Addressing the challenges of teamwork and teamwork assessment in multidisciplinary education

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Abstract

Since the Department of Petroleum Engineering at Heriot-Watt University started its integrated programme at master's level in the broad area of reservoir description and simulation, 95 students have attended the MSc in reservoir evaluation and management and we hope to have our 100th graduate in September 2003. The experience has taught us a lot about cross-disciplinary training and the assessment of that training.

The course was constructed to address a perceived niche in the market of courses on the understanding that:

- Industry wanted people with a broad multidisciplinary training and formal training at master's level in geoscience and engineering
- Industry professionals would seek to upgrade their skills in this area
- A leading research institute in reservoir description and simulation (5* RAE 1996 and 2001) needed to be a mechanism for transferring things discovered back into the industry
- Industry would eventually adopt the concept of a reservoir geoengineer as a natural evolution from reservoir geologist, reservoir geophysicist, petrophysicist or reservoir engineer

The breadth of applications and the employment of our graduates over the years (Fig. 1) suggests that there is indeed a market for this sort of education.

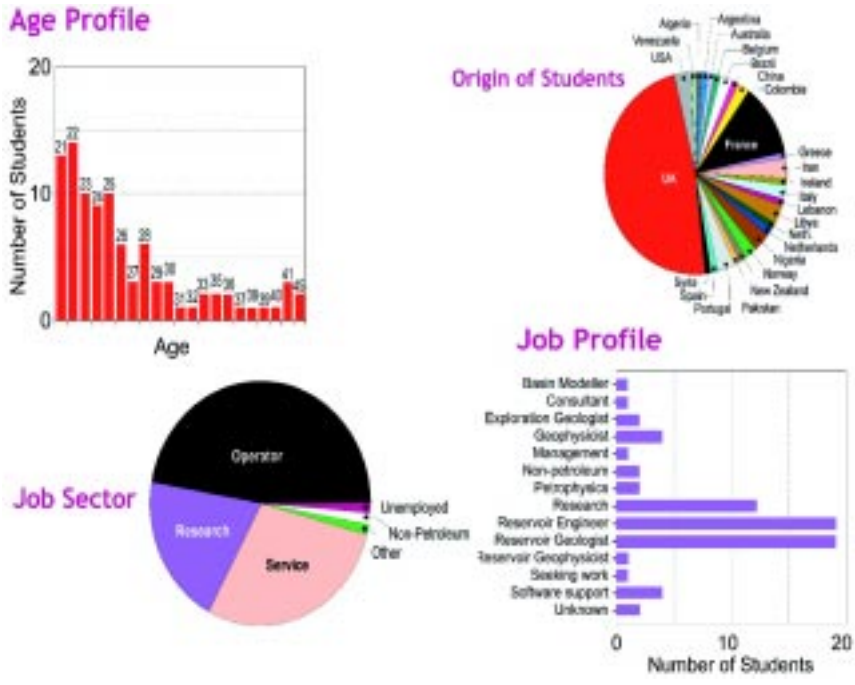

Figure 1 Course statistics for the MSc Reservoir Evaluation and Management (1993–2002).

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Figure 2 MSc Reservoir Evaluation and Management students working and presenting in teams in the field.

The students are a mix of new graduates and seasoned professionals. First degrees include geology, geophysics, computer science, petroleum engineering, mining engineering, geological engineering, civil engineering. Many students already have master's degrees and some even doctorates. Funding comes from self-funding, EPSRC (in the past), NERC, industry sponsorship (some for staff, some open-ended), British Council, SPE and Heriot-Watt scholarships. The course is international in the origin of students. Heriot-Watt University Engineering Faculty recently achieved a commendable rating in a national audit.

This is the background of the incoming students. The challenge is to give them a multidisciplinary technical training in a range of geoscience and engineering subjects (40% geoscience, 20% petrophysics, 40% engineering) and to assess them both individually and in teams. The individual assessment is a traditional university mixture of formative (continual assessment) and quantitative (exams) exercises. The teamwork and teamwork assessment is another challenge for the students in which we attempt to recreate the situation in the industry they will be going in to (or returning them to).

Team training starts during the field seminar (Fig. 2). Teams are selected on the basis of exam performance and experience in order to pick equivalent teams. Teams are encouraged to select a leader during the field work. Students are required to undertake self-assessment before the exercise using Belbin questionaire (Belbin 1981). This allows the individual to score their performance as co-ordinator, shaper, plant, monitor/evaluator, resource investigator, completer/finisher, team worker, implementer. These are not necessarily used to balance the teams, but a balance is often achieved by the need for 'equivalent teams' above. Notably one student evaluated herself as a poor leader, however, the team picked her after a week in the field together, and that (winning) team was praised for its management. The student concerned is now much more confident about her management skills!

The project involves the interpretation of a North Sea oilfield data set to assess the critical uncertainties (Fig. 3). There is a natural competition between the teams and that drives the standards of the commitment to the project through the roof. A continuous working stretch of 54 h was reported one year! Whether this is a useful skill to learn at a university is open to debate! The incorporation of 3D seismic data into this study is proving to be a major challenge, but one we hope to solve this year. With teams of five people and only one month to complete the work, processing this amount of data is a major challenge for the students. They always find the exercise the most rewarding part of the course.

Having numerous teams evaluate the same data produces interesting insights to the uncertainty in the data and also presents challenges in the evaluation of teamwork. In team-

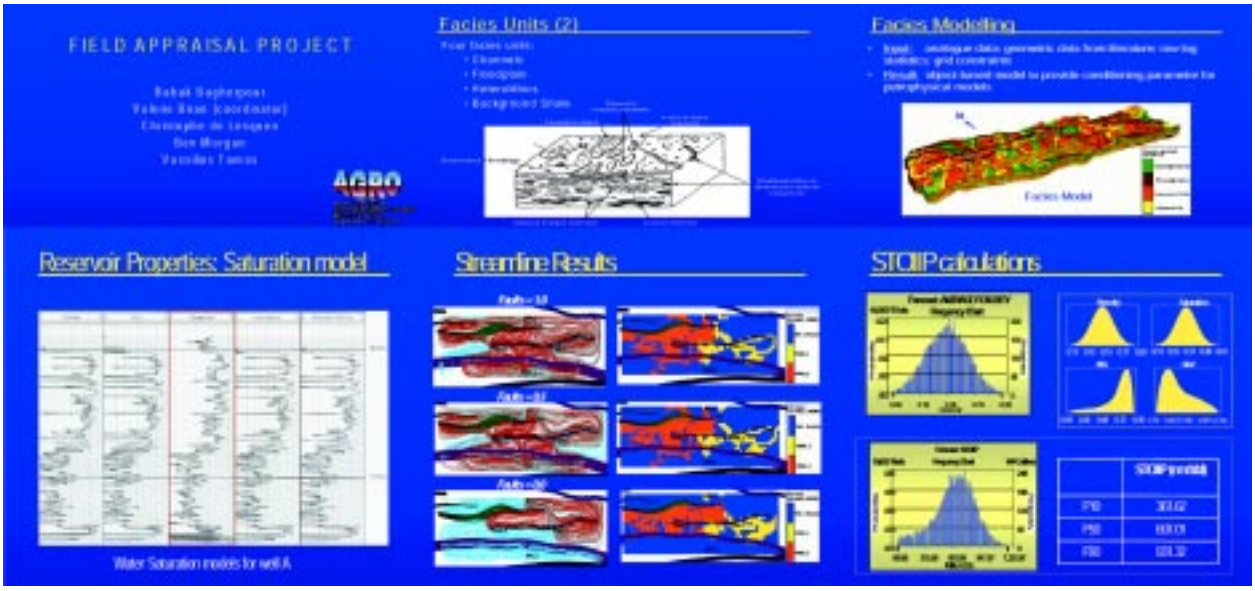

Figure 3 MSc reservoir evaluation and management results from a North Sea field project.

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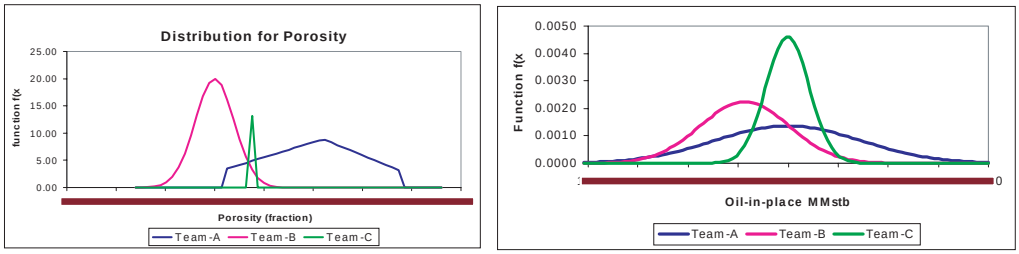

Figure 4 Input data (porosity) and oil in place distributions (from Fakehinde, 2001).

work, it is the results of the team that get evaluated and carry the most weight. Figure 4 shows the results, in the form of probabalistic property input and oil-in-place estimates for the dataset.

Team B provided an oil-in-place distribution that was closest to the operator's estimate (with a much larger data set, their estimates of OIP were considered the correct answer). However, Team B's estimate of porosity was notably wrong! Somehow the team managed to get the right answer from two wrong inputs! Another thing to notice in Fig. 4 is that Team A was possibly the least experienced and produced the largest uncertainty. Team C was the most experienced and produced the least uncertainty. One could say that Team A was accurate but imprecise and Team C precise but inaccurate (Kimminau 1994). A message from this example might be that experience can lead to over accurate estimation of properties and under-representation of uncertainty.

The assessment of the field evaluation is by written thesis and oral presentation. These follow standard university procedures of cross-evaluation and examination by internal and external examiners drawn from a range of academic and industrial backgrounds. To assess the degree of teamwork, or to expose any non-teamworking or 'disintegration' of the story, the students are not told what aspect to present until a few days before the exam. This replicates what might happen in a real-life situation where a colleague falls sick at the last minute and the team has to present his work. This is a tough challenge for the students and one that they don't relish. Clearly the examiners must understand what work the student was involved in and what they've been asked to talk on. Finally, the students conduct peer assessment by grading each team member according to their efforts in working with others, planning and organising, effectiveness under stress and commitment to the team. These results produce a numerical modifer which is used to modify the team mark for the individuals. There is also an earlier (single well petrophysical and core) study that individual's conduct and this allows a true reflection of the individual's contribution. The peer assessment modifer is real but modest, avoiding any distortion due to personality clashes! The challenge of undertaking this kind or peer assessment across the wide range of cultures (Fig. 1) is interesting and the subject of more research.

In conclusion, the teamwork and teamwork assessment is an important aspect of cross-disciplinary and integrated education. Teamwork raises many practical challenges in the university environment, but challenges that are possibly not dissimilar from those faced by educators in industry too.

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