NCVER

Training skilled workers

Lessons from the oil and gas industry

Jane Figgis
AAAJ Consulting Group

Alf Standen
Training and Assessment Services

A National Vocational Education and Training **Research** and **Evaluation** Program **Report**

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Key messages

Global industries such as the oil and gas industry understand the value of training and do not need to be convinced to conduct training or to train more. Lack of engagement with the formal vocational education and training (VET) sector is not necessarily a sign that these industries disdain training: the oil and gas industry spends many millions of dollars annually on training. Lack of engagement with the sector, however, may be a signal the sector might reflect on.

- Workers' attitudes are key in developing a high performance/high skill workforce. Commitment to safety, a willingness to question and to learn are attitudes required to be recruited to the oil and gas industry. They are non-negotiable. VET providers working with candidates at entry level need to understand that developing appropriate attitudes in students is as important as their acquiring specialist skill and knowledge. This adds a considerable challenge to the training task.
- Competencies are more important than qualifications in the oil and gas industry because, when it comes to assigning work, competencies are the only currency. Qualifications on their own are insufficiently informative—a view shared by employees and employers.
- Skilled workers are different from entry-level learners in that, on the whole, they are far more confident learners and, in this industry, thrive on challenge. In a workplace that affords them the opportunities, they effectively take charge of their own learning program; they act like the autonomous professionals they are. This is a reminder that VET produces professional workers in the true sense of the word.
- Advanced skill learners reported requiring training with 'bite'. This means training where, to quote Dewey, people learn by doing, 'but the doing is of such a nature as to demand thinking'. This requires thoughtful instructional design where the trainer perceptively judges the degree of challenge ('bite') in light of each worker's capacity to meet the challenge.
- There is a market for assessment and recognition of competencies. The 'safety case' regime, which identifies major risks in a facility and outlines ways of avoiding them or dealing with them should they occur, is now in effect in the oil and gas industry. This means that evidence of workers' skill and applicable knowledge must effectively meet a legal standard, which requires expert assessment of competencies. The VET 'recognition system' (where recognition of competence is formally granted) is more important than the traditional TAFE 'training delivery system' in this industry, and is in urgent need of attention.
- The role of time in learning needs re-thinking. Extended and repeated experience appears to be a critical element in acquiring advanced skill. No one is suggesting a return to 'time-serving', but we need to better understand whether (or where) repeated practice does not stall progress but actually opens out new horizons and expertise.
- Developing advanced skills in global industries has implications for Australia's immigration policies. Experiential learning to master leading-edge skill requires the learner to work alongside an expert. In global industries such expertise often resides outside Australia yet it is exceedingly difficult to obtain permission to import experts to work here for specified periods, even though a demonstrable outcome is the growth of local capability.
- Enterprises ought to conceptualise the workplace as a learning environment as well as the site where products/services are created. Learning environments are characterised by the tasks people are given, the resources at their disposal to complete the tasks, and the support offered. Experience suggests that it is of real benefit for employers to envisage their workplaces in terms of this trio of learning 'affordances' and observe the quality of the learning that emerges.

Executive summary

This report explores ways existing workers develop advanced skills in a technically demanding industry. The underpinning rationale is that the ability to develop workforces operating at the leading edge of skill and knowledge is critical if Australian enterprises are to be globally competitive. It is also important to understand whether the policies and practices of the formal vocational education and training (VET) sector—which have, in recent years, emphasised entry-level training—are equally applicable to advancing the skills of already skilled workers employed in their industry of choice.

The oil and gas (hydrocarbons) industry was chosen as the technically demanding global industry for two principal reasons. Firstly, enterprises in the industry take training seriously. Large companies spend many millions of dollars each year on the capability of their workforces and even the smallest companies now regularly review and update their work practices. This training has, however, been dealt with as a private, even proprietary, matter. Thus the second reason for selecting the hydrocarbons industry: it has developed a new interest in connecting with the formal VET sector through its response to the Chemical, Hydrocarbons and Oil Refining Training Package PMA02.

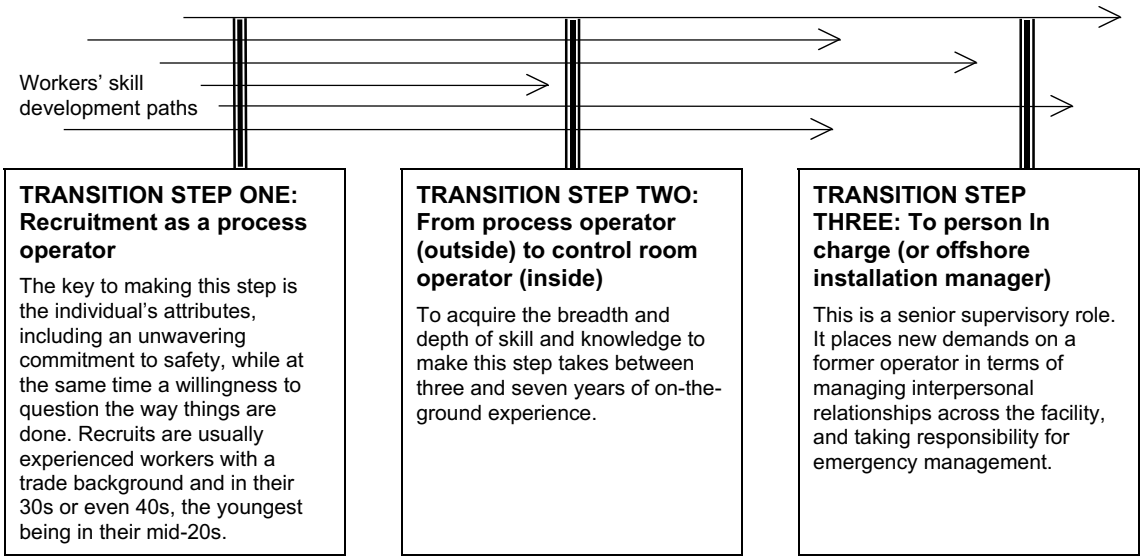
Within the wide range of activities under the banner 'the oil and gas industry', the production phase was selected for special attention in this study. This phase includes extracting oil and gas from deep underground, often offshore; 'cleaning' and separating components; and loading these for transport. It is essentially a process operation and its advanced skill issues are likely to be congruent with those of other industries (from food to power generation). It is also the area where assessment of workers' skills and knowledge is required to reach a legal standard in line with the 'safety case' regime now in place. This regime identifies major risks in a facility and outlines the measures needed to avoid these risks or cope with them should an incident occur. It also commits organisations to ongoing and detailed evaluation of safety and emergency management procedures, as well as more general competencies of workers carrying out assigned tasks.

Acquisition of advanced skills

Identifying critical steps along the path to leading-edge skill was key to this study. Figure 1 illustrates the concept and describes the three skill transition points chosen to be the most instructive. The selection was made in consultation with industry: the study team interviewed 50 individuals from 27 organisations and enterprises, many of these more than once.

From a training point of view, the most revealing step concerning skill advancement was the second transition point—operators' gradual accumulation of expertise in the years between recruitment and permanently stepping into the control room. This is fundamentally a story of acquiring expertise through experiential learning and provides some insight into that elusive phenomenon.

Figure 1: Critical steps to leading-edge skill



Two potential misconceptions about this journey need to be eliminated at the start. Firstly, technical difficulty is not a significant barrier to learning; much of the knowledge and skill developed during the period *is* technically sophisticated but not so difficult as to block progress. Secondly, the difference between an operator taking three years or seven to gain this expertise appears to be a matter of personal inclination and cannot be seen as a failure of learning on the part of the employee, nor of teaching on the part of the employer.

Factors which enable operators to develop advanced skills through work include:

- *Expectation*: Operators are told at recruitment stage that they have been chosen explicitly and precisely because they were perceived to have both the aptitude and attitude to master the technical (and other) demands of the skill trajectory.
- *Challenge*: Operators recognise and appreciate high-quality, challenging training. On the other hand, they were scathing about what was considered boring, going-through-the-motions training. From their stories, it is clear that what quality training delivers is 'flow' in Csikszentmihalyi's (1990) sense; that is, a balance between degree of challenge and the person's (ultimate) capability to meet the challenge, so he or she is not only stretched, but finds the process fully absorbing.
- *Continuity of practice*: A common theme in the interviews was the importance of operators asking questions—questioning what they are doing, and what they see others around them doing. The extensive skills and knowledge gradually acquired in this way is, in their words, a 'more and more' process. The workplace gives them the opportunity to work at more and more tasks in more and more areas so they can find more and more questions to ask.

  For process operators the expertise, once acquired, seems reasonably fixed since they find they can take up where they left off when they return to the industry, even after a lapse of several years. This is not the case with drilling or the coded welding required during construction. In those cases, skill levels deteriorate if not continually honed.
- *Targeted training*: The importance of operators picking up skills by 'looking around' should not be taken to imply that formal training in technically difficult areas is unimportant or ignored. Experts are regularly flown in for a specific purpose; vendors instruct workers on the finer aspects of using their equipment; many operators recruited for a new installation spend time with the company designing and building the facility; sophisticated simulation programs are available; and so on.

The simple conclusion is that steady progress towards expertise in leading-edge skills depends on the fit between the opportunities for learning provided by the enterprise (affordances), and the

motivation of the workers to pick up on the opportunities (engagement). What is critical is enterprises being alert to, and sophisticated about, creating workplaces which by their very nature are conducive to learning. This was concisely described in an interview conducted some time ago:

> Employers need to be told: 'you might think you are managing a business—well, you are managing a business—but you are also managing a learning environment, whether you like it or not, that's what you do: manage a learning environment! (Figgis consultation 2002)

A scheme for analysing the ways in which a particular workplace is, or is not, conducive to learning is described in this report (see table 2, which describes learning-conducive conditions of work). It is recommended that enterprises experiment with this scheme and use their experience to help refine it.

Relationship to the formal VET sector

The extensive, high-quality formal and informal training delivered within the oil and gas industry has essentially been conducted in isolation from the formal VET sector. A possibility for bridging that divide has opened up with the industry's interest in the Training Package PMA02. The oil and gas industry has shown particular interest in the package's well-defined process operation competencies, and its new incident response and emergency management competencies (which have not been available in such a systematic and rigorous form before). There are also two weaknesses in the industry's present skill development program: the underlying science in process operation is not widely understood; and supervisory skill (and mentoring skill) is left too much to chance. At entry level, a new industry-wide apprenticeship scheme was inaugurated in 2004 to counter anticipated shortages.

There are some clear lessons in this study for the formal VET sector—in particular, for public registered training organisations and policy-makers—if it is to capitalise on current opportunities to engage with the oil and gas industry. These lessons are:

- Competencies, *not* qualifications, are what enterprises in this industry care about both in recruiting and advancing their workforces. Similarly, the existing workers in this study are not interested in qualifications per se, but view them as a nice extra when offered.
- There is a pronounced difference between advancing the skills of already skilled workers and developing entry-level skills. This has not received much formal attention in VET literature. For the skilled workers in this study (compared with entry-level learners), the difference lies in both their positive motivation to learn and their confidence in their ability to learn. This affords their commitment to master a subject a resilience which less advanced learners often lack.
- Attitude and temperament provide the foundation on which skill development is built. If the formal VET sector is to meet industry needs, it must help potential workers to develop appropriate attitudes, especially attitudes such as eagerness to learn, vigilance about safety, and curiosity. These are not taught by reciting theory, but by using educational practices which encourage and reinforce the attributes, and by modelling.
- Both attitude and temperament lie largely outside the province of education and training. However, it is incumbent on VET practitioners that they understand the subtleties and paradoxes in the attributes required in a demanding industry at the advanced skill level. Workers need to be cautious *and* comfortable working in a risky environment; they need to adhere strictly to procedures *and* question the ways things are done; they need to be independent thinkers *and* cooperative team members. Discussion about 'generic skills' seems to miss this point.
- The industry does not need a campaign about the value of training. Enterprises already want training products and services of the highest quality, delivered with 'bite', and adapted to meet their needs.

For training at the advanced skills end of the spectrum, the technical equipment and expertise required are likely to exceed the resources of most non-enterprise-based registered training

organisations. The solution is to develop partnerships where careful attention is given to the VET sector's potential contribution. This is its pedagogical knowledge and experience; for example, skill in instructional design, the capacity to bring out the best in learners, and the provision of evidence-based assessment. The indications are that this is relevant to all technically demanding, globally competitive industries.

Context

Background

The importance of workers continuously redeveloping their skill sets is now widely appreciated. This is a recognition that changes in technologies, benchmarks, products, processes and business strategies are relentless and, consequently, the skills and knowledge that employees require keep shifting. Further, employment itself is increasingly insecure. Remaining with a single employer or even in a single industry over a working lifetime has become the exception where it was once the rule.

What is needed now is to understand accurately and comprehensively the many ways in which workers' skills are developed to meet the challenges of job insecurity and change (both technological and managerial).

This study explores the skill development trajectories of workers in the oil and gas (hydrocarbons) industry. It was designed to understand how leading-edge skills are acquired in a demanding industry. The overall scheme was to understand the array of skills used on-site in the extraction of oil and gas, both offshore and onshore. Individual workers talked about their particular journey across this map: the skills they acquired, and how, when and why they acquired them.

The work builds on several foundations. One is the significant research (Hayton et al. 1996; Falk, Sefton & Billett 1999; Billett 2000, 2001; Figgis et al. 2001; Chappell 2003)—a great deal of it in Australia—on important areas such as learning in the workplace, what drives employers, employees and industries to embrace training, and the transmission of tacit knowledge. A second foundation is the Australian National Training Authority (ANTA) national strategies for vocational education and training (ANTA 1998, 2003b) which identified significant issues for the sector. Note has been taken of those concerns, both in designing this study and analysing its findings. A third foundation is the in-depth knowledge of the hydrocarbons industry acquired by Alf Standen during the last seven years: first in writing competencies for, and then reviewing the industry's training packages (PMA98 and PMA02), as well as evaluating training used by enterprises both onshore and offshore.

Key issues

Three specific issues guided this project.

Advanced skills training and the VET sector

There has been relatively little work done on the development of advanced skills within the Australian VET sector. The emphasis, both in research and in practice, has been on entry-level training. This is understandable, particularly in light of the community's intention to ensure the employability of young people. Further, the public training sector has focused, also understandably, on its equity obligation to address the needs of groups whose members have been disadvantaged in the past. Employed, skilled workers rarely meet the criterion of disadvantage.

However, global competitiveness hinges on the Australian workforce possessing leading-edge technical skills (see, for example, Karmel & Stanwick 2002; Department of Education, Science and

Training 2004; Business Council of Australia 2004). More attention needs to be paid to the training of already skilled workers to take them to the leading edge (or beyond).

Individual worker's motivation for further training

There is a considerable body of research on the factors which drive enterprises to provide training for their workforces. Early on, Hayton et al. (1996) found that certain circumstances induced Australian firms to provide training. These included the firm's acquisition of new technology, changes in government regulation, competitiveness within the industry itself and the extent of workforce casualisation—all of which, as it turns out, characterise the hydrocarbons industry. The fact that the individual worker tends to play the crucial role in determining whether training is taken up, not the employer, was first noticed by Rod McDonald (private communication 1999).

Billett (2000) developed a finer-grained model of workplace learning in which the extent and kind of learning depends on both employer and employees. Workers need to be given the opportunity to learn (which the organisation delivers) but much turns on the workers' willingness to learn (which the individual delivers). Billett describes the former as the *affordances* or invitational qualities of the workplace and the latter as the *engagement* of workers. Previous work by Figgis and colleagues (Figgis et al. 2001) suggested that, where workplaces have developed a powerful learning culture, the distinction between affordances and engagement almost disappears. In such organisations the drive to skill development becomes seamless and unproblematic to both management and workers.

One of the key aims of this study was to understand the dynamics of fully employed skilled workers deciding whether to 'stretch' their current level of competence. Which side drove the decision: the employer or the employee, and why?

The nature of experiential learning

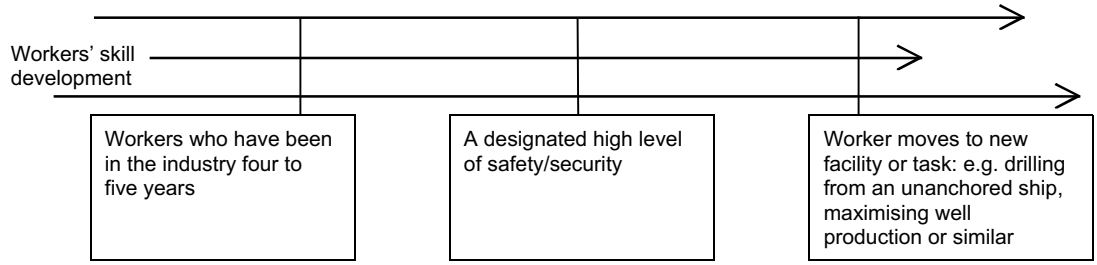
Throughout education (but in vocational education and workplace learning in particular) the place of experiential learning, unconscious cognition and tacit knowledge are subjects that are receiving increased and sophisticated attention (Australian Centre for Organisational, Vocational and Adult Learning 2003; Sternberg et al. 2000; Sternberg & Wagner 1994). Experiential learning plays a critical role in skill development in the hydrocarbons industry. It was hoped that this study could shed some light on the complex and almost paradoxical phenomenon that there are things that cannot be taught, but that can be learned. As John Dewey described it:

> [The learner] has to see on his own behalf … Nobody else can see for him, and he can't see just by being told, although the right kind of telling may guide his seeing and thus help him see what he needs to see. (cited in Schön 1987, p.17)

This study was designed to investigate precisely how these issues play out and are handled through the many years during which workers advance their already well-honed skill sets. The central idea was to identify three critical skill transition points across the oil and gas production skill map that might effectively act as barriers to further skill development—effectively, testing points in the trajectory of advancing skill.

Figure 2 illustrates this. The transition points nominated here were not used in the final version, but are taken from the original proposal to indicate the authors' thinking at the time. The final choices, all different from these, are explained in the chapter in which the findings are presented.

Figure 2: Original skill transition points for the study



Why choose the hydrocarbons industry?

The hydrocarbons industry was chosen for three reasons:

- ✧ The principal issues at the heart of this study about affordance and engagement with effective training/learning are dealt with daily in the industry. Other significant VET issues are reflected in the industry, including the changing nature of work, the ageing workforce, training markets and user choice.
- ✧ Enterprises in the industry take training seriously: larger companies spend many millions of dollars each year on the capability of their workforces. Specialists are routinely sent to the Hague or Houston or Aberdeen for up-skilling. Even the smallest companies regularly review and update their work practices.
- ✧ It was an opportunity for others to see at close quarters an industry which is surrounded by both suspicion and mystique.

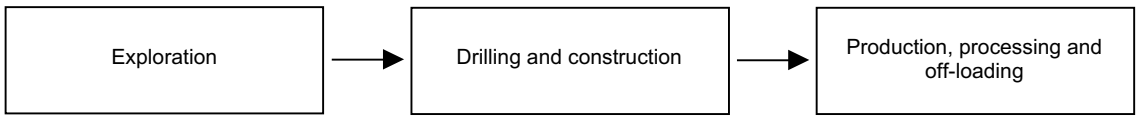
It might prove useful in fully setting the context for this study to begin by painting a fairly detailed picture of the hydrocarbons industry, and showing what is actually involved in extracting gas and oil from deep underground. That picture is followed by a brief outline of other significant VET issues seen in the skill development of its workforce.

The hydrocarbons industry

The hydrocarbons industry is, in the authors' view, a fascinating one. Its work sites are unique and few people have the privilege of viewing them up close.

As figure 3 illustrates, there are three fundamental tasks in the industry: exploration; drilling and construction; and production, processing and off-loading.

Figure 3: Fundamental tasks in the hydrocarbons industry



Exploration primarily calls on the specialised services of geophysicists, geologists, and seismic engineers and their ilk to collect and interpret the range of signals (satellite images, sonar reflections, geological structures) which indicate the presence of a significant hydrocarbon deposit under the earth's surface. Even with the backing of longstanding science and sophisticated technologies at their disposal, this is a high-risk game because there is no certainty that a deposit will be found. As one senior oil company executive explained during this study: his company went through a patch of drilling 14 exploration wells, all based on promising exploration data, and every one was dry. Each well costs between $30 million and $70 million to drill. It is no wonder a new well in a new field is called a 'wildcat'.

Drilling is a complex and often dangerous process, especially offshore where people are working in unpredictable seas. In the initial stage of tapping into any oil or gas field, the drillers encounter material that has been trapped for many years. The well acts like a release valve and blowouts are a constant concern. There is also the problem of actually reaching the deposit, which might entail drilling to a depth of five kilometres through rock and then, often, out horizontally another three kilometres. Further, each time the drill gets through about 9.1 metres of strata, a 9.1 metre extension pipe has to be added on. In the event that a drill bit comes loose or otherwise needs to be replaced, the crew has to unscrew up to eight kilometres of pipes in 9.1 metre segments in order to retrieve the tool.

The catalogue of technical difficulties is long and impressive. Casing has to be put down as the well is being drilled so only the bottom is left open. And drilling mud, of exactly the right density, has to be forced down the space between the drill and the walls of the well to keep all the pressures balanced. The drill bit itself costs two million dollars.

Traditionally, drill rig crews were strictly hierarchical. Roughnecks, mud loggers, and well engineers were separated, almost physically, according to the degree of skill (and education) underpinning the role. But there is now considerable teamwork involved and, obviously, a great deal of problem-solving. This change is reflected across the industry. It is common to find people who started as rig hands with very limited technical training moving through the industry (and skill sets) to relatively senior positions.

Production is the extraction step: getting the oil or gas out of the ground and off the premises into a pipeline or cryogenic tank. In the early stages of production, the oil or gas (sometimes both) might flow of their own accord, but eventually engineers will have to coax it out—if injecting steam or gas under pressure can be called coaxing. The image many people hold of hydrocarbon deposits as underground lakes is completely wrong. The hydrocarbons are locked into minute crevices in rock and have, as one engineer nicely put it, 'no inherent wish to expel themselves from it'.

Processing is the stage where the hydrocarbon mix goes through a number of processes to separate the various hydrocarbon fractions (roughly, gas from condensate from oils) and all from water. The processes take the fluid mixture—often at high temperature and pressure—through heat exchangers (which are what ruptured at Longford[1]), valves, compressors and similar devices which deliver the separated components to different storage and offloading facilities.

This picture (figure 4) of an offshore installation (kindly provided by ConocoPhillips) illustrates the overall advanced nature of the production and processing facilities being employed and suggests the complexity of the plant and the strangeness of the environment.

[1] In 1998 an explosion and fire at the Esso Longford gas plant in Victoria killed two men and injured eight workers. The state's gas supply was effectively shut down for two weeks; damage to the economy was estimated at more than $500 million. The Royal Commission into the explosion found that, although workers on site had executed inappropriate actions for correcting an initial disturbance (actions which led to the explosion and subsequent fire), Esso—and not the workers—were to blame. The Royal Commission said the fundamental cause of the tragedy was Esso's failure to adequately train its employees or give up-to-date operating procedures to guide them.

Figure 4: Offshore installation

Source: Photograph provided by ConocoPhillips

Offshore, it is common for facilities to operate 24 hours a day, with personnel undertaking a 'swing' of two or more weeks prior to returning onshore. During this time, shifts are commonly of 12 hours duration, seven days per week.

For several reasons, expanded below, the production/processing phase is the area of work chosen for this study.

- ✧ It is where the skills match the provision of the VET sector. Competencies in these process and control operations are now reflected accurately in Training Package PMA02. But it is also where there is a gradual, almost imperceptible shift, from competence to expertise, where highly complex systems knowledge, understanding and skill are mastered and internalised, until they are gradually embedded in the individual.
- ✧ It is where the journey from entry level to 'person in charge' can be clearly observed. People come onto production platforms with a range of skill backgrounds (typically a trade but sometimes a less skilled qualification or even no qualification). These entrants can, and frequently do, advance to the position of person in charge or offshore installation manager.
- ✧ It is where safety concerns are most prominent. The seminal wake-up call to the whole industry occurred during production at Piper Alpha. This platform, in the North Sea, is where 167 people died in 1988 after an explosion initiated a catastrophic series of events. In Australia, the explosion (and death of two workers) in 1998 at Esso's Longford plant in the LaTrobe Valley (Hopkins 2000) and the subsequent findings of the Royal Commission have helped to shape the incident response and emergency management competencies currently being added to Training Package PMA02.
- ✧ It is where the pattern of work, especially offshore, places special demands on workers. A 'swing' or 'hitch' is the period a worker is on site. It usually lasts two or three weeks and the work is 12 hours per day, seven days per week. There is usually a corresponding amount of time back home 'on the beach', however, the pattern can vary slightly with three-on, two-off. For some who are being groomed for advancement, the pattern may be three weeks on-site, three at home office and three 'on the beach'.

Secondary issues

Describing these as 'secondary' issues is *not* to imply that generally they are of lesser importance than the key issues described earlier. They are of secondary importance only in the context of this

particular report. However, these issues are central enough, that, if the report can shed some light on them, they are worth mentioning.

The issues are:

- *The changing nature of work*

  There has been widespread concern about the move to contract and casual labour at the expense of permanent employment—indeed, the concept of permanency has almost vanished from the language of work (NCVER Research Forum 2000; Australian Centre for Industrial Relations Research and Training 1999; Noon & Blyton 1997). The oil and gas industry has long relied on contract labour. Partly this reflects the fact that fields which come on stream, especially smaller onshore fields, are relatively quickly exhausted. But it also reflects the contractual nature of most of the work done in the industry. Oil and gas companies often contract construction, drilling and maintenance to other companies. One informant to this study, a senior manager in a large oil and gas company, said that if he was asked to drill for oil on the moon, he would need to take 400 people with him but only 20 would actually be employees of his company.

  Workers in the industry know that contracts are the standard form of employment. From our observations, they have a different attitude towards discontinuous work than workers who expect more secure employment. Nonetheless, the lack of continuous work has an impact on their skills.

- *The ageing workforce and the older worker*

  There is, to be frank, a great deal of nonsense talked about problems in skilling and re-skilling older workers. There is, on the other hand, the start of serious investigation into the skilling of older workers in Australia (ANTA 2003a; Chappell et al. 2003). The hydrocarbons industry presents an interesting case for testing these tired assumptions, since typically people are in their mid-30s or older when they *enter* the industry. In recent recruitment campaigns for offshore operators, most of the successful applicants were in their 40s, a few in their 30s, and the youngest 26. As a general rule, oil and gas workers retire later than in many industries.

- *User choice*

  The vast majority of training and skill development undertaken in the hydrocarbons industry is performed in-house or through private providers. The private providers often do not even have registered training organisation status but are expert in a particular technology or skill set. Public registered training organisations have delivered only a very limited portion of training for the industry thus far. There are a number of reasons for this. Enterprises in the industry have considered their training to be proprietary knowledge; in fact, the industry is fiercely competitive. Employers have been more interested in experience and attitude than in qualifications. It is also the case that the equipment on which people need to be trained is highly specific, frequently updated and often extremely expensive.

  Nonetheless, there may be opportunities for greater involvement in the future. The industry established its first apprenticeship program in 2004 and this exercise has brought a new sense of cooperation in training amongst the enterprises involved. Further, some enterprises have helped to fund the development of simulations for use by public providers. One state training authority (the Western Australian Department of Education and Training) is itself underwriting significant learning resources for the industry Training Package PMA02.

The hydrocarbons industry does not employ large numbers of people. It is very difficult to get reliable figures, but the estimates consistently lie between about 3400 and 7000 in Australia. Nonetheless, the oil and gas industry contributes so substantially to the economy—the several liquefied natural gas deals signed with China in 2002 and 2003 are reported to be worth more than $35 billion—and it is so clearly a global industry that its advanced skill acquisition, and any barriers encountered, need to be understood.

Methodology

Overview

Since the intent of this study was to understand the skill development of existing workers from their perspective, the methodology was founded on in-depth interviews with a wide range of people in the hydrocarbons industry—more than 50 in total, and some were interviewed a number of times. Two facilities were visited; one offshore, with the other being onshore. Five informants who had relatively recently passed the second skill transition point were identified: men who, as platform operators, had over a period of years gradually acquired the on-the-ground expertise required to move 'inside'. These five were interviewed in detail about their personal skill development trajectories both inside the industry and outside it. (Five men were chosen because, although there are a few women on production platforms, none was available for this study.)

From the start, people at all levels in the industry—managing directors, divisional directors, senior operations and asset managers, human resources managers, trainers, as well as people 'on the tools', like drillers, process operators and control room operators—were willing to participate. This is in no small measure due to the support of Don Sanders, Director (Western Australia and Northern Territory) of the Australian Petroleum Production and Exploration Association. He not only contacted association members regarding the study, but also lent the authors the use of its boardroom on numerous occasions. The authors also benefited from his knowledge of the industry and are greatly in his debt.

While conducting this study the authors were involved in two other unpublished projects in the hydrocarbons industry. Both Figgis and Standen (in partnership with Pracsys) were undertaking a feasibility study for the Department of Education and Training on the establishment of an oil and gas skills development facility in Western Australia. Alf Standen was also part of the team developing the difficult, if much-needed, incident response and emergency management competencies to be added to the Training Package PMA02.

Early on it was thought that it might be best to keep the three projects separate. However, this plan was abandoned once the interconnections between the projects became apparent. Interviews set up with one study in mind turned out to provide ideas and insight applicable to the others. The studies informed one another in rich and sometimes surprising ways.

The one difficulty in allowing the three studies to cross-fertilise was that, particularly in the feasibility study, confidentiality was absolutely guaranteed to informants. As it turns out, informants to the National Centre for Vocational Education Research (NCVER) study alone may have requested anonymity because details about training are often considered proprietary information in the industry. In reporting here on the NCVER study the authors have, contrary to their normal practice, not identified speakers or their organisations.

Stages of the study

The initial phase consisted of meeting with managers and supervisors to identify key skill transition points in a production worker's journey from recruit to person in charge. Documents on training protocols and patterns were collected from a number of enterprises. That phase was followed by

in-depth interviews which 'snowballed' as each interviewee was asked to suggest likely candidates for the study.

The selection of the five production personnel who had made the transition from process operator to offshore installation manager/person in charge was based on obtaining a diverse range of current employment, as table 1 indicates. As it turns out, these five men, with an average of 18 years in the industry, have altogether worked in more than 15 companies and each has experienced several quite different production cultures.

Table 1: Current employment of individuals whose case histories were explored

Subject	Nature of current oil–gas company	Location of facility	Size of facility
1	Large (Australian)	Onshore	Large and complex
2	Major (international)	Offshore	Large and complex
3	Medium-sized contractor	Onshore	Small
4	Medium (international)	Offshore	Medium
5	Small industry advisory body		

It was originally planned to survey a sample of production operators about what they learnt as they crossed the key skill transition points. It gradually became apparent that a survey would not add to the study for two principal reasons.

Firstly, once the authors began to talk broadly to people in the industry about progression through the skill transition points, the story was so uniform and consistent, there seemed little need for quantitative data. There was no disagreement about the points themselves or of how people made the transition—there was nothing identifiable that needed resolving by asking 150 people the questions explored qualitatively with 50.

Secondly, the number of people who work in the various phases of the oil and gas industry was overestimated. It is actually quite difficult to count the people in the industry: the figure changes from one year to the next, depending on the amount of exploration underway, and whether new large fields are being opened or old ones shut down. For example, the Australian Bureau of Statistics (ABS)—which has a specific classification for employment in oil and gas extraction (1200)—found that in Western Australia (the major region for oil and gas production in Australia) 1143 persons were employed in 1996, and 2508 persons in 2001 (ABS 1996, 2001). The authors had estimated that there were some 17 000 people working in the oil and gas industry in Australia. In fact, the industry's figure, similar to that of ABS, is somewhere between 3000 and 5000. There is a little confusion as to whether an engineer in a construction company building a gas pipeline, for example, is 'in' the oil and gas industry or in the construction industry. However, the consensus seems to be that in the area of interest to this study—the skill progression from process operator to person in charge—probably involves no more than 400 or 500 people.

One of the strengths of this study is the extensive range of interviews conducted (a list of interviewees appears in appendix 1) and the depth of understanding acquired about enterprises' case histories. Formal interviews were confined to companies based in Western Australia for budgetary reasons. Informal discussions, however, were held interstate when the opportunity presented itself. Concerns about skill development were consistent across the country. Interviews were also conducted with training organisations (both public and private) which provide skill development services to the industry (some 12 organisations altogether). This occurred both through registered training organisation forums conducted at the Australian Petroleum Production and Exploration Association's premises, and in discussions with individuals directly involved in the delivery of services to the industry.

A landscape of industry skill requirements and, in particular, a register of problem areas in the acquisition of skilled personnel was sent to key industry people in October 2003. Feedback was

requested for the feasibility study for a skill development centre for the oil and gas industry which the authors were simultaneously working on, but the confirmation that the landscape was accurate also served as an important corroboration for this report. The landscape document is reproduced in appendix 2.

A further feedback mechanism was also used. The final draft report was sent to a group of key industry people who had served as an informal advisory group for this project, but the draft sent to them was missing the key messages. The advisory group met to discuss the report and to tell the authors what *they* thought the key messages should be. From a research perspective, this provided extremely rich feedback because it let the authors truly see the work through the advisory group's eyes. The group also believed that there was an important *implied* message in the study's findings: that developing advanced skills in a global industry such as oil has implications for Australia's immigration policies, because of the need for a free flow of international experts to work alongside (and thus teach) local workers. This particular observation has been included in the key messages.

The qualitative methodology used in this study is a combination of approaches and does not fit any single case study methodological classification, although it adopts aspects of many (Lee 1999; Yin 1994; Robson 1993). The interview protocol is reproduced in appendix 2, but it should be recognised that this is a guideline only. The authors found it invaluable to tailor questions in ways that challenged the interviewee and thus provoked the most thoughtful responses. The fact that the authors sometimes talked to these people while wearing several different 'research hats' provided an unexpected bonus, in that it widened the conversations and triggered examples and recollections of experience that might not have turned up in response to a narrower line of questioning.

The analysis of qualitative research that proved most beneficial was that of Flyvbjerg (2001), in his well-received monograph *Making social science matter*. He quotes Hans Eysenck, who had long thought qualitative research was a method for 'producing nothing more than anecdotes' (p.73), but eventually came to think differently:

> Sometimes we simply have to keep our eyes open and look carefully at individual cases—not in the hope of proving anything but rather in the hope of learning something.
>
> (Flyvbjerg 2001, p.73)

The methodology has allowed the authors to learn a number of 'somethings' about the way advanced skills are developed and refined for (and by) mature workers in a demanding industry.

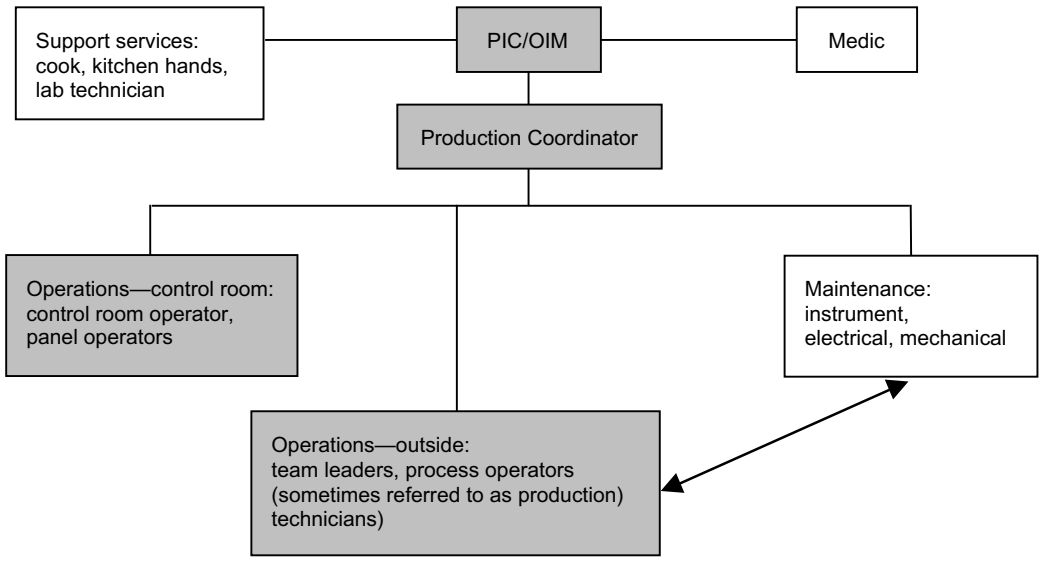
Findings

The sketch of the extraction/production phase provided in the 'context' chapter should have made it clear that operators and supervisors carrying out this work cope with an untidy (and variable) mix of oil, gas and water emerging from deep underground, sometimes at very high temperatures and pressures. The various components are separated at the production installation by being piped through multiple compressors, valves, pumps, and separator devices. This extraction/production process ends when the separated fractions are offloaded, which could be to a pipeline connected to a downstream processing plant, a cryogenic tanker taking liquefied natural gas to Japan, or a truck carting oil to a refinery.

The operators and supervisors who carry out these functions have two fundamental responsibilities: to keep everyone safe from harm and to meet production targets—in that order. The skill of installation operators and managers, then, lies in responding to upsets, maintaining and fixing equipment, keeping flow within optimum parameters and staying vigilant at all times. This is a commodity industry and appears not to meet the rhetoric of the new 'knowledge economy' (in other words, the use of knowledge such as new ideas, software, services and relationships to produce economic benefits). However, the reality is that getting the product to market depends on the knowledge and skill of these workers.

The personnel structure on an offshore production platform generally adheres to the diagram in figure 5. Onshore installations tend to be smaller, with a consequent collapsing of some of the positions (for example, the person in charge is also the production coordinator). The shaded boxes form the skill development path of interest in this study. Outside operators are the start of the trajectory which ends, for those who advance, at person in charge or offshore installation manager.

Figure 5: Personnel structure of offshore production platforms



Note: PIC=person in charge; OIM =offshore installation manager

Variations to this basic pattern can occur. The reasons for these variations are discussed below.

- Increasingly, routine maintenance and repairs are carried out by operators who have been multi-skilled. In doing this, enterprises do not need to keep a separate maintenance team on hand. Major maintenance is outsourced.
- The size of the installation or platform can impact on this pattern. For example, small operations may not use all the positions in this structure.
- Offshore platforms can be mounted on the sea floor or anchored in position. In the latter case, operations may be carried out from a specially designed floating production, storage and offloading facility—essentially a ship—and will therefore have special marine crews to attend to positioning and stabilising the vessel.

The drive is towards minimum staffing. Each new generation of technologies tends to decrease the number of personnel deployed. Work is carried out in teams which typically comprise fewer than five operators (including the team leader). There will be a number of teams on site for the series of shifts and, occasionally, several teams will be required to join together. Small onshore installations may have only two operators on a night shift (with a person in charge on stand-by).

One of the first tasks of the study was to identify the points along the development path which reveal most about the acquisition of advanced skill and knowledge. It was assumed this would be a matter of identifying the technical competencies which people find difficult.

However, one of the first findings of this study was that technical competency rarely, if ever, presents an obstacle to advancement. The three skill transition points identified by informants to this study as most worthy of attention are:

- *Entry-level process operator*: unlike many industries, entry to oil and gas production is basically restricted to experienced workers. Recruits to process operations have typically worked elsewhere for at least five or ten years, usually in a trade, but some have been farmers, fishers and, in one case, a teacher. The youngest are in their mid-20s but often people enter the industry in their 30s and even 40s. There are real and important barriers to achieving this entry step. (Note that an industry-wide apprenticeship scheme for process operators began in 2004 with an intake of 30.)
- *From process operator (outside) to panel operator (inside)*: it takes somewhere between three and seven years working as a process operator outside—that is, physically working with the plant and equipment—before an operator is considered ready to move permanently into the control room. The skill and knowledge acquired through those years of experience constitutes a very gradual but nonetheless identifiable skill transition point. However, the term 'point' is possibly misleading; in some ways, the process is more like a balloon which slowly inflates.
- *From control room operator to person in charge or offshore installation manager*: this person is responsible for the entire installation—indeed, offshore for everything that happens within a 500-metre radius of the platform or floating production, storage and offloading vessel. Informants describe this move as a 'steep step' since broad managerial skills are required, as well as a significantly extended set of incident response and emergency management competencies.

These skill transition points are discussed in detail below.

First skill transition point: To process operator

There is an adage in this industry which is fundamental to understanding process operations and process operators:

> Anybody can stop the production process. But only everybody can change it.

It explains a key finding of this study: in considering whether to admit a person into the oil and gas industry as a process operator, the applicant's set of technical competencies is a surprisingly minor consideration.

Across the industry—large companies and small, onshore and offshore, gas or oil—of primary interest is the person's attitude and aptitude. The following quotations illustrate this absolutely consistent pattern. It needs to be pointed out that each quote came from a different interviewee, because what is remarkable is the way the statements almost flow directly from one to the next—as if it were a single conversation amongst people sitting in the same room:

> When this facility moved into production we needed 25 new people to augment the core of 15 we already had. It's easier and faster to bring them in if they have a trades background and some IT [information technology], but in selection we're looking for the ability to fit in. So during the interview we're trying to understand if they are the kind of person who will ask questions. If they don't ask questions, they won't learn.
>
> As long as we are sure they will be able to master the technical stuff, we don't worry about what they don't know when they start. But we know the environment they are going into, so the important questions for us are: (1) are they going to fit in? and (2) are they afraid to ask questions? The point is, they are going to have to talk to all kinds of people so they can't be afraid to talk. And they will need to question—with their ears and eyes as well as voices—without being cocky but genuinely pleading to understand why such-and-such is done that way and not some other way.
>
> Safety is the overlay. That is why it is attitude that trumps technical skills. If the technical competence isn't right, something breaks but you haven't hurt anyone. On the other hand, if safety's not right …
>
> Safety's the issue. We don't want people who blindly accept but rather say 'I'm not comfortable with that …'. So we're looking for people who think ahead—even dream—about what could happen next. What we are looking for you could call 'consequence imagination'.
>
> They have to have common sense. They have to be good problem-solvers. They need to have mechanical aptitude. And be alert. That's what I look for—I need to sense the person is switched on.
>
> We brought in nine new operators. We looked for people who could develop as the site grew—people who wanted the opportunity to build systems and have a say in how things developed … one guy didn't have a high level of process skills but he had demonstrated initiative in undertaking safety courses. We'll provide him with the process skill … the youngest lad we took was a farmer's son. We trust him. He fits in well with the team and we've got good rapport with him.
>
> We have to be able to gauge the aptitude of people because we're stretching them.

The attitudes and temperaments required by the industry are in some ways paradoxical. It wants individuals who are unwaveringly committed to the safety of themselves and their co-workers, who relentlessly 'dot i's and cross t's', yet are genuinely at ease working in hazardous environments. It wants people who are willing to carry out their tasks precisely and yet retain a questioning frame of mind and confidently experiment when problems arise. Operators need to be team players and capable loners. They must want to go on learning long after they have mastered routine operations.

Time and again the informants to this study emphasised that these temperaments and attitudes are non-negotiable. This is not to minimise the importance of technical skill—only to reflect the view that technical skills are comparatively straightforward to acquire if underpinning attributes are in place.

When operators and former operators were asked why they went into the industry, their answers mirrored those of the managers. They wanted to be challenged. One, now an offshore installation manager said, 'It's great: after 20 years in the industry I'm still learning'.

The importance of workers having the right attitude and aptitude is further reflected in the tough-mindedness of the selection process. Tests, including psychometric tests, are increasingly being used. During the probation period, people are carefully observed and those who are judged as 'not going to make it'—especially if they are careless about safety—are let go within weeks. There is little tolerance for poor skills or not giving one's best. On the other hand, companies expect each recruit to advance through the ranks 'to their full potential'. Companies need recruits with the capacity to progress because otherwise there would be no team leaders or control room operators.

Second skill transition point: To control room operator

The transition from process operator to panel operator is a move from physically working with the equipment outside to working inside monitoring banks of computers. If conquering the first skill transition point (being hired to work as a process operator) could be consistently and explicitly described as the acquisition of a well-defined set of attitudes and attributes, conquering the second skill transition point is almost exactly the opposite. Becoming ready to move to the control room is considered an almost mystical process. Indeed, an accomplished process operator is referred to in some parts of the industry as a 'magical mythical beast'. One informant tried to explain this:

> A platform [like the one pictured in figure 3] is a big, complex machine. Good operators come to understand the integrity of its operations. They know what it is made to do and what it cannot do. These people come to know the look and feel of it and know when something doesn't sound quite right and they can tell whether it's a malfunction or just a change in operating conditions … No, I take it back. It's not a machine. A platform is a living, breathing animal. It can flare up or nicely purr along—sometimes with a few flies buzzing around.

Behind the romanticism of this 'mysterious' acquisition of insight is a long process of on-the-job learning. Informants pointed out that it takes between three and seven years—on average about five years—for a new process operator to become sufficiently knowledgeable to consider stepping into the control room. This is because, once inside, a panel operator needs to be able to assess what the signals on the computer screen actually mean—why, for example, that icon is flashing red.

> You need to be able to visualise how what is happening on the screen relates to the real thing because equipment that appears adjacent on a computer schematic may, in reality, be in entirely separate locations. You need to have a sense of what is happening as fluids flow through the pipes and valves—how gas breaks out of oil, whatever. I could train someone to run a panel in six months but if they've never been outside they would make the wrong decisions.

Another said:

> We could almost train monkeys to respond to flashing lights and warning alarms—but we don't. What we rely on our process operators to do is to bring into the control room situation a *feel*, the *smell* and an *awareness* of not just what is happening but *why* it is happening. And an in-depth understanding of what they might do about it.

Trying to unpack the learning in those five years became a focus of this study because it was recognised quite early that skill transition points—at least those that are meaningful—are more often a gradual integration of insight and expertise than the acquisition of a specific discrete competency. As the preceding comments indicate, six months studying with a computer simulation does not deliver five years' experience.

It needs to be pointed out that the authors are not the only people curious about what is being learned, and how, during the years spent accumulating experience. Many oil and gas companies, both large and small, have been reassessing their skill development programs. In part this is an outcome of the industry's acceptance of the Training Package PMA02 as a valuable source of competency standards. Prior to PMA02 there was PMA98, but this early package was only picked up in a small way by a few firms. What really sparked the renewed interest in training was the

incident at Esso's Longford plant, which made it exceedingly clear that the industry had to improve training or, to be completely accurate, had to improve the outcomes of training.

Before the incident at Longford, companies either had their own in-house competencies or relied on supervisors' intuitive judgements about what needed to be learned and whether it had been. There were no industry standards and little inclination within the industry to share knowledge about training and learning. The Longford explosion made it clear that what counts as responsible management is not only the provision of training, but workers' applicable knowledge; that is, learning which is remembered and used.

The knowledge required of workers also received renewed attention because of the drive, mentioned previously, to minimum levels of staffing caused by technological advances. Many traditional platforms are being replaced by sub-sea manifolds which direct the product from the seabed, via pipelines, to onshore production or floating production, storage and offloading facilities. In addition, many existing platforms are being converted to facilities which are controlled from locations many hundreds of kilometres distant, with only programmed maintenance crews flown out to operational areas on a rostered or needs basis. Numerous unstaffed platforms operate, for example, in the Gulf of Mexico, and that is expected to expand.

> The obvious advantage of networking multiple platforms to a central control point is reduced staffing at each platform. By operating a specific platform as the control point, the other networked platforms can function effectively without direct intervention.
>
> This reduces personnel requirements to only the number required for maintenance and repair. Additionally, control may shift to an alternate platform, should heavy weather at the primary control site force its evacuation. (Smith & Kimball 2003)

In some areas existing process workers are being replaced by 'specialist workers'. These are often contractors playing a significantly different role, that being the 'changing out' (or removing or replacing) of components or programmed maintenance tasks.

Where the technology has not been applied to the point of unstaffed platforms—the case in Australia thus far—there is nonetheless a significant reduction in staffing levels as the result of improvements in technology. Crews on platforms and floating production, storage and offloading vessels have been reduced by as much as 60% over the last decade. In this case, the skill profile change is to multi-skilled rather than specialist operators. The most recent intake of apprentices for the industry, for example, are not being trained as 'process operators' but as 'process technicians'. These technicians will have combined highly sophisticated electrical and instrument skills with process knowledge, thereby considerably changing the role and knowledge base of the traditional process operator. As things currently stand, multi-skilling production personnel is a key strategic objective across the Australian industry.

One further driver for thinking about the skill development of production workers is not new at all. It is the challenge of maintaining a work environment that is stimulating to operators even after they have mastered routines. The industry repeatedly says it wants people who 'ask questions', 'want to learn', 'are switched on'. The people it hires say they 'want a challenge', 'want to know how things work', 'like to figure things out'. So there needs to be a continuing 'stretch' for operators across that five-year period, and longer. Some people spend many years outside before moving into the control room. One person whose history was reviewed spent about 11 years outside, 'I was young enough, not in a hurry'. Others prefer to remain outside permanently. Preventing boredom is a real and ongoing obligation which companies must find ways to meet.

The industry is, in fact, exemplary in the scope of learning mechanisms it uses to develop its workforce across all learning gradients (including engineering specialties and senior management). The investigation here of the lessons which move a novice process operator to the point of being able to go in to the control room illustrates particularly well the way informal—although by no

means unintentional—learning is mixed with formal training, and both are channelled to a clear goal. The principal mechanisms are:

- ✧ initial formal induction
- ✧ workplace supervision
- ✧ on-the-job training
- ✧ constant reinforcement
- ✧ mentoring
- ✧ project assignments.

To capture the experiential nature of this learning, the various mechanisms are sketched through the stories (abridged) which informants shared. Pseudonyms have been used.

Initial formal induction

Colin's story

> I was apprenticed as an electrician straight from school in Victoria. My first move into the oil and gas industry was about 12 years ago into downstream processing—that was before the plant was built, so 17 of us got seven months full-time training. Got a folder on Day One: for the next four months you will do instrumentation; then four weeks for a boiler ticket at RMIT [Royal Melbourne Institute of Technology], and so on. A lot of it was ICI [Imperial Chemical Industries] technology so they did the training. It was great.
>
> I've had three lots of really good training like that. When I transferred from the plant to an FPSO [floating, production, storage and offloading vessel] that same company put a bunch of us through really intensive study conducted by some consultants who came in. And again when I came across to this company to work on an offshore platform we got some good process operations training, fire training and teamwork stuff. I remember the panther pole where I had to jump two metres to a trapeze. I was shaking like a leaf. I'm okay with heights now.
>
> If I think about it, what worked for me was being pushed to the edge of the envelope in this training … it had real bite to it. It bothers me now that some of the operators we've hired recently, who are experienced instrument-electrical tradesmen, are doing a Cert. I in hydrocarbons and some of the things they have to do are so far beneath them. They are frustrated and I am frustrated. When I ask 'why no RPL [recognition of prior learning]?' I'm told it's easier to do the modules. But it's not for these guys, It's a real turn-off.

Workplace supervision

Hank's story

> I started out as a roustabout on a drilling rig and it set the pattern for the way I learned things all the way through. It was mostly by observing and then getting small opportunities to do it yourself. The derrick-man saying 'would you look at the gauges while I have a smoke'—so you got used to monitoring. Similar thing being allowed to operate the rig one day to get experience.
>
> If there were extra people on the rig crew for some reason, I might go over to operations with one guy for a week. Then when he goes away for a week, you step in. It is a gradual but clearly defined pathway. It works because there are always people to ask.
>
> Like most, I've been given opportunities to move in different directions: maintenance, production, drilling. The pay stays the same. There's been cases where a guy has moved from a supervisor 'down' to production operations but they kept the same pay rate. So progress is not necessarily up but across—you keep adding capabilities. It's plus, plus, plus. It's taking on board challenges and you keep on adding challenges. So not so much upwardly mobile as just mobile.

Dave's story

I had three years at technical college training for the North Sea—along with 50 others. This was the early/mid-80s and there was a huge demand for offshore operators. The first year offshore is where we learned most—a tremendous amount. You spend time in each different process area and I just got stuck into it. I was highly enthusiastic—very keen. I would follow everything in the process through. Watching people.

You learn one area at a time. It takes a couple of trips and then the supervisor thinks you might be competent to run something on your own. No formal competency assurance. There was a form of logging and ticking boxes but no gathering of evidence.

Now it's more formal with competencies. Also, on our latest platform you can't rely only on supervisors for skill development. Because it's so complex there is too much work for them to do. So we've got formal skill auditors now. But that pattern of having base skills, learning to use specific bits of equipment and then having the whole thing come together one area at a time still holds. And progressing through that still depends on supervisors.

On-the-job training

Kevin's story

The key to our offshore training is that there are two guys out there keen to skill people up. They were there before we took over the operation and their presence actually became part of the contract.

They've both got external qualifications and now are using [Training Package] PMA02. They've got the structures in place and they integrate it with what the blokes do on the job—getting hot work permits, for example. They have to get permits time and again as part of their job. The extra is having someone to document it.

They're taking people on to cert. III which is done in people's own time—mostly when they are on the FPSO [floating production, storage and offloading facility]. They actually do have time out there. Twelve-hour shifts on a steady production vessel are not exhausting. Drillers are exhausted and sometimes, like last Friday when we had a shut down, people didn't get to bed till 3 am. But usually the work is steady and they can do some studies. You certainly couldn't ask that they do it in a semester.

Sometimes while the operators are offshore we fly a specialist in to give them training for specific things like gas detection or a particular control system. There's only one helicopter a week for this platform so the specialist goes out for a week and spends time with five or six people. These short sharp bursts of training are the core of industry training.

Hank's story

The new field has been run by the contractors who commissioned the field. When it's ready for ongoing production we take over with our crew. There's an overlap of a couple of months when the contractors basically give 'tuition' to our guys—that's normal for most start-ups, small and large.

I'm not sure I should call it tuition. It is really more mentoring or even coaching. The contractors don't have any particular expertise in training but it's been working well. An example just now was Julian isolating a well so he could measure flow rates, but what I want them to really pick up is being able to manage several tasks at once.

Mentoring

Tom's story

> We've actually got a formal mentoring program in place. But there is a lot of less formal mentoring too. People talk about the look-listen-hear-feel skill. Some people manage this almost naturally, others need assistance. That assistance comes by helping to identify an operator's strengths and weaknesses. Team leaders do this, perhaps not formally. In fact doing it informally requires good psychological insight, probably more than if it was formal.

Dave's story

> When we first went offshore in the North Sea we had had good training at Tech. We were supposed to be mentored on the platform but the older blokes weren't ready to receive us—they didn't know what mentoring was, so the multi-skilling program was abandoned.

Project work

Hank's story

> The steepest learning curve for me was the preparation for Thevenard Island. They brought us in well in advance—there was nothing there. They put eight of us in the Perth office for eight to nine months while it was being built. We looked at P&IDs [piping and instrumentation diagrams] … and tried to write procedures. Not easy. We'd go on field trips and walk around the plant to see the thing while it was being built and we'd come back and re-write. They put us on a few little courses which were not really relevant but the overall experience was a great challenge.
>
> Earlier when I was still new to production I learned most by what you could call micro projects—when that thing that dialled down [showed a reduction in the reading] breaks, you fix it and then you can figure out the whys, you start understanding why the level dropped.

There are a few important aspects of the skill development of process operators during their five years on the job which are not obvious from the preceding stories.

The first that informants pointed out is that one form of learning has been neglected: not enough process operators thoroughly understand the phase properties of the hydrocarbons and water coming up from underground and flowing through the platform—what one labelled 'the science stuff'. The problem is that it isn't possible to get an intuitive understanding of this by observing and tinkering—the fluids stay quite invisible, hidden away in pipes. There's no obvious way of knowing from the outside the nature of the mixture of fluids flowing through.

Second, because there is a worldwide shortage of process operators, work in the industry is currently fairly steady. People do move in and out of jobs as platforms close and others are commissioned. Some move in and out (and back into) the industry for personal reasons. In the case histories in this study, these reasons included: marriage, divorce, wanting a change, getting tired of the two-weeks-on two-weeks-off roster, remarriage, wanting to buy a house, and similar. These people didn't find it difficult conceptually to return after some years, although it took time to get used to a new environment and, especially, to catch up with the ever-expanding information technology demands.

However, there are areas in the industry where the work is intermittent and this has serious repercussions for skill development and, importantly, skill maintenance. Drilling is a good example, as one local drilling contractor explained:

> It's hard to be a good driller … Our company just drilled onshore. Typically that's a 30-day job. There is rarely enough work to give the people on the tools continuity. Even the large drilling companies struggle to maintain crews. And if they don't keep up the skill it declines.

Third, it would be a mistake to think that because so much of the learning appears opportunistic, it is also unrecognised. Even without agreed levels of certification in the hydrocarbons industry, individual companies have kept track of the capabilities of their workers—increasingly in terms of competencies monitored through computerised learning management systems. The introduction of the safety case regime in Australia has made careful inventories of skill and knowledge yet more critical. The Training Package PMA02, with its agreed set of competency standards, is likely to drive greater uniformity in monitoring skill. Certificate IV is likely to become the benchmark for the industry.

Most companies in the industry encourage people at all levels to undertake further study. One process operator acquired an engineering degree and several others said that if they had wanted to study short or long courses, they would have been well supported.

Third skill transition point: To supervisor (person in charge/ offshore installation manager)

Depending on the size of the installation, the hierarchy of supervision can be as small as one—a single supervisor, the person in charge, at a small onshore field—or composed of several levels of superintendents and supervisors when 70 or more people work on an installation.

The step to supervision from operations is invariably a major one. The following comments from four informants were typical.

> The hardest step is from technician to supervisor where you have 15, 16, 20 guys in maintenance and production. It's hard because you're moving from mate to supervisor. You end up leading by example but it's a tough call.
>
> Teams of operators can manage the technicalities of their work together quite well. Managing their interpersonal behaviour is something they are learning but that still requires the watchful eye of a supervisor.
>
> There is a lot of pressure on people becoming, politically, part of the management team. Before then you are out there with the guys. But then you start running five to six supervisors and 50–60 operators. That's a huge step change in a career path. Some make it; some don't. Some find it very uncomfortable sitting up there with management answering questions and looking at the bigger picture.
>
> What we're looking for in an OIM [offshore installation manager] is someone who can manage people and facilities and emergencies. They have to make the decisions the company would.

The supervisory role, as the comments suggest, has three principal components: managing people; representing head office in the field and representing the field to management; and managing emergencies. The fourth component, managing the production flow and proper functioning of equipment and facilities, was rarely mentioned in the interviews. Again, it would seem that this technical capability is not a hurdle even in taking on responsibility for the whole technically demanding installation.

Formal training and even informal mentoring for the three 'new' tasks have been relatively rare and there remains a sense that people either have 'it'—the ability to supervise well and democratically—or they don't. It would be useful to distinguish the supervisory skills required for the three tasks because different strategies ought to be used in addressing each.

- *For managing people*: the Frontline Management Initiative—the first national initiative in Australia designed to support workplace and organisational learning—has proved an effective skill development tool when used wisely. Few of the production supervisors interviewed have been through the program. Companies have relied on short courses of one or two days duration, which is not sufficient to ensure a new supervisor is able to rebuild relationships with former peers.

- *For acting as a fair two-way conduit between management of field workers*: several of the smaller oil and gas companies are making concerted efforts to ensure a gap doesn't exist. One has created a third superintendent position and a roster to match so superintendents spend three weeks offshore, three weeks in the Perth office and three weeks on leave. The general idea is to ensure the office knows what is happening offshore, and equally (and openly) to enable superintendents to 'wear the management hat offshore: if they never come through the office they'll simply be one of the boys'.
- *For managing emergencies*: incident response and emergency management are complex matters. Training is available for many specific elements—for example, isolating leaks, shutting down sections of the plant, directing full evacuations—typically delivered by private specialist providers. The uncoordinated nature of this training has been of concern to the industry for some time. Recent pressure for better coordinated training comes from changes in the way health and safety are conceptualised:

  Behaviour-based safety is where we need to be now. That's where there are no set rules and processes: what is safe and unsafe for people in the field is their personal responsibility. So not rules of 'thou shall' and 'thou shan't', but they build safe ways of working from the ground up by awareness of their environment and the benefit safety delivers.

  A set of incident response and emergency management competencies for the Training Package PMA02 was finalised in 2004. This should see a marked improvement in the overall coherence of the training provided and clarify the varied roles supervisors play in emergency management, incident response and overseeing of general health and safety.

Finally, it should be pointed out that the person in charge/offshore installation manager position can be accessed from two directions. The more typical is upwards through the operational ranks, which is the skill development trajectory of interest in this study. There are some, however, whose background is university engineering and who come to the position through engineering work in the industry. It is not unusual for two persons in charge/offshore installation managers on an installation (one for each shift) to have these complementary backgrounds. It is important to note this because one of the interesting features of the industry is its wonderful indifference to 'where people come from'. There is a special disinterest in someone's educational background. People are judged by what they can do.

Implications

This study was undertaken to investigate three principal issues:

- how existing workers develop leading-edge skills—important if Australian enterprises in globally competitive industries *are* to be globally competitive
- the motivation for existing workers to acquire advanced skills—the balance between individuals making a personal choice to train and employers driving the agenda
- the nature of experiential learning and its role in developing advanced vocational skill.

The discussion of these issues identified implications for the four groups who have a role to play in improving the delivery of advanced skills to Australian workers: enterprises in the oil and gas industry; enterprises in similar industries; providers and policy-makers in the VET sector; and researchers of VET issues.

The principal issues

1 What kind of training takes existing workers to leading-edge expertise?

The answer is simple: training that is stimulating and challenging. One of the clearest messages from this study is that workers capable of developing leading-edge skills will not put up with mediocre training. The people who seek to advance their skills are primarily interested in reaching positions where they will find fresh challenges. If routine, insipid training is put in their path, they will resent it, at best, and dismiss it if possible.

The clearest difference between existing workers advancing their competencies, and entry-level students is that the former—at least in this study—are confident of their ability to meet challenges and, consequently, are eager to be stretched, or to attend courses with 'bite'. They are outspoken and demanding customers. This is not typically the case with entry-level learners. Anecdotal evidence from trainers and teachers in registered training organisations (public and private) and universities suggests that significant numbers of entry-level learners are extremely wary of their capacity to learn successfully. This anxiety, which borders on real fear, affects learners in a wide range of fields, whether aged 17 or 40.

Besides confidence in tackling learning, the other great advantage of existing workers is that they have extended access to a relevant workplace. The significant amount of time available to them in an authentic learning environment is a bonus that public sector registered training organisations, in particular, seem not to recognise. They continue to offer training in terms of semesters or blocks of weeks—limiting the learning time, not enlarging it. Using the workplace for learning is discussed in more detail under the issue of 'experiential learning'. However, it is appropriate to point out here that it is the *integration* of workplace and classroom, the *integration* of underpinning knowledge and active practice that maximises the value of existing workers having a workplace.

The gradual progress to advanced skill and knowledge illustrated in the oil and gas industry calls back into question the role of time in learning. Part of the drive to competency-based training was to remove the time-serving element from learning so that people didn't get stalled in the mindless repetition of already acquired competencies. Now, few in this industry (or elsewhere) want a return

to time-serving, but it may be useful to re-open discussion about the role of time in learning to understand, whereby repeated practice does not stall progress but actually opens out new horizons. This study did not answer the question about the role of time in learning and, indeed, did not set out to raise it. But the findings make it clear that it is an issue that might profitably be investigated in specific contexts across the VET sector.

2 Does the motivation to acquire advanced skills come from the employee or employer?

In this study, most of the respondents—not only the five whose learning trajectories were explored in depth—described themselves as eager learners and, often, robust experimenters. The motivation to acquire new skill is a personal one they bring to the industry. It needs to be said, of course, that by selecting our sample through 'snowballing' recommendations, it was neither a random, nor necessarily a representative one. On the other hand, while the individuals in the sample are well regarded by their colleagues, they were not all high fliers—many had dropped in and out of the industry, and few had been in a great hurry to move up the hierarchy. It needs to be remembered, too, that being eager to learn (and capable of doing so with a degree of independence) is exactly what the oil and gas companies look for in recruiting operators. One would expect self-motivation to be common in the industry.

In the circumstances, the employers' role in motivating workers to advance to leading-edge skills is somewhat masked. Pay is not even a significant motivation: most production jobs and all offshore jobs in the industry are well paid; further, pay is not tightly coupled to hierarchical position. There were few signs that employers have to pressure production workers to take up opportunities for formal advanced skill training. Workers know it is available.

It is important to note that neither employees nor employers are motivated by the acquisition of qualifications per se. Their interest is in competencies, in skill sets and underpinning knowledge, not in qualifications.

3 What is the role and nature of experiential learning at work?

The people spoken to in this study to did not find it easy to explain how they had learned on the job the immense range of skills they possessed. This is not entirely surprising since unpacking experiential learning—how 'nosing about', 'poking around', 'watching others', and working on projects translates to new competence—is the subject of much professional research.

One scheme that is helpful in thinking about learning at work is the chart of 'learning-conducive conditions of work' cited in ANTA (2003c, p.10) based on Norwegian research, and is reproduced in table 2. The chart, in the authors' view, needs further refinement. For example, it implies that the employer does all the 'affording' of learning but this study demonstrates the ways many employees design learning situations for themselves—so 'autonomy' may be another conducive condition for learning. Likewise 'trust' is not mentioned, but operators asking tough questions is central to workplace learning and critically depends on trust. Nonetheless, the chart may prove a useful starting point for employers and employees in reflecting on existing learning opportunities and suggesting new ones. It would be interesting, and a great service, if companies using it were to track changes which make it more useful.

Table 2: Learning-conducive conditions of work

High degree of exposure to change	Degree to which employees are exposed to changes in the form of new technology and new work methods.
High degree of exposure to demands	Degree to which employees are exposed to demands from customers, management, colleagues or group/network.
Managerial responsibility	Degree of managerial responsibility in the job.
External professional contact	Degree of opportunity to participate in professional forums outside the company, conferences, trade fairs etc.; contacts with suppliers and customers.
Direct feedback	Degree of opportunity to learn through seeing direct result of one's own work.
Management support for learning	Degree to which the individual employee experiences support and encouragement for learning from management.
Rewarding of proficiency	Degree of direct and indirect rewarding of increased productivity at work.

Source: (ANTA 2003c, p.10)

4 Related issues

Several 'secondary issues' were described in the 'context' chapter which it was thought this report might make some small contribution to clarifying. The issues and relevant observations are described below.

- *The casualisation of the workforce from permanent jobs to contract work*

  The production workers spoken to do not feel disadvantaged by working on contracts, although it has to be acknowledged that they are handsomely paid. The exceptions are in drilling wells and coded welding, where skill declines if workers do not have an ongoing opportunity to stay practised (that is, reliably continuous employment).

  More important for the purposes of this study is that contractual employment does not appear to be a barrier to employers providing training. Training is increasingly provided because the *proven* competence of every worker on site, no matter how long employed for, is a central risk minimisation strategy for the enterprises.

- *The ageing workforce and older workers*

  With the significant demographic shift in the Australian workforce, the need to retain older workers and ensure they continue to develop skills has become a topic of public concern. The hydrocarbons production workforce tends to be older due to its entry-level requirements but it is not 'old' in the stereotypical sense of declining ability to contribute. The Society of Petroleum Engineers (Starling & Robertson 2004) has expressed concern about the demographics of its profession and there may be an opportunity here for the VET sector to work more closely with the higher education sector to up-skill vocationally trained engineers.

- *User choice*

  The consultation with industry which underpinned this study in the oil and gas industry has helped to clarify why the industry has relied on in-house and private-provider (often from overseas) training with almost no training from Australian public registered training organisations. The reason is simple: the latter have neither the expertise nor the quality resources required. What the public sector ought to be able to contribute is a sophisticated understanding of educational practices. This is discussed further in the chapter on implications for registered training organisations and VET policy-makers.

Implications for advanced skill development in the oil and gas industry

Enterprises in the industry have long been committed to training their workforces: they spend the money that is required and many are in the process of reassessing and systematically improving their approaches to advanced skill development. There are, however, two points that need to be addressed by the industry if it is to maintain its reputation for a world-class production workforce in the face of a tightening labour market. Firstly, it must ensure that underpinning knowledge is thoroughly internalised by operators and, secondly, that there is industry-wide cooperation in the development of leading-edge skills.

✧ *Underpinning knowledge*

One weakness in the industry's reliance on workers learning so much through experience—which the workers themselves recognise—is their lack of a thorough understanding of the chemical and physical processes which the fluid mixtures are undergoing as they move unseen through the installation. This, by definition, is something they cannot observe. The likely cause of the Longford explosion was that operators did not apply knowledge about brittle fracture to the situation facing them. However, blame for the accident was not attributed to these operators but to company policies and practices that allowed this 'ignorance' to determine the outcome.

Instilling the relevant scientific and technical underpinning knowledge so that it remains active, accessible and useful will require astute instructional design and delivery.

✧ *Cooperation in the development of leading-edge skills*

A significant feature of oil and gas producers is the extent to which each sees itself as exceptional—as different from (and usually above) the norm. Two factors are responsible for this perception: the constellation of characteristics of each hydrocarbon field means that no two facilities will be exactly alike or require exactly the same advanced skill sets; and there are significant differences in the organisational cultures, structures and web of alliances which give each company its undoubtedly special ethos.

This study has revealed that, from a skills development point of view, these perceived differences are largely illusionary. The authors found that workers' transition points, their developmental pathways, even changes in the ways enterprises have addressed (and are currently re-addressing) how best to meet skill development needs, are almost identical. The same picture emerges irrespective of the size of the organisation or whether personnel were directly employed or sub-contracted.

There is a genuine, if relatively recent, interest amongst enterprises in working as an industry to address issues in skill development. This change is attributed to a number of factors:

- The development of Training Package PMA02 has established a uniform set of competencies which the industry as a whole helped to design and revise and of which it is very supportive. Thus, enterprises seem to be moving in the same direction in terms of competencies. They want to develop more multi-skilling, more certificate III and IV level competencies, and more emphasis on supervisory and interpersonal skill.
- The establishment of the safety case regime in Australia commits oil and gas organisations to ongoing and detailed evaluations of safety and emergency management competence. Experience in the industry suggests that, where organisations are subject to identical regulation, they are more likely to provide joint training. This is done, for example, with blowout prevention where workers must be regularly recertified to a single standard.
- As the industry confronts a worldwide shortage of skilled operators and controllers, the realisation that the companies will be equally subject to skill crises becomes more obvious. This has led to an industry-wide approach to establishing an apprenticeship scheme for process operators.

Enterprises in the industry are already thinking about the balance between the training that is specific to their enterprise—technically, culturally and commercially—and what can be done jointly.

To an outsider, the historical industry position of placing the balance almost 100% on the side of 'specific and secret' seems poorly conceived. It may be that a significant amount of training can be done more cost-effectively on a more collaborative basis.

It is also the case that, by pooling resources and experience, the calibre and quality of training available for the industry from Australian providers could be lifted. Such a cooperative stand could help bridge the sectoral divides which still exist between VET in Schools training, technical and further education (TAFE) and registered training organisations, and university. One of the particularly admirable features of the industry is the way that, once a person is accepted into the industry, the educational sector from which the person emerged fades into insignificance.

Implications for skill development in other industries

Two key features of advanced skill development that have been observed in this study are likely to be relevant, sooner or later, in a range of other industries.

- *Importance of employee's attitude and aptitude*

  Where jobs require the person to show initiative, solve problems and make decisions, a qualification alone is often insufficient to determine whether an applicant will fit in and work well. How a person feels about the work—whether they take it seriously, whether they are keen to learn more, to be challenged—are significant factors that more and more employers are taking into account.

  Consequently, employers (and the VET sector) are going to need to understand the extent to which aptitude and attitude are 'a given' in the individual, and the extent to which they can be shaped to fit the industry's expectations. In the oil and gas industry there are already people who, in principle, are qualified to join the industry (with certificate II) and are eager to enter but who are not getting work because of the judgements made about attitude, in particular.

- *The demand for competency assessment that meets legal standards of proof*

  A number of industries, like hydrocarbons, operate in a regulatory or legislative framework that sets standards for their continued operation. These include construction, mining, aerospace, health, community care, food and utilities. In each, simply being *trained* is no longer enough; individuals in the workplace must demonstrate they can *apply* knowledge and skills to the standard required. If it cannot be proven (to a legal standard) that the organisation has competent workers, penalties can be severe. Loss of licences, fines, increased insurance premiums, greater controls by regulators are all potential consequences.

The general trend observed in this study is that organisations in industries subject to conditions similar to the oil and gas industry will face new challenges in developing the skills of their workforce. In particular, assessments must be more thorough, job specifications and selection criteria must be strengthened, and more realistic linkages between job profiles and competency standards introduced.

Implications for registered training organisations and VET policy-makers

The three implications for registered training organisations and policy-makers are presented below. Although they are listed as discrete items, they are not disconnected, and are linked in a deliberate order.

The fundamental linking idea is that operators in the hydrocarbons industry work under considerable pressure. They need robust skills and ongoing opportunities to extend those skills, to understand more and better. The demands on them continually shift, and inevitably seem to

increase, as the evidence described in the 'findings' chapter indicates. The three implications for the VET sector that emerge are based on that fundamental point.

Given that the industry requires advanced skills training of a particular nature, the implications are as follows.

✧ *VET providers need to form alliances with industry and amongst themselves to access the resources, technology and expertise required to deliver advanced skill training.*

Traditionally, TAFE has been geared to entry-level training. It is the case, of course, that with shortages apparently looming in a number of the entry-level trades areas (including specifically trained process operators), TAFE will be able to make a significant contribution to the oil and gas industry by retaining a focus on the certificate II and III levels.

However, if public providers are to join the main game in this (and other) industries, they are going to have to develop strategies for delivering advanced level skills. The clear direction for this, already well understood by registered training organisations, is to work very closely with the people who have access to the technology, the expertise and the resources required. There needs to be a blurring of boundaries, not only between industry and vocational education and training, but amongst all the providers of skill development: industry, schools, registered training organisations, independent (international) training providers, and universities.

✧ *VET providers need to find their niche in this alliance, suggest their unique expertise in teaching and—especially—assessment.*

If there is a necessity for alliances amongst all the parties interested in developing advanced skills, the question logically is: what is the specialty that registered training organisations contribute? Its niche seems obvious: its special expertise in teaching—that is, in ensuring learning happens—and in assisting in the assessment process.

Two kinds of teaching are currently (and for at least the mid-term) needed by the industry. These are those that:

- instil attitudes and values in aspiring recruits
- help existing workers to develop their supervisory and interpersonal skills *in the context of oil and gas environments*. There is a question about how 'generic' the so-called generic skills are—how transferable 'supervision', for example, is. Industry informants to this study consistently implied that they are quite context-specific: focused on the kinds of problems these people have to solve together, the environment in which they do it and the history in which they are played out. The industry has recognised the ad hoc nature of skilling supervisor positions and is in the process of developing guides for coaching.

Assessment is of critical importance to the industry and is increasingly receptive to independent certification of workers, partly in response to the safety case regime. In terms of qualifications, the industry makes an interesting distinction between training and assessment. Enterprises will not *train* for qualifications but are willing to *assess* for qualifications, with the stipulation that the relevant training package is flexible enough that the set of competencies which the enterprise requires can be packaged into a recognised qualification. Training Package PMA02 appears to meet that flexibility requirement. The industry is gradually progressing its workers towards certificate IV outcomes by using recognition of current competencies assessment as its first rather than the last strategy.

The recognition of prior learning system in the formal VET sector is exceedingly important for this industry, more so than the traditional TAFE delivery system which places delivery at the forefront of the process and prioritises that process over recognition. In their view, this system is in urgent need of attention.

A reminder here (although few VET policy-makers would be unaware of the point): there is a considerable mismatch between the sector's administration rules and the way the industry works. A critical point of difference arises over the timing of courses. What sense does a semester make on an oil rig where people work 12-hour days, seven days a week, on two-week

swings? And what about the costing of courses, and contact hours? These types of structures cannot apply in this industry.

- *Quality counts: VET providers need to seek out and pay attention to uncompromising feedback.*

  The word we heard time and again in discussion with people in the oil and gas industry, to the point that it became almost a cliché, is that they were 'there'—wherever 'there' was in the hierarchy—because they liked being 'challenged'. If they were going to learn through formal training, often not their preferred way, they wanted it to have 'bite'.

  Because this is a global industry, people move from organisation to organisation, often specifically in pursuit of more interesting work. The consequence is they will have experienced many learning environments. They are knowledgeable and demanding customers of advanced skills training.

  Many of the most sophisticated training providers also have a global reach, and companies are prepared to pay top dollar to send their operators, as well as their engineers, to The Hague or Houston for weeks if that is where the best training is. This is a rich industry, although the point does need to be made that these companies will not spend a cent more than they believe they need to. They are scrupulously driven by commercial considerations and will go where they get the best quality and service.

  There is a perception on the part of industry that training providers—some training providers, by no means all—inflate their capacity and their offerings. They are too willing to believe their own publicity. Admittedly, it takes a degree of courage to ask one's clients, 'what really could I have done better?', and to discuss it with them. But it needs to be done. Sending out a questionnaire with a Likert scale that asks 'extent of satisfaction' is not effective feedback. Do respondents all mean the same thing by 'satisfaction'? Further, marketers say that unless a client marks the box 'exceedingly satisfied', forget them: you haven't won them over.

The implications may sound somewhat harsh. They were not intended that way. In fact, this research on the advanced skills development of existing workers suggests, above all, that there are exciting and rewarding opportunities for the VET sector to make inroads on the traditionally internal training market of the oil and gas industry. But the research also says that it is a market which will stretch the sector. There appears to be particular scope to develop innovative approaches to online learning, but it will not come cheap.

Implications for further research

There are two possible avenues for future research.

- *Are 'skill transition points' a useful research device?*
  The initial idea of this study was that process operators would stumble across technical and conceptual issues that would resolutely intervene in their slow trajectory to expertise—skill shortages would be found because there were skills that were 'too hard'. However, skill transition points of that nature were not found. Nonetheless, the 'steps' uncovered are significant and gave an indication of the broad brush of training and skill development in the industry. It would be beneficial to test the tool in other industries.

- *Are there fresh models for centres which specialise in developing leading-edge skills?*
  It is Australian Government policy to foster innovation. This specifically includes dynamic workers in on-the-ground production—not just supporting technological research, development and commercialisation. In another (unpublished) study of the oil and gas industry, the authors examined international facilities (in Canada, the United Kingdom and the United States) for developing advanced skills for the industry. The level of skills development and innovation unleashed in some of these is impressive. There are doubtless models in other industries that bring together a range of partners to produce advanced skills in imaginative and cost-effective ways. Investigating these would be the basis for a continuing and broadly partnered research program well worth doing.

This study has led the authors to conclude that the Australian VET sector is still in the early stages of meeting the fundamental task of having a highly skilled workforce *and* being a world leader in understanding how to educate and train such a workforce. The potential is there.

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Appendix 1: List of interviewees

Australian Oil and Gas Industry Training Consortium:	Terry McNeill
Australian Oil and Gas Industry Training Centre:	Geoffrey Graham
Australian Petroleum Production and Exploration Association:	Don Sanders John Robertson
Apache:	Ivor Alexander Chris Jackson Bruce Lake Ross Payton Paul Stevens Jeff Thompson
ARC Energy:	Barry Ashwin Peter Cooper Eamon Murphy Derrick O'Keefe
BHP Billiton:	Mike Ollis Mark Shircore Phil Sinel Diana Russel-Coote
Chamber of Commerce and Industry:	Garry Collins
Chevron Texaco:	Mark Crook Pam Richards Ian Templeton
Clough:	Mike Cahill Peter Chamberlain
ConocoPhillips:	Lina Dickens Ken Fraser Diane Jaksa
DARE Contract services:	Christopher Hicks
Expertest:	Ian Maynard
Focal Petroleum Engineering:	Kevin Mann
Halliburton Australia:	Ralf Mahncke
Hardman Resources:	Jim Sheppard
Kellogg Joint Ventures:	Gerald Humphrey
Newfield Exploration Company:	Robin Wright
Nexen:	Ken Fitzpatrick
Oceaneering:	Jim Luke
Oil Drilling and Exploration Pty Ltd:	Neil Dean
PMITC:	Mike Jakins

Resource Personnel Services:	Francis Coreless
Schlumberger Oilfield Australia:	Melissa Waldon
Transfield Worley Woodside Alliance:	Victor Calvo
Transocean/Sedco Forex International:	Mike Sukudom
Unions WA:	Dave Robinson
Wesfarmers LPG:	Keith Mackintosh Peter Wilson
Woodside Energy:	Frank Aquino Garry Eglinton Suzanne Giltrow Rod Magnus Keith Spence

Appendix 2: Interview protocol

Interview protocol and key questions

This protocol is to be applied to the gathering of information in relation to Project NR3016 – Training of skilled workers in the hydrocarbons industry. The protocol is to be applied to all discussions concerning this project but should not limit the range or scope of questions asked during the contact.

Contact name:	
Organisation:	
Contact details:	
Date and location of contact:	

Location/contact arrangements

Industry contacts should be approached on an "as is where is" basis, the key factor being availability of the individual at an appropriate time to suit them. Contact is to be made initially by phone or email and a follow-up visitation or interview date arranged. Given that some of the people we need to speak to may be offshore, several weeks lead time may be necessary. For on-site visits suitable long sleeved shirts and safety footwear will be required.

Key points and questions for interviewees

Key points or questions	**Chkd**
Please describe your present position and the role you play in the organisation.	
How did you come to participate in the hydrocarbons industry?	
Was there any specific training that you undertook to assist your entry?	
What qualification(s) did you posses at the time?	
Was there any specific experience or experiences that you felt were particularly valuable in assisting your entry?	
How did you get to your present position?	
Thinking back over your career in the industry what experiences or factors stand out as key points in changes of career direction?	
Has there been much by way of skills development or specific training activity during your time in the industry and if so please tell me about that?	
Of that training, how much would you say has been provided by your organisation?	

What part, if any, has formal training played in the development of your career once in the industry?

Thinking back over your career, what sort of training do you think has been most valuable to you in the industry?

Do you notice any pattern to the people who advance in the oil and gas industry and those who don't?

Are there any factors other than qualifications that have led to your ongoing participation and/or advancement in the hydrocarbons industry?

Are you currently undertaking any studies or developmental activities?

With whom are you undertaking that study or development?

Who is paying for that study or development?

Are the outcomes of that training meeting present needs or have they met previous needs?

Other issues that arise

Note here any issues, questions, queries that arise in regard to the interview.

Additional notes for interviewer

Note here any matters pertinent to the interview that require follow-up or further attention

Interviewer

Appendix 3: A skills landscape

A skills landscape for the oil and gas industry in WA

Over the past three months we have listened carefully to advice received during our discussions with organisations in the oil and gas industry, their contractors and service providers concerning factors which affect the possible development of a skills development facility for the industry in WA. We have also spoken to and very carefully listened to advice from organisations including APPEA, the WA Chamber of Commerce and Industry and WA Chamber of Minerals and Energy. In all of these instances we are grateful for the frank and revealing information we have received. We now believe we understand the nature of the skills development landscape which exists for the industry in WA and the factors which point to the measures which need to be taken to address apparent shortfalls.

We would appreciate you looking at the following landscape and advising us of whether you see yourself as part of that picture. As always any comments you make to us will be treated as confidential and we will not pass that information along in any form which can identify individual organisations.

Exploration and production organisations	**Construction contractors and fabricators including maintenance**	**Support services (drilling, wireline logging etc.)**
Tertiary qualifications: ✧ petroleum engineers, geologists, reservoir engineers, mechanical engineers, chemical engineers, electrical engineers, drilling engineer sand the like – good supply from reputable institutions in Australia such as UWA, Curtin, University of Adelaide; University of Sydney and from overseas ✧ some limitations for drilling training since most is done by contractors (offshore drilling mostly by international contractors)	*Tertiary qualifications:* ✧ mechanical engineers, electrical engineers, construction engineers – good supply from UWA, Curtin and other Australian universities and overseas ✧ limited numbers of persons trained as reliability engineers, supply line managers and logistical integration managers.	*Tertiary qualifications:* ✧ drilling and wireline engineers, mechanical and electrical engineers, computing and software engineers, reliability engineers, seismic engineers and geologists – mostly employed on contract internationally (offshore operations contracted out to international organisations providing infrastructure and personnel)

Exploration and production organisations	Construction contractors and fabricators including maintenance	Support services (drilling, wireline logging etc.)
Diploma and certificate level qualifications	*Diploma and certificate level qualifications*	*Diploma and certificate level qualifications*
✧ instrument/electrical tradespersons, mechanical tradespersons, electrical tradespersons, refrigeration mechanics and the like – good supply from reputable institutions such as TAFE colleges and private vocational education providers ✧ process operators and control room personnel – perceived to be a growing shortage of good process operators due to time required to train and develop experience and aging workforce. Number required in the future uncertain due to technology improvements and irregularity of projects and their timing ✧ permanent and long term contract supervisory staff on facilities deemed to be quite good because of length of experience acquired in achieving supervisory position	✧ contracts, estimating and quantity surveying, costing personnel – in reasonable supply ✧ skilled metals tradespersons – readily available and good training facilities in TAFE and private sector ✧ coded welders – a problem of supply with specialists due to intermittent nature of contracts which makes retention of core skills and development of expertise difficult. ✧ supervisors - on-site supervision of major construction presents problems due to lack of depth in supervisory skills, especially understanding of work practice management and getting the best out of people due to transitory nature of employment as supervisors.	✧ drillers (onshore), electrical and mechanical maintenance personnel, computer technicians, contract supervisors administrative personnel – no major problems with availability or numbers, good courses and supply through TAFE colleges and private providers
Uncertified skilled support personnel	*Uncertified skilled support personnel*	*Uncertified skilled support personnel*
✧ general services operators, cooks, cleaners, etc – not in short supply	✧ trades assistants etc – not in short supply	✧ drillers assistants, roughnecks – not in short supply

Key skill development landmarks in the industry

As a general rule the industry draws on three primary sources of skill sets:

- ✧ The tertiary sector for a variety of engineering, chemical and business skills sets from institutions across Australia and overseas
- ✧ The vocational education and training sector for skilled tradespersons and front line management personnel
- ✧ Its own resources for specialised training in a wide variety of professional and operational areas, many of which are addressed through the resources of global in-house training arrangements or the expertise of global partners or international specialists.

From the tertiary sector graduates are selected for their interest in particular areas, for example petroleum engineering, then located in a specific office or division. Graduates are often rotated through several divisions and work with specialists in the fields. As their expertise and knowledge grow they may be assigned to particular projects which might be offshore or in other locations outside Australia.

From the VET sector the industry draws on two general groups of people: (1) tradespersons who usually come into the industry once they have gained some years experience elsewhere such as mining, maintenance, general engineering or other; (2) IT support people. There has been a limited history of apprenticeships in the industry, however, this is currently changing with efforts to establish an industry group apprenticeship program in conjunction with WA CCI Group Training. There has also been an emerging interest in Front Line Management and process operations training, including the possibility of traineeships, through the PMA98 national Training Package and more recently the PMA02 national Training Package.

From its own resources the industry provides comprehensive in-house training arrangements. Many of these take advantage of the global nature of the industry. Organisations such as Shell in the Hague and BP provide leading-edge training in areas of expertise to partner companies as well as their own personnel. Other specialist organisations such as the John M Campbell Company, RGIT Montrose, CAPP and the OSSC for example are utilised on a needs basis to address specific skill development. Organisations routinely send senior or specialist personnel to the UK, Europe, USA and Canada to attend courses.

One of the most notable aspects of skill development in the oil and gas industry is its reliance on the individual gradually acquiring expertise and depth of knowledge through experience. This is the case whether the person's original qualification comes from higher education, VET or an uncertified skills background. Once a person enters the industry, training becomes ancillary to this day-in-day-out, year-in-year-out accumulation of experience. Experience comes first and training is offered once the person has demonstrated real readiness. It is an industry that relies very much on the attitude and aptitude of people – their willingness to learn for themselves by solving problems. This has served the dynamic and demanding oil and gas industry well in the past.

In Western Australia, the industry does not generally suffer from damaging skills shortages though the timing and number of projects can critically effect skilled labour supply in the short term. Nonetheless, we have been advised that several areas exhibit chronic problems and represent centres of concern:

- Process operations training for operators is regarded as of growing importance particularly from the point of view of developing a better understanding of oil and gas processes and consequently developing a more multi-skilled, flexible and productive workforce.
- Incident response and emergency management training have for some time presented difficulties due to the limitations on simulated plant and equipment and a lack of suitable standards for RTOs (and companies) to deliver against.
- Control room operator training is a concern given that the step from process operator to control room can be a lengthy one if there is no prior knowledge about control systems and a thorough grounding (up-dated) in IT; and
- In the construction area, in particular, the lack of on-site supervisory skills (due to the transitory nature of employment in supervisory roles) is a concern because lack of skill impacts on both safety and productivity.

Do you see yourself in this landscape?

Our efforts at this stage of the study are focused on confirming, on an industry wide basis, the nature of the skills development landscape as the next step towards determining (a) the extent of any need for specialised facilities to serve the needs of the industry and (b) to provide a focus for subsequent business modelling for any such facility. We would therefore appreciate your feedback as to how closely the preceding circumstances are similar to those in your organisation.

- If we have it right and the scenario described is accurate please indicate with a simple 'yes' here _____ and email the document back to us.
- If we have it wrong please spend a few minutes and explain to us how the circumstances don't fit your organisation; you can do this either by email using the next page or by giving us a call. We recognise that the industry does not speak with a single voice and accordingly your views are important.

Thank you for your valuable input; our contact details, should you wish further information or if you wish to make a verbal comment, are as follows:

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