroleum engineering research projects. As a result, the established universities often operated either undergraduate or course-work Masters programs, or both.

The price of oil gradually increased along with student demand and the need for qualified petroleum engineers, so many universities started new courses based on the method of the Masters conversion course.

In the 1980s, the only major oil and gas fields in Australia were those located in Bass Strait, where Esso Australia was the operator and BHP was the Australian partner. As a result, it was natural for Sydney-based Esso to support the establishment of a petroleum engineering educational capability at the University of NSW (UNSW) in Sydney. By the time the 1990s arrived, new discoveries were being made in northern South Australia and offshore in the North West Shelf area of Western Australia where giant gas fields were present. During the mid-1990s, a number of petroleum engineers from the Perth industry were attracted to Curtin University to set up its Masters program in petroleum engineering. Meanwhile, Santos decided to underwrite a local school of petroleum engineering at the University of Adelaide to supply its expanding needs for qualified engineers. Soon after, the University of Western Australia (UWA) established a Masters program in oil and gas engineering, which was more downstream than the other three university upstream programs.

The number of internationally well-known Masters programs from well established schools are shown in Table 1. There are, of course, many more programs, but these are the schools that most international students would recognise and favour.

FINANCIAL MODEL

The Masters programs were based on the conversion course approach, and were successful from the start in providing a steady supply of engineers to their local market. In Australia, the graduates from UNSW initially worked for Sydney-based companies but over the years have worked elsewhere as prominence of the industry in Sydney reduced. Graduates from Adelaide have been biased towards working mainly for Santos, while those from Curtin and UWA worked for the local Perth industry. However, without subsidy, the question was whether such courses were financially sustainable in a country where the university financial model is payment per student. This works well for large classes (such as nursing or business studies where there can be 80–200 students per class) but not for small classes such as in petroleum engineering where the number of students was typically around 20.

Any business needs the financial income stream to equal or better the financial outgoing stream for the business to survive. An experienced professional engineer may have a salary package of around \$20,000 per month. A Masters student typically pays \$2,000 per month tuition, with the teaching department receiving no more than 50% of this or around \$1,000 per month. So, to pay a single professional engineer their monthly salary package, they would need to teach around 20 students continuously throughout the year. According to the 2007 Society of Petroleum Engineering (SPE) salary survey (SPE, 2009), the median petroleum engineering salary for 2007, including incentives and car allowance, was \$160,000, and this figure increased to \$198,000 in 2008. When it is considered that some 10 different topics may be taught by at least five different specialists, it is not hard to see that the sums don't add

up. Major subsidies are required either through company underwriting, research, or State and university funding.

The Department of Petroleum Engineering at Curtin University was fortunate that soon after it was established, there was major support for research projects from the State Government. The academics doing the research were then able to subsidise part of the teaching program by providing free teaching. In addition, a number of engineers employed by the department and paid at relatively low level academic rates were encouraged to consult to industry to bring them up to industry standard income. This allowed them to work with industry while being involved with students, which along with the research project income became a short-term practical approach to resolving this financial dilemma.

The year 2007 will, however, rate in history as the turning point in petroleum engineering education, not just in Australia but around the world because the shortage of petroleum engineers was a global phenomenon. Within the year, the price per barrel of oil increased dramatically, resulting in an average engineer's salary in industry almost doubling.

The result was that engineering faculty left academia for industry in droves. In Australia it didn't just affect petroleum engineering—when the resources boom kicked in it also affected civil, chemical and mechanical engineering. Some Australian universities had half their academic and research staff leave for industry in these areas—a problem that affected all petroleum engineering universities around the world.

What was the solution? Universities in the US have solved the problem by obtaining industry funding to allow offers of substantial salaries to bring the academics back to university (a number of US and Middle East universities typically offered five-year contracts at US\$250,000 per annum). The UK has not had this luxury, as operating fields were gradually depleted, and they consequently suffered. So what did Curtin do? It considered an alternative approach.

ALTERNATIVE FINANCIAL MODEL

The alternative model was structured around the following 10-step plan:

I. Research

The quality universities around the world are known for their research not their teaching, which in many respects underpins their research. Australia is presently involved in the Excellence in Research Australia (ERA) initiative (<http://www.arc.gov.au/era/default.htm>), which requires all researchers to prove their abilities through publications in highly ranked journals and, therefore, this cannot be ignored when considering directions to move forward. Furthermore, basing a department's future on research, while risky, is attractive at a time of ERA.

Academic life is often more attractive to those who like developing new ideas anyway. It takes a special breed of

Table 1. Well-known and established universities teaching petroleum engineering.

School	Location	Country
Colorado School of Mines	Golden, Colorado	USA
Curtin University of Technology	Perth	Australia
Delft University of Technology	Delft	The Netherlands
Ecole Nationale Supérieure du Pétrole et des Moteurs	Rueil-Malmaison	France
Heriot-Watt University	Edinburgh, Scotland	United Kingdom
Imperial College of Science and Technology, Royal Sc	London	United Kingdom
King Fahd University of Petroleum and Minerals	Dhahran	Saudi Arabia
Louisiana State University	Baton Rouge, Louisiana	USA
Montana Tech of the University of Montana	Butte, Montana	USA
New Mexico Tech	Socorro, New Mexico	USA
Norwegian University of Science and Technology	Trondheim	Norway
Pennsylvania State University	University Park, Pennsylvania	USA
Robert Gordon University	Aberdeen, Scotland	United Kingdom
Stanford University	Stanford, California	USA
Sultan Qaboos University	Muscat	Oman
Texas A & M University	College Station, Texas	USA
Universidade Estadual do Norte Fluminense	Macaé	Brazil
University of Aberdeen	Aberdeen	United Kingdom
University of Adelaide	Adelaide	Australia
University of Calgary	Calgary, Alberta	Canada
University of Houston	Houston, Texas	USA
University of Louisiana at Lafayette	Lafayette, Louisiana	USA
University of New South Wales	Sydney	Australia
University of Oklahoma	Norman, Oklahoma	USA
University of Texas at Austin	Austin, Texas	USA
University of Tokyo	Tokyo	Japan
University of Tulsa	Tulsa, Oklahoma	USA
University of Western Australia	Crawley	Australia
Waseda University	Tokyo	Japan

person to forgo the high salaries offered by industry in preference to those offered by research and the Australian Research Council (ARC). A well-respected department becomes known for its research rather than student output, so it becomes important to develop staff who have a strong interest in research, but are able to do their teaching as an additional duty; on top of that, they are teaching the future PhD students they need for their research. Furthermore, this raises the teaching standard and the abilities

of the graduates. Curtin University aspires to be a leading research university, so the concept to base the future of the department on research was totally acceptable to Curtin's administration.

To commence a research activity, it is important to establish capability. The department has a core-flooding laboratory (Fig. 1), which is now being used by the likes of CSIRO and the CO2CRC. The remaining faculty members had research interests in three-phase flow, geomechanics,

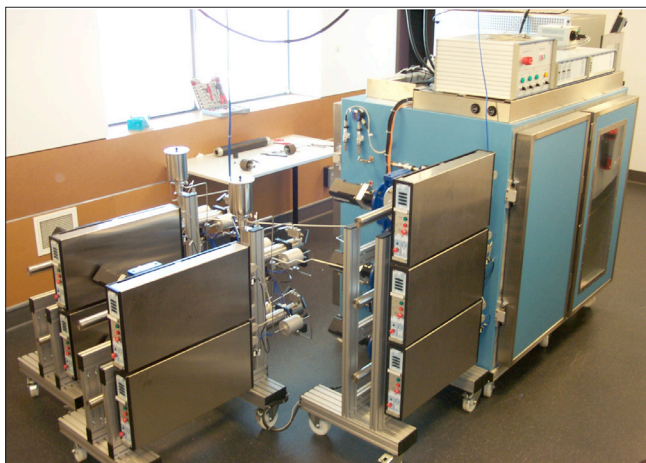


Figure 1. Curtin University's core flooding laboratory.

reservoir characterisation, smart well engineering and reservoir geophysics. Since the future research would focus on these areas and alignments made with other universities would build on these areas, it then became necessary to obtain funding to upgrade existing capabilities. Curtin University was supportive of this approach and consequently funds were sourced to be able to make the core flooding laboratory one of the few in the world which could use ultrasonic scanning to track fluids through cores in real-time (Fig. 2). A new geomechanics laboratory was also designed and constructed (Fig. 3). In short, Curtin's research approach is one that must focus on niche market places and to develop the future research focus in areas we are expert in. Once those products are producing research projects, Curtin then moves on to the next niche area.

The result has been the award of a number of industrial research projects and the inclusion of this department in two CRCs (CO2CRC and Deep Exploration Technology CRC). We are also taking up a lead role in the WA: Energy Research Alliance (WA:ERA) Tight Gas research project.

2. Increasing PhD student numbers

In order to increase research, it becomes necessary to increase the number of research students; the major unseen benefit of this is that the PhD students can assist with teaching and marking. The department previously had a lower level of research activity and most of these students were working full-time in industry. Part-time PhD students are not always helpful to the teaching program, nor are they useful to establish a university department's credentials as a research powerhouse. Bringing a tranche of full-time PhD students into a department is a lengthy process with the requirement to obtain a grant (which can take a year), and then locate an acceptably qualified person. A qualified PhD student must have a B Eng or M Eng in petroleum engineering and, as we knew at the time, any local potential student would be snapped up before we got to them.

The answer was to attract international students. The department had previously operated a joint Masters program



Figure 2. Unique ultrasonic measuring core holder.

A



B

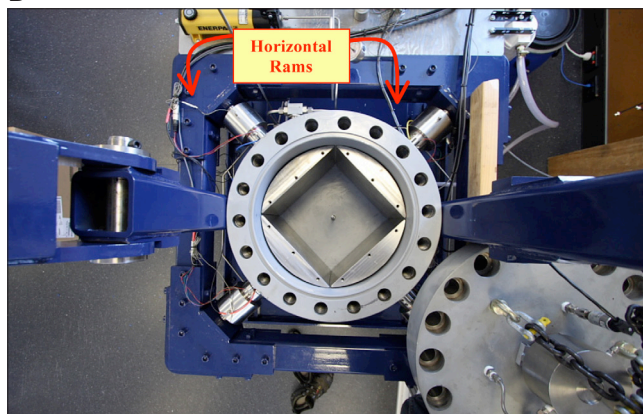


Figure 3. Petroleum geomechanics laboratory. (A) a general view of the TTSC; (B) the horizontal rams to apply stresses.

with the Petroleum University of Tehran (PUT), Iran and we knew that a number of the 100 graduates were keen to return to Perth. We approached the university to find out how to attract university scholarships and found out that there were about five university Endeavour scholarships awarded per year to the top overseas graduates. Endeavour scholarships provide: course tuition fee for three years for a Doctoral degree as well as Overseas Student Health Cover (OSHC) for the recipient and their dependants for the duration of the award. In addition, all successful ap-

plicants receive a Curtin University Postgraduate Scholarship (CUPS) valued at \$20,427 (2009 value). This tax-free stipend is indexed annually. A top graduate is one who has produced at least 10 conference and journal papers in quality international journals over the previous two years—which, frankly, we thought would be impossible. However, we were shocked to find that one of our past and outstanding Iranian graduates has worked for a service company in Islamabad for the last two years, and had produced no less than 14 publications during that time—and he wanted to leave Islamabad for Australia. So we put his Endeavour application forward along with the other 70 applications, and were very pleased that his was approved.

The final step was to bring as many PhD students into Australia as possible. Curtin University has another scholarships scheme known as the Curtin International Research Tuition (CIRT) scheme, which is basically a fee waiver by the university and also by the research department; the students' stipend had to be supported by the department or by other sources. While this was unattractive since it did not provide fee finance, it did provide the chance to bring in quality students from overseas. Consequently we discussed the situation with a number of Iranian companies, and after some effort, reached agreement with them to fund four students' stipends on projects appropriate to their needs.

Now 18 months later we have a cohort of nine very smart full-time international PhD students, who are working in areas of interest to the industry, and who are now able to provide teaching and marking support to our over-worked academic staff. Two have already been awarded second prizes in international SPE conferences and four have posters at the APPEA 2010 conference.

3. Change short course teaching to semester-based

Short course teaching crams the subject matter into short timeframes and frees up time for consultancies rather than research, which tends to be longer term. A consultancy project may be one month long, often requiring the consultant to spend a month or more in the company office away from the university. Company research projects by comparison, are often longer term and can often only be accommodated if the researcher is continuously resident (such as having to use core laboratories on a daily basis). Therefore, the research approach fits better around weekly semester-based teaching rather than block form.

Short course operations require the teaching of lectures to be performed by the same lecturer every day for a block of time—for example, for three weeks. Students cannot absorb a large amount of information over a short period in time; lecturing the same material over a longer 14-week period delivers better results. Block teaching results in assignments often being reduced in quantity and quality since lecturers do not have the time available to mark them, particularly when consultants are used. In comparison, semester-based teaching involves continual knowledge-growth by students and more comprehensive

teaching from faculty rather than consultants. Semester-based teaching also reduces the short term cost of consultant teaching fees, which makes it more palatable for the administration, which is set up to fund longer term teaching rather than block fees.

4. Undergraduate Bachelors program becomes possible

The Curtin Petroleum Engineering Industry Advisory Committee (IAC) has some 15 companies who meet every six months to discuss issues to do with the petroleum engineering program. The IAC was called to provide input into the strategic and operational direction of the Department. The IAC was also interested in employing the best graduates. After one meeting, it became quite clear that the Australian industry preferred employing local students rather than international students, simply because a local student would likely stay in Australia once employed and because there were no visa problems, which was always an issue with international students.

In the last year, the number of domestic students had reduced from a majority in the Masters class to a trickle. The obvious way to raise the domestic numbers was to introduce a Bachelors program. UNSW, Adelaide and UWA already operated Bachelor Degrees in one form or another, which did not appear to quench the market thirst for domestic graduates, so this was an obvious solution. In addition, the benefit from semester-based teaching is that if an undergraduate B Eng course is now introduced, the operation of such a course is no longer stymied by the short course nature of the Masters teaching, but now allows students to attend the same classes during the semester as the Masters students while having different assessment and laboratory practices. It was then argued that a B Eng (Pet Eng) potentially offers a better quality student to the industry than can be provided by the Masters program. It is well accepted in the university system that a Masters student who has a degree already, though being technically and more mature having done a first degree elsewhere, is not as enthusiastic about completion of the program as an undergraduate who still has to win his or her spurs.

Accordingly, a Bachelor's program was developed, which incorporated all of the relevant Masters units plus laboratory and project work. During 2009, this received provisional accreditation by Engineers Australia and is running for the first time during 2010.

5. Industry scholarships

The IAC was instrumental in assisting the establishment of a Bachelor of Petroleum Engineering program. Attracting the top quality students to take this degree was the next step. It was well accepted that major industry players often provide scholarships to top students at all universities, so it was reasonable to assume that these companies may be approached to provide scholarships for this program. Woodside was then approached to enhance the marketing of the Bachelor's degree through the provision of scholar-

ships. Since the normal Curtin University first year in any Bachelor of Engineering program is common to all students, there was the potential to have one scholarship for the top tertiary entrance exam (TEE) student, and potentially one for the top first year engineering student who would like to defect to petroleum engineering.

After reviewing scholarships that were offered to top TEE students, Woodside agreed to a program that would fund one scholarship for the top TEE student per year and another for the top first year engineering student per year. A top student is a student whose TEE mark is likely to be in the 95+ region, has done the appropriate mathematics, physics and chemistry, and has an interest in petroleum engineering. This scholarship was fundamental in attracting a reasonable cohort of some 25 students to switch into second year petroleum engineering, and it enhanced the advertising of the course.

6. Joint teaching with other universities— teleteaching and Petroleum Engineering Australia (PEA)

Where faculty members have departed for industry, it is possible that faculty members from other universities may be prepared to lecture two classes rather than one alone through the use of the teleconferencing method. We therefore moved quickly to agree to jointly teach UWA units where we retain the expertise, using teleconferencing capabilities over the internet—we call it teleteaching. It is much easier to find a video technician to deal with the technical needs of teleconferencing than to find a second experienced petroleum engineer to teach. During the first semester of 2009, the first successful teleteaching lecture took place between UWA and Curtin—a Western Australian first use of this technology. The web-based Access Grid software was supported by the Perth-based Interactive Virtual Environment Centre (IVEC), and has the potential to allow teaching multiple locations in real time. The major benefit of this is the reduced cost of using a technician instead of an engineer. Figure 4 is a photograph of the teleteaching of two classes in Fundamentals of Reservoir Engineering. The students in the photograph are at Curtin while the students shown in windows on-screen were the students at UWA.

As stated earlier, the loss of lecturing staff in Australia during 2007/8 resulted in a severe shortage. As a result of this, the universities collaborated and pushed for the development of a new educational package known as Petroleum Engineering Australia (PEA), which was modelled on the Minerals Education Alliance (MEA) program. The concept is that if the four universities could each provide lecturers to teach two units to the others, then the basic eight unit program of a petroleum engineering degree could be supported, thereafter allowing the joint program to be marketed overseas, lessening the risk to a university of staff leaving for industry. There were many other benefits to this proposal which is still gathering pace at the time of writing, but suffice it to say that much depends on APPEA and the industry for support of the proposal in the future.

7. More international Masters students

The university funding model is such that an international student is worth marginally more than a domestic student. Consequently, bringing more international students into the Masters classroom expands the financial base, and in Australia we need more engineers, so the industry welcomes them irrespective of any possible visa problems. So what could be done to increase the numbers while trying to reduce the visa issue (apart from introducing the Bachelors program)?

A major hurdle with employment visas was that the Immigration Department required a minimum of two years of education in Australia. The Masters program had been modified to make it all course work and no project, since a short project is worth more effort than it appears, and becomes little more than an exercise in writing a report in English for overseas students. So instead, why not keep the Masters program as it was but tag on to the end, a six month research project, which would be long enough for companies to support and be solid enough to be more than just a technical report in English. So we introduced the new M Eng Sc (Pet Eng) degree, which is six months longer and matches the Immigration Department's need for two years of study. This would only be taken by overseas students who had successfully completed their three-semester Masters which then allowed them to take a six month project of benefit to a company. It would also allow them to become a company intern, completing the project while working for a company.

The M Eng Sc (Pet Eng) was introduced in 2008, and four overseas students opted for this award with three current students switching from the M Pet Eng. On completion, they will find that processing their work visa will be much easier and will take less time.

An additional creative solution was to have the existing post graduate Diploma in Petroleum Engineering form an entry point instead of it being an intermediate award for underperforming Masters students. Visa requirements for Indian students stipulated that they must show cleared



Figure 4. Photograph of teleteaching lecture, Curtin University to UWA.

funds to the amount of course fees in their account at the point of application. This was not financially viable for some students as they needed to show 18 months worth of money. Applying for the post graduate Diploma and then switching to the Masters program allowed them easier entry as they only needed to show one year's fees. This resulted in a surge in applications and increased the numbers of Indian students.

8. Updating the program content

The standard Masters course offered around the world has elements of geology, wire line logging, fluid phase behaviour, drilling, reservoir engineering, production technology, intervention and stimulation, reservoir simulation, asset management and project economics. We have all of these units as standard units, but introduced a new unit in advanced drilling practices that would allow horizontal and deviated well design to be taught at the Masters level. In addition, we introduced new units in the Bachelor program in consultation with our IAC, in the areas of petrophysics, petroleum geomechanics, reservoir property mapping and reservoir geophysics so that the students would have the latest knowledge of technology specifically in the areas where we have strong research teams. This would then feed the smarter graduates directly into those research areas—and not only would our research develop, but the students would graduate with knowledge of the latest technologies.

9. Part-time classes

It became important to operate classes at times during the day that would be conducive to allowing personnel from industry to come in during the late afternoon to sit in lectures, thereby increasing the income base of each class. In addition, such people add to the expertise in the classroom and provide their own industrial experiences, which enrich any lecture. Consequently, we started running classes from 3 pm onwards each day, and have found that workers from industry like to attend in the late afternoon. Our top student is from industry, and consequently we have been pleased with this approach to teaching. In addition, when we have industry people come in to lecture the students; a lecture commencing at 3pm is much easier to manage against normal duties than starting one at 9am.

Curtin is no stranger to industry-driven education. The recently introduced oil and gas MBA in the Graduate school was as a direct result of a training requirement by Woodside of its employees, some of whom did not possess a background in the industry. This online solution enabled oil and gas professionals to enhance their knowledge of the industry while maintaining their careers and also opening up other opportunities for advancement as a result of their new qualification.

Another program operated by Curtin is the MTech program, again with a history of providing online training to Shell employees. Such was the success of this program that it has produced over 200 graduates with Curtin aligning itself with industrial-educator Petroskills, which had a

proven track record of training in the industry and broadened the opportunities to industry personnel by offering online assessment of work based projects and assignments.

10. Publicity—website, flyers, newsletters, exhibitions

Course publicity is a major feature of our future. Entry surveys of international students show that they get the first impression by looking at the website design. If a web site is appealing, user friendly and full of description, then it becomes of interest to the reader. So we spent some time on changes to our website, and tied that in with Bachelors and Masters flyers advertising the course programs. We maximised the information in the flyers and linked their design with the website.

We developed a quarterly newsletter called the Curtin Oil & Gas Newsletter, which is sent out to all SPE (WA) members. The first page of the newsletter has departmental news about what has happened over the last three months. The second page is a technical article—usually the abstract of a PhD thesis. Since we have been producing a PhD graduate once every three months, this has been very convenient for us to promote our research capabilities.

Finally, we started funding booths at career expositions and conferences. We recognised that to sell to our Bachelor market, we need to talk with Year 10–12 high school students; to sell to our Masters market, we need to talk with mature graduates who are looking to change their career. So we have attended appropriate expos, both in Australia and overseas, to sell our products. We believe that all these measures have added to our reputation as a department, and now we feel that in the space of two years, we have travelled from a vulnerable department to a thriving department in the centre of the gas hub of Australia. The local industry activity also has something to do with our success, and local service providers have been very happy to teach students about their products. There have also been offers of employment to graduating students, with some students starting their careers before they graduate—such is the demand for engineers.

CONCLUSIONS

Incremental changes in all areas of departmental activity on their own provide only a slightly improved financial return of some form, but taken as a whole, these changes can turn around the fortunes for the petroleum engineering department and raise the standard of the student teaching and learning experience.

In the past 20 years, two of the main methods of training new students in petroleum engineering at Curtin University have been to provide a Bachelor of Engineering in chemical engineering with a minor/major in petroleum engineering, or to offer a Masters in Petroleum Engineering as a conversion course for graduates of an appropriate science or engineering discipline.

When the industry picks up strongly and there becomes a shortage of skilled professional engineers, the industry

employs anyone who has skill and experience. A knee-jerk reaction is to turn to academics, enticing them with attractive salaries, thereby depleting the stocks of quality petroleum engineering teachers. This results in a weakening of the very education system that is expected to provide quality graduates in the future.

Curtin University Department of Petroleum Engineering was no exception. Our first step in response, however, was to base the department on high quality research so that we were not dependent upon short term income from industry and so that the PhD students would support our teaching and research. The next step was to change the Masters teaching base to semester rather than block teaching. This allowed faculty members to enter long term research contracts and to teach over the full semester period. Additionally, we extended our Masters program (M Eng Sc) to two years to make it more attractive to international students who could then apply for permanent residency in Australia following their studies. The final step was to commence local and international publicity for the Bachelors and Masters programs, and make our presence felt in the Perth-based industry. As a result of these changes, student numbers increased by 100% over two years. The Bachelors program looks like it will start with around 25 in the first year, and the early indications are that this will increase to 45 by second year. Once we start producing Bachelors for industry, we will only take the cream of the international students into the Masters program, thereby once more raising the standard of graduate output. Figure 5 shows the comparison in student numbers having made the changes outlined in this paper.

The result has been a return to stability and optimism, with a number of research contracts assisting the support of our lecturing staff, which has grown from three in January 2008 to seven by December 2009. Presently, we have a dedicated team who are committed to raising the standards of our teaching program and to ensure the finest quality of petroleum engineering graduates enter the Australian market place.

Additionally, our success will be evaluated by our IAC, which is committed to the success of the department. The Bachelor's program has been accredited by Engineers Australia, which will provide a high level of continuing evaluation of the outputs of the department—this is welcomed. This will only assist in strengthening the department's aspiration to be a world-class provider of teaching and research in all areas of sub-surface petroleum engineering, through a blend of lectures and practical courses that are industrially-focused.

With the benefit of hindsight it is relatively easy to provide commentary on lessons that other academic institutions could benefit from. The most obvious are to build strong foundations through research and not to rely solely on the income provided by teaching—economic trends make this too vulnerable a position to be in. Academic institutions that also rely on industry sponsorship (such as the Santos' support for Adelaide), may find it difficult to survive if the funding is removed.

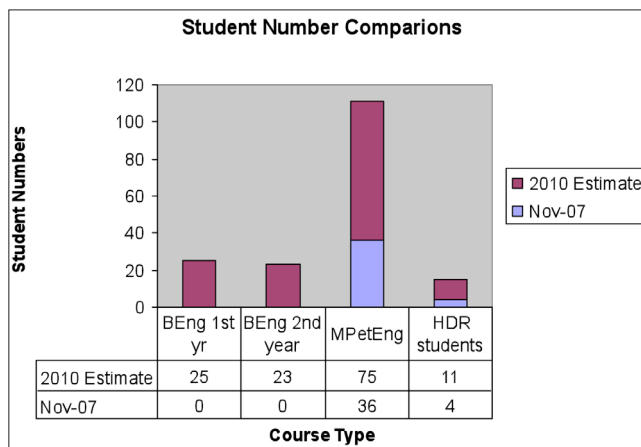


Figure 5. Student number comparisons.

University teaching departments need to employ personnel who are fully engaged in a particular research area; and who will not be swayed back into industry for higher remuneration packages or through consulting externally. There is an opportunity for industry to fund chair positions in teaching departments to further support research and the university who is feeding the marketplace with quality graduates.

Above all, there is a call to action to use the expertise within universities. It is much cheaper to commission consultancy research than to pay for operational challenges encountered in the field when they could have been researched beforehand and a potential solution found. That said, universities also need to better promote their research capabilities to industry.

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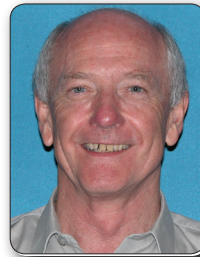
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Brian Evans is Professor and Head of the Department of Petroleum Engineering at Curtin University and Director of the Board of MERIWA. After graduating as an electrical engineering from Liverpool JM University, he worked as a design engineer with GEC Automation, and then turned to mud logging with Geoservice. Subsequently he worked as an instrument engineer with GSI, travelling around the world for a number of years until joining Southern Geophysical Consultants of London as a consultant geophysicist. In 1976 he established Perth's only geophysical consultancy at that time, with four consultants working until 1983 when the oil price collapsed. He then obtained a Masters in geophysics at WAIT and a PhD at Curtin University. He established the Department of Exploration Geophysics and Australia's first research consortium (CRGC) in 1992. He joined the Department of Petroleum Engineering in 2008 to assist its strong expansion. Brian is author of the SEG book *Seismic Acquisition in Exploration*. Member: ASEG, SPE and SEG.



