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Collaboration on Talent Development

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Meeting the New Energy Challenges

By Stephen M. Cassiani
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STEPHEN CASSIANI *joined ExxonMobil in 1969 after having earned a BS degree in geology and an MS degree in geophysics from Boston College. His initial assignments were in geophysical interpretation, both onshore and offshore, in the Gulf basin of the southern United States. Cassiani progressed through various Exploration and Production Department assignments and was named Vice President for U.S. Exploration in 1987. In 1992, he was named Executive Vice President for Global Exploration. He assumed his present position in February 2001. Cassiani is a member of SPE, the Society of Exploration Geophysicists, and the American Association of Petroleum Geologists. He is currently Chairman of the Greater Houston Chapter of the American Red Cross.*

We are experiencing a period of great public interest in the energy industry, sparked by increased recognition of energy's importance in global development and the challenges associated with meeting energy demand. As a result, energy has become a leading news story with an increasing number of reports about the economic, social, geopolitical, and environmental consequences of energy supply and demand. Concerns about issues such as energy pricing, security of supply, and greenhouse-gas emissions create challenges along with new opportunities.

Addressing these concerns and opportunities will require innovative technologies and creative people as well as research organizations that support this key combination. But based on our industry's long history of past accomplishments, we can view this time of change, challenge, and opportunity with confidence that our record of technology achievement will continue.

The current interest in energy is stimulating widespread technology development, due in part to new R&D initiatives to develop unconventional and alternative energy sources. Each energy source has its own set of technology-development needs:

» The main challenges for increasing conventional oil and gas supplies are improving resource discovery, accessing resources in harsh environments, and optimizing total recovery. Because conventional oil and gas still provide the bulk of global hydrocarbon production,

making advances in developing these resources can yield significant benefits.

» For unconventional oil and gas resources—such as tight gas, heavy oil, shale gas, and shale oil—the major technology-development needs are new and enhanced recovery methods. Unconventionals represent vast known resources and are currently the object of major R&D investment in recovery methods.

» The key technology challenge for coal, another huge known resource, is affordably mitigating environmental impact from its use. Economical methods are needed for converting coal to "cleaner" gas or liquid fuels and for reducing the emissions from combustion or conversion processes.

» Alternative or renewable energy sources such as wind, solar, geothermal, biofuels, and biomass present a different set of technical and environmental challenges. These include the high cost of development, limited scale of operations, and lack of supporting infrastructure. And while commercial alternative-energy operations are growing rapidly, these energy sources are expected to provide only a small share of energy-supply needs for decades to come and will remain heavily dependent on some form of subsidy.

One measure of the growing significance of technology development in our industry is recent action by SPE to increase awareness of upstream R&D activities and needs. A few years ago, the SPE Board of Directors created the SPE R&D Advisory Committee to identify, encourage, and facilitate global R&D activities that will help to develop needed technology. Among its various actions, this committee helped establish the new SPE R&D Technical Section in 2006 and, earlier this year, sponsored the first SPE R&D Conference. The R&D Technical Section goals include promoting technology development, increasing communication, identifying focus areas for interaction, and encouraging cooperative R&D efforts. The SPE R&D Conference discussed R&D challenges involved in identifying, developing, and securing the world's future energy supplies. Given the enthusiastic response these initiatives have received to date, interest and participation is expected to grow.

Responding to our industry's challenges will require skilled people and effective work processes to develop needed technology and ensure that it is properly applied. New ways of working and collaborative work environments represent key enablers to achieving success. One example of an effective work model can be illustrated by the process of developing an accurate understanding of the hydrocarbon reservoir, arguably the most important step in reservoir-depletion planning. For optimal results, this process should combine the geoscientist's and reservoir engineer's perspectives on the static and dynamic properties of the reservoir, respectively. It should also facilitate application of the latest technology and provide a visual, collaborative work environment for data interpretation, with the goal of producing an integrated solution. When communication and collaboration are frequent and clear, a cross-pollination of ideas occurs at the interface between disciplines, and new insights and discovery can result. Organizations can support this process with an appropriate collaboration mindset, a common software environment, and a set of tools that enable sharing of data, ideas, and results.

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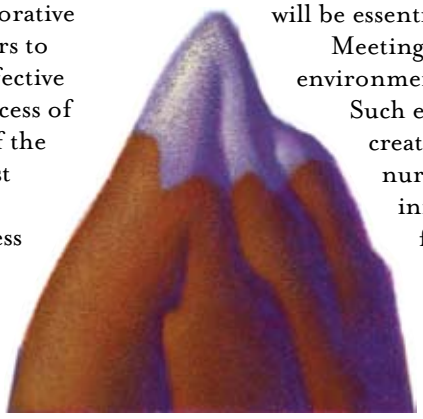
As another work-process example, research to address the impacts of greenhouse-gas emissions will require new collaboration among a broad set of disciplines that may include chemistry, biology, math, physics, materials science, and climate science, in addition to the geosciences and engineering. Carbon dioxide capture and storage (CCS) is receiving an increasing amount of attention, which is appropriate. An effective CCS initiative will require a breadth of technologies, extensive technology development, and holistic solutions. Furthermore, enabling regulatory structures must be in place before large-scale implementation can be considered. Upstream- and downstream-company experts will need to work together on CCS technology development, and this effort will benefit from partnering with external technology providers and from joint-industry research efforts. In this process, extensive communication; idea sharing; and collective, rather than discipline-specific, thinking will be essential to achieve the desired outcomes.



Meeting our energy challenges requires R&D environments that facilitate technology innovation. Such environments recognize the value of creative ideas and ensure that they are nurtured and pursued. The process of innovation starts with developing a deep, fundamental understanding of the need or goal, which provides a stimulus to generating ideas. By providing flexibility in research program plans, new ideas are allowed to give rise to alternative paths of inquiry.

Innovation occurs when the creative idea is transformed into something of real value, such as a problem solution or commercial opportunity. Research programs should not only support incremental technology improvements but must also include higher-risk, high-reward projects that stem from breakthrough ideas. Such projects, when successful, provide the step changes in technology that enable major progress. Also, they require a sustained, long-term commitment to technology-development goals, since many years of effort may be needed before benefits are realized.

Technology innovation also benefits greatly from the formation of high-performance teams to advance particular ideas. Although a creative individual is often at the center of a new idea, the complex nature of our needs usually requires formation of a full-time team to develop an idea to its potential and get it applied. Such a team needs a diversity of skills, experience, and points of view. The team may frequently include staff from both the technical and operational sides of the business and combine experienced and less-experienced staff, with less-experienced staff often providing enthusiasm and fresh perspectives that tend to invigorate the overall effort. In some cases, team engagement with external technology providers may be useful. When business needs are well understood and the capabilities of external technologies are known, creative ways may be found to match business problems with novel external technologies to produce new solutions. Productive teams of talented people have proved their value repeatedly and have advanced technology more rapidly than thought possible.

Achieving our technology-development and -application goals will also require new models for attracting, training, and developing staff. Given the magnitude of skilled-staff needs, the process must start with the nurturing of students as early as the middle-school years. We should capitalize on public interest in energy issues to acquaint young students with the highly technical nature of our business and inspire them with our challenges and goals. SPE and other industry societies offer programs to support this activity, but more education outreach efforts are needed. One such effort, called the National Math and Science Initiative (NMSI), was recently launched in the U.S. with the support of a USD 125 million commitment from ExxonMobil. It provides training and incentive programs for advanced placement (AP) and pre-AP courses that include extensive training of teachers, identification and development of "lead" teachers, and financial incentives based on academic results. NMSI will also develop a new generation of highly qualified math and science teachers by replicating the acclaimed UTeach program. Beyond the middle- and high-school levels, current engineering and science college students need active coaching from counselors to encourage them to stay enrolled in their majors and complete their degrees. University courses on innovation methods would also be beneficial, as would curriculum programs that combine education in specific disciplines with broader training in practical applications to energy-related problems.

Achieving our technology-development and -application goals will also require new models for attracting, training, and developing staff. Given the magnitude of skilled staff needs, the process must start with the nurturing of students as early as the middle school years.

Staff training and development must continue in the workplace throughout a career. This process begins by receiving mentoring from experienced staff, proceeds with training in common work flows and best practices, and continues with gaining experience through applications and interactions with others in global operations. Global functional organizations, formal training programs, and standard technology software and delivery systems can greatly benefit the transfer and application of new technology. These components can also provide a feedback and learning system that improves work practices over time. Staff need to be receptive to adapting and learning throughout their career, since technology will continue to advance, and the pace of future change is likely to continue unabated.

We are entering an exciting period of discovery and progress in the energy industry, driven by strong interest in a secure energy future and protecting the environment. Global public awareness of energy issues and challenges has never been stronger and is not expected to diminish in the foreseeable future. As a result, the industry is experiencing a significant expansion that includes new players, new energy sources, and new technologies. The challenges are numerous and large and will require major long-term investment to achieve solutions. Our industry has historically risen to meet or exceed the needs of the time and has developed the necessary technology for progress. As in the past, future success will depend on technology innovation and the contributions of talented staff to develop and apply new methods. For those involved, it will be a motivating and very rewarding experience. ❖

SPE President's Executive Summit on Talent & Technology

A Changing Dynamic: The Need for Collaboration on Talent Development and Climate Change in the E&P Industry

The twin challenges of growing demand for oil and gas globally and increasing expectations for the oil and gas industry regarding global climate change mean that significant pressures are building on the industry. While much collaboration exists within the industry on many subject areas, particularly in technology, the question is whether the new external factors require a different mode of collaboration.

Organizations need to collaborate when external factors require changes that cannot happen through normal market forces or are beyond the capacity of the individual organization. The example of an industrywide collaboration most often cited is that of the US semiconductor industry during the 1980s. Market forces caused that industry to become fragmented, and the links between academia and within the industry were broken and inefficient. Overlapping research and development were being conducted and resources were wasted in an industry that had become weakened by overseas competition. The reaction of the industry was to collaborate on an industrywide basis to align corporations, academia, and regulation to move things forward consistently. Pivotal in this was the Semiconductor Industry Association, which acted as the broker across the industry organizing collaborative efforts, initiatives to share knowledge, and a forum to engender and support the collaboration—a role it performs to this day.

Strong parallels exist between the E&P sector of the oil and gas industry of today and the US semiconductor industry of the 1980s: The market alone is unlikely to offer a solution to the pressures the industry faces, and this suggests that collaboration is required. Indeed, in the field of carbon capture and storage (CCS), much collaboration already exists between companies, academia, and government. In the area of talent management and development there is little collaboration except on a piecemeal approach, or on a bilateral basis, between particular E&P companies and particular academic institutions. Currently, no formal mechanism exists to produce an accurate forecast of aggregated global demand vs. supply of talent, nor to enable the disparate parties to exchange insights, discuss initiatives, and channel their collective energies toward the most important issues: quantity and quality of talent. Moreover, there is little coordination in the matter of industry image—making the industry appealing to young people still in high school or university and contemplating their choice of career.

It is clear that in the modern world, particularly in the western world, the choices that young people make about their careers are influenced to a great extent by the wider contribution made by the organizations they are considering joining. In particular, it is often the case that an organization's approach to climate change and how it can be mitigated is of great influence. Thus the two-pronged approach of reducing the E&P industry's direct contribution to greenhouse gas emissions and offering a wider solution to the problem of CO_2 storage could have a significant impact on the recruitment of skills into the E&P industry.

STEPS TO SECURE PETROTECHNICAL PERSONNEL THROUGH 2020

Supply and demand for petrotechnical graduates has become unbalanced in recent years. On the demand

Editor's note: *In late June, 2007 SPE President Abdul-Jaleel Al-Khalifa hosted an executive industrywide summit with 75 global leaders to advance cross-sector collaboration on two critical issues facing the oil and gas industry. Talent scarcity has been a pressing and recurring item on company agendas for several years. On the technology front, the heightened focus on climate change and greenhouse-gas (GHG) emissions from fossil fuels is expected to influence many areas including media, legislation, and policymaking. The oil and gas industry has been actively involved in various technology projects to promote carbon sequestration. The summit provided a venue to frame and boost an industry position on this critical and widely publicized subject.*

Corporate leaders from BP, Total, Baker Hughes, Norsk Hydro, and Weatherford championed the summit. Shell, Schlumberger, and Repsol also provided support and participation at the highest corporate level. The program committee was formed from technology and talent representatives of these eight companies as well as academic experts from Stanford University, Texas A&M University, and Institut Français du Pétrole (IFP). The program committee drafted a white paper to share with the attendees during the summit, which is excerpted here.

side, three factors are influencing the equation. Consistently strong crude prices and expanding E&P budgets mean established industry players need more geoscientists, drillers, and engineers to fulfill new projects. Second, there are more companies seeking talent: The expansion of national oil companies (NOCs) in recent years has introduced additional demand. Last, the age profile of the workforce in established international oil companies (IOCs) and service companies is moving inexorably toward and into retirement, creating an experience gap.

On the supply side, not enough talent, and of the requisite quality, is being produced by educational institutions around the world. In Organization for Economic Cooperation and Development (OECD) countries, notably the US and the UK, universities that previously produced hundreds of petrotechnical graduates each year cut back drastically in the 1980s and 1990s—ironically because the industry did not need their graduates in such numbers. Now, these schools are scrambling to expand program numbers to catch up with actual and projected demand. This year, total world demand for petrotechnical professionals is forecast to exceed 11,000, up nearly 300% on comparable demand a few years ago, and data suggest it will stay at these levels through 2010 at least.

Fortunately, supply is picking up fast. The latest survey of student enrollments in geology, geophysics, and petroleum engineering disciplines worldwide shows expansion of between 30 to 40% vs. 2004 levels. Between the established schools such as Texas A&M University, Colorado School of Mines, and Imperial College, London, and newer institutions in countries such as Azerbaijan, Russia, India, and Malaysia, academia is producing many more petrotechnical graduates: in total 5,000 more than they did in 2004. Not all of these young people end up in the oil and gas industry. Professions such as consulting and investment banking siphon off many graduates. But the result is forecast to be a rough equilibrium between supply and demand by 2008.

However, the industry cannot relax because a number of other factors need to be taken into account. It is expected that geosciences graduate numbers will barely match demand over the next few years; these and petroleum engineers will be subject to the lure of other industries facing talent shortages, notably the nuclear, telecommunications, defense, and high-technology sectors.

Equally important to the argument about whether the quantity is sufficient is the debate about the quality of those graduates. While additional supply is coming out of newer universities in China, India, and other Asian and African countries, many industry practitioners question the caliber of these programs and the quality of the output. Collaboration and support for new initiatives to improve quality are occurring, such as the collaboration between the IFP in France and Angola's Agostinho-Neto University, but these are small and often isolated initiatives. Moreover, the challenge of developing and deploying complex new technology will only increase in the next decade, requiring even better educated graduates.

OPPORTUNITIES TO INCREASE THE TALENT SUPPLY: OECD LOCATIONS

Two proposals are made here that offer the possibility for long- and short-term (sustainable) interventions to attract a greater number of students into oil and gas careers. Initially, these initiatives should start small but are capable of expansion.

To address the issues of image and sustainable energy, the short-term proposal requires an industry-led consortium to support collaboration with two or three top universities (in the US, UK, and in at least one other OECD country) to develop a new curriculum for future "energy professionals." While still composed of the fundamentals of either Earth science or engineering, the aim would be to create an expanded curriculum to tap into the subjects that engage the younger generation. The curriculum would include a broad-based introduction to the energy industry, including the topics that would attract a greater number and broader range of students. The course would cover alternative energy and carbon footprints/CO_2 sequestration as well as more-traditional oil- and gas-related material to ensure that graduates have the necessary core skills. Students would focus their studies down more-traditional paths in subsequent years. Interestingly, Stanford University recently changed the name of its oil and gas program to "energy resources engineering."

...the aim would be to create an expanded curriculum to tap into the subjects that engage the younger generation.

An alternative to this idea would be to create a 1-year energy engineering master's degree program. Students who have graduated from the basic petrotechnical degree courses could enroll in this master's degree program to enhance their knowledge of specific topics in the wider field of energy.

The proposal would be developed in partnership with three core universities to establish an appropriate curriculum for each region, as evidence suggests partnerships are most effective in this area when managed with more of a local or regional scope. A key element in this approach could be the opportunity for late career industry professionals to participate in the teaching faculty, while allowing university departments and students unlimited access to current industry knowledge and challenges. Once the course is established and can

provide substantive data of success, the model could be replicated in other learning institutions. It is estimated that this could happen within 5 to 7 years. Coordination and oversight would be through an industry forum, or Talent Council, which would select and monitor pilot programs, authorize funding, and maintain a watch on the overall supply position.

Substantial industry backing through both financial resources and full-time support from staff members is critical to success to mitigate expected resistance from universities and to provide incentive for change. Equally, universities may need assistance in the shape of experienced industry practitioners to "debottleneck" any shortage of teaching resources. The vision of "converting" a number of students who would otherwise choose an alternative field of study at a number of institutions has the possibility to provide a significant long-term impact providing hundreds of additional engineers and petrotechnical graduates each year.

A second, longer-term proposal could loosely be described as "building an energy engineer from scratch" and would focus on an intervention that could produce results in a 15-year-plus time frame. This approach would focus on school children from the age of 11, to begin a process that encourages them to study science. School initiatives of this nature exist today, but are largely individual company initiatives. A broader-based and collaborative model across the industry has greater potential. The program would be aimed at raising awareness of the energy industry to stimulate a greater interest in science and engineering subjects. Participating companies would provide support through dedicating members of their own in-house education/public affairs departments to assist in the design and delivery of materials, which could be coordinated by an overall sponsor such as SPE or the American Petroleum Institute. In addition to reaching the target audience, the longer-term intervention would touch many of the key influencers, such as parents and teachers, who have a significant affect on student career choices but may not have much industry knowledge and may perpetuate negative perceptions.

OPPORTUNITIES TO INCREASE THE TALENT SUPPLY: NON-OECD LOCATIONS

The opportunities in non-OECD locations can be categorized into two broad types: those nations where significant hydrocarbon deposits exist but the existing education infrastructure may be ill-equipped to generate high-quality petrotechnical graduates (e.g., Nigeria, Angola, Indonesia, and Sudan) and countries that have little or no indigenous hydrocarbons, but where exceptional energy demand is evident and educational infrastructure is more robust (e.g. India and Singapore).

Clearly, each nation has its own characteristics and unique circumstances. There may indeed be a third class of non-OECD country that does not fit either category—countries such as Venezuela and Iran, where hydrocarbons are abundant and education is good, but other issues such as language are evident, or countries such as Saudi Arabia where the issue appears to be a lack of teaching resources. Rather than attempt to categorize every single instance, this section lays out different models that could be adopted to improve both the quality and quantity of petrotechnical talent in any of these countries.

The three general models have very different implications in terms of potential cost and the level of coordination required: an offshore campus model, an offshore program, and a visiting-academic program.

The Offshore Campus Model. Best illustrated by the current initiatives of the Colorado School of Mines in Abu Dhabi and Texas A&M University in Qatar, this approach partners leading universities with host-government education departments or NOCs to create a fully equipped local campus specializing in petrotechnical degree programs. Each represents a huge investment by the host country, as well as considerable effort by the partner university. The most obvious advantages of this model are the scale and focus it brings and the sustainable infrastructure it creates in-country. These are strategic initiatives by the host nations, aimed at creating a large cadre of indigenous engineers and Earth scientists, relatively quickly.

The Offshore Program. Characterized by joint collaboration between a local university and an established petrotechnical OECD university, this process can involve either the award of a degree by both institutions or the oversight of a local program by a more experienced partner. Perhaps the best examples of this type of approach are the graduate program in petroleum engineering co-organized by IFP and Agostinho-Neto University of Luanda, and the collaboration between Stanford University and the Nanyang Technical University of Singapore on environmental engineering.

A scaled-down version of the full campus model, this approach has the advantage of bilateral focus: Two academic institutions help each other to raise standards and create new opportunities for in-situ education of local nationals. Although successful, both examples are essentially small-scale efforts and therefore may not make a material impact upon the overall supply of talent. And clearly, both programs require significant and sustained effort.

The Visiting-Academic Program. The simplest model to set up, this process requires a local university to engage a visiting academic (or possibly oil industry expert) to lecture at the host institution. Many OECD universities encourage faculty members to establish links with counterparts in non-OECD universities. Evidence of how individual companies encourage experienced practitioners to support such initiatives is harder to pinpoint. Advantages of this model include the ease

of administration, low cost, and its flexibility relative to other approaches. As a long-term intervention, capable of making a material impact on numbers, this approach has clear limitations. Equally, it does not build sustainable capability within the local institution.

Clearly, it is possible to envisage variants of these three models. But certain issues emerge, which need to be considered:

» Collaboration between industry, academia, and host governments is not simple to arrange. This implies the need for a coordinating body, capable of representing industry at least.

» For the industry to benefit collectively, any program needs to generate significant numbers of graduates. For the host institution or government to benefit, a clear transference of capability needs to occur.

Globally, best estimates indicate the industry will need in excess of 11,000 new entrants each year for the next few years.

» Sustainability of commitment and constancy of purpose—particularly among the industry collaborators—will be necessary. Money is the obvious constant, and it may prove necessary to set up structures and make covenants to fund multiyear programs. Equally, it should be possible to strike a bargain with host governments for what is, in effect, a subcontracted education initiative.

» Intervening at the university level may prove the best option in the short term. Longer term, the industry may be confronted with a need to support improvements at the high school or even junior high school level.

CONCLUSIONS

A decade ago, the consultant company McKinsey coined the now-famous phrase "the war for talent" to reflect the struggle facing organizations as they sought to secure much-needed manpower. Many observers believe the war is over, and talent has won. A combination of factors has driven the supply of petrotechnical talent downward in recent years, just as the industry began to demand many more such people. Globally, best estimates indicate the industry will need in excess of 11,000 new entrants each year for the next few years. Universities are struggling to meet this demand, and the margin for error looks very small. Longer term, we can only guess how attractive the industry will be to youngsters about to choose their career path. Can we afford to be sanguine about their choices? Evidence from the current generation suggests not: They, their parents, and society in general are increasingly concerned about the impact of hydrocarbon consumption on the world environment.

Many initiatives are under way to address both the quantity and quality of petrotechnical programs, as well as influencing young people to study engineering and science. Maybe now is the time for a new model: collaboration, on a wider scale and among more interested parties than ever before. The common interest appears clear and compelling. The common thread appears to be finding the right mechanism to engage the disparate parties in a series of industry-supported actions, perhaps through some type of Talent Council. The solution undoubtedly requires a segmented approach, using varied initiatives in different countries, targeted at different time periods. The alternative appears stark: Individual companies pursue independent but duplicative efforts and lose the advantage of scale.

THE CHALLENGE OF GLOBAL CLIMATE CHANGE

The consensus that global climate change is happening and that human emission of CO_2 and other GHGs, although low, might be a significant factor. There is wide debate about what should be done about it, but equally there is a general view held by the public at large that GHG emissions must be confronted. The E&P industry's contribution to this must be visible both for the contributions it makes and for the importance placed on it by potential recruits to the industry.

Of total CO_2 emissions, about 40% comes from power generation and a further 18% from industry in general. E&P's portion of this is about 1.5% of global CO_2 emissions. In addition, one of the E&P industry's primary "products" is methane, which acts as a GHG and escapes to the atmosphere as part of the industry's normal course of business, either deliberately (cold venting) or accidentally (through leaks).

As the industry moves to develop nonconventional oil and gas resources, the industry's carbon footprint will go up. Carbon emissions from consumption will remain the same on a like-for-like basis since the products used are largely the same, but carbon emissions from the production process will vary significantly. For example, carbon emissions from the production of oil sands or extraheavy oils are between two and three times those of conventional oils.

Carbon sequestration, or storage, is seen by many as having major potential for addressing global climate change in the medium term. The global economy currently emits approximately 26 billion tons of CO_2 each year into the atmosphere. Estimates of the total amounts of CO_2 that could be sequestered are very large: 600–1,200 billion tons in oil and gas fields, 3–200 billion tons in unmineable coal seams, and up to 1,000–10,000 billion tons in deep saline formations. This represents between 70 and 500 years of storage at current production rates and excludes deep ocean storage options and mineral carbonation.

In comparison, current CO_2 injection is tiny, amounting to about 30 million tons/yr and almost all of it associated with enhanced-oil-recovery (EOR) projects. However, the E&P industry is uniquely placed

Technique	Technology	Research Phase	Pilot Project	Economic	Mature
Geological storage	EOR			■	
	Gas/oil fields		■		
	Saline formations		■		
	Enhanced CBM recovery (ECBM)		■		
Ocean storage	Direct injection (~1 km)	■			
	Direct injection (>3 km)	■			
Mineral carbonation	Natural silicate minerals	■			
	Waste minerals		■		

Source: CRA Analysis; Carbon Sequestration Leadership Forum

Fig. 1—Maturity of carbon capture and storage technologies.

to play a key role in the sequestration of carbon because of its assets and skills base. Some of the infrastructure necessary for the transportation of captured CO_2 is already owned and operated by the industry for other purposes. Finally, the industry has almost all the available skills for analysis of subsurface structures and the techniques for accessing and managing them. This would also point to a further pull on the skills and talent resources required within the industry.

INDUSTRY RESPONSE

Although piecemeal in its approach, the industry has made significant progress in reducing its global-climate-change footprint, though much remains to be done (**Fig. 1**). It is actually difficult to compose a fact-based picture of what the E&P industry has achieved in the areas described below. There is a dearth of information that is published and shared by companies—at the very least, there is a need for collaboration around benchmarking, either on an open or a blinded basis, to show what can be achieved by organizations.

More than 150 billion m^3 of associated gas is flared or cold vented each year. That represents more than the gas requirement of the UK, 30% of the European Union's requirement, or 25% of the US gas requirements. About 400 million tons of CO_2 are emitted into the atmosphere annually (1.5 % of the total 26 billion tons for all sources). Building on a Norwegian initiative in 2001, led by the World Bank and launched at the 2002 World Summit on Sustainable Development, the Global Gas Flaring Reduction (GGFR) public/private partnership has been supported by governments of hydrocarbon-producing countries, OPEC, IOCs, and NOCs to overcome the barriers to reducing gas flaring. Best practices are shared, and country-specific flaring-reduction programs are implemented. The majority of the GGFR partners have agreed to endorse a voluntary standard to eliminate venting and reduce flaring significantly within the next 10 years. A framework is provided for all key stakeholders to consult each other's experiences and reports/follow-ups on flared-gas statistics through a Web portal.

CO_2 CAPTURE AND STORAGE

The oil and gas industry has led the implementation of the first large-scale CO_2 injection projects from

Project	Country	Project Started	Approximate Injection Rate (TCO_2/day)	Total Planned Storage to 2015 (million tonnes CO_2)	Storage Reservoir Type
Sleipner West	Norway	1996	3,000	18	Saline formation
Weyburn	Canada	2000	3,000–5,000	17	EOR
In Salah	Algeria	2004	3,000–4,000	12	Gas field
Snohvit (planned)	Norway	2007	2,000	5	Saline formation
Lacq (sanctioned)	France	2008	200–215	0.15	Depleted gas field
DF-1 Miller (Planned)	UK	2009	2,700	8	EOR
Gorgon (planned)	Australia	2010	10,000	12	Saline formation
Saskpower	Canada	2011	8,000	n/a	Saline formation
DF-2 Carson (planned)	USA	2011	10,000	16	EOR
FutureGen (planned)	USA	2012	To be determined	To be determined	To be determined
Draugen (planned)	Norway	2012	7,000	7	EOR

Fig. 2—Major CO_2 sequestration projects.

anthropogenic sources (**Fig. 2**). Three projects inject CO_2 into a variety of geologic formations, using varying amounts of CO_2. All three projects involve the long-term storage of CO_2 and extensive monitoring programs:

» Sleipner—This is a private-sector project that stores CO_2 from processed gas into the subsurface beneath the North Sea in Norway. The lead operator for the project is Statoil, in association with Esso Norge, Norsk Hydro, and TotalFinaElf Exploration Norge. The project began injecting CO_2 in 1996. Sleipner was the first industrial-scale CO_2 storage project in the world, and the operators have established extensive monitoring procedures,including models to predict long-term movement of CO_2.

» Weyburn—In May 1999, PanCanadian Resources (now EnCana) broke ground at the Weyburn EOR project in southeastern Saskatchewan, Canada. This EOR project takes approximately 5,000 tons/day of CO_2 from a coal gasification plant in North Dakota in the US and uses it to recover incremental oil. A pipeline transports the CO_2. The first CO_2 was injected in 2001. At the conclusion of the project, 19 million tons of CO_2 will have been sequestered.

» In Salah—In Salah Gas is a gas-development project in central Algeria that was designed to test the commercial viability of CO_2 storage as a CO_2 mitigation option. It is a joint venture involving BP, the Algerian NOC Sonatrach, and Statoil. The project began in 2004 and involves the injection of up to 4,000 tons/day of CO_2. The project includes a facility that removes CO_2 from the natural gas produced from the field followed by the reinjection of the CO_2 into the aquifer that underlies a gas reservoir, with a planned total storage of 17 million tons of CO_2.

Collaboration needs to be inclusive and involve IOCs, NOCs, service companies, academia, and regulators.

Other major projects that will be operational in 2007–08 are the Norwegian Snohvit, with a capacity of 0.7 million tons CO_2/year, and Gorgon in Australia with approximately 2.7 million tons/year.

The oil and gas industry can help the acceleration of the CCS technology uptake by

» Sharing best practices to be used for site assessment.

» Leading the measurement, monitoring, and verification of CO_2 injection. Technologies required (e.g., time-lapse seismic, wellbore monitoring, reservoir simulation) are widely used in industry and require limited adaptation for CO_2.

» Contributing to improved risk-management practices. Development of wellbore isolation and wellbore surveillance for the injection of potentially corrosive fluids is within the capabilities of the oil and gas service industry.

» Participating in communications and outreach efforts along with other stakeholders.

POSSIBLE WAYS FORWARD

Given the themes and analysis that have come out of the work developed for this paper, there are a number of areas in which the E&P industry can move the overall collaboration agenda forward in the fields of talent and technology. It should be noted that collaboration needs to be inclusive and involve IOCs, NOCs, service companies, academia, and regulators. Recommendations include

1. Establish an industry Talent Council, and focus on the actions described in the white paper to improve quality and quantity of graduate supply, together with the long-term image of the industry.
2. Encourage increased EOR activity on existing fields by improving the fiscal terms for such projects. An economic study led and supported by SPE and involving both operators and governments could identify current successes where both operators and governments benefit. This study would also identify areas where EOR is restrained by current fiscal arrangements and provide positive examples to encourage local application of such schemes to benefit both the host government and operator as well as increasing reservoir recovery.
3. The oil and gas industry is ideally positioned to provide key expertise for the storage component of CCS. Cooperation with international organizations is recommended.
4. Oil and gas companies, the service sector, and academia could create and fund a task force with participation from other organizations related to the development of CCS. Potential actions would include developing industry guidelines for storage-site assessment and site monitoring, establishing methodologies for environmental-impact analysis, organizing joint technical conferences on CCS, and creating databases of CCS projects.

SPE has a particular role to play, which is an extension of its existing role. This would have the benefit of

» Showing the industry acting as one, independent of individual company actions.

» Acting to connect its membership to the overall industry agenda on climate change.

» Acting as a clearinghouse for best practices in the way it already works through its papers and conferences.

It is therefore recommended that SPE extend its remit to include the effects of GHG emissions on the role of the industry in both the technology and socioeconomic arenas. It is also recommended that SPE become better connected to the industry in the way that it is connected to its membership. It is suggested that an advisory board be established for SPE leadership, which sits on a long-term basis to act as a connection between industry players and SPE. ❖

Quantifying the Workforce Crisis in Upstream Oil and Gas

By Christine A. Resler
Director of Mergers, Aquisitions, and New Ventures
Smith International

Demand for oil is rising; the time it takes for a well to reach its peak production levels has decreased from 8 years to 2 years, and the price of oil just keeps rising. All of this means that the number of wells being drilled or worked over is increasing, yet the number of experienced employees in the oil industry keeps decreasing. In fact, the Independent Petroleum Association of America estimates that 40% of the industry's skilled professionals will reach retirement age by 2010. The lack of experienced employees has reached crisis levels.

To be certain, the shortage of experienced talent is the biggest issue in the oil patch today **(Fig. 1)**. While demand for technical and service professionals has increased, the quantity of qualified people is actually decreasing. More than one-third of the technical workforce is over the age of 50, and the American Association of Petroleum Geologists reports a 70% decline in enrollment in programs related to geosciences since the 1980s. The oil field is technical, which typically attracts young talent, yet only 27% of the oil and gas workforce is 20 to 40 years of age, compared to 59% in corresponding technical fields, such as the software industry.

There has been very little written or researched on the financial impact of this workforce shortage, until now. Recently, Boyden, a global executive search firm, in conjunction with the C.T. Bauer College of Business' Applied Strategic Program and the Global Energy Management Institute at the University of Houston, captured the economic impact of the industry's workforce shortage in the study "The Workforce Crisis in the Upstream Oil and Gas Sector."

Most notably, the study reports that the sector's talent shortage cost the industry more than USD 5 billion in pretax profits in 2006. Although it required a number of assumptions, at a minimum this analysis helps to shed some light on the magnitude of the financial impact and its components. The framework for this analysis can be a guide to quantifying the impact in your own organization.

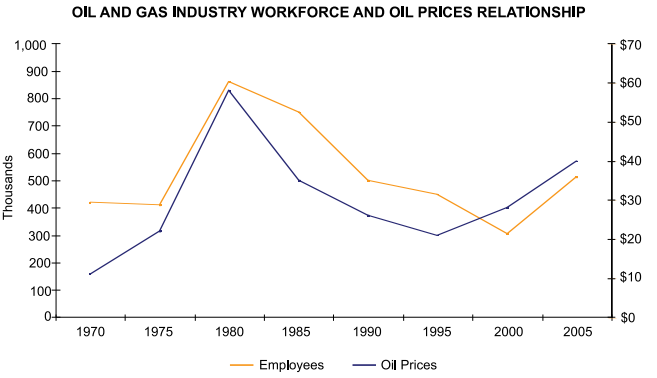


Fig. 1—Industry employment trends have generally followed the trajectory of oil prices.

The study separates the impact into three categories: direct employee costs, lost profits because of the lack of employees, and the strategic opportunity cost to the integrated oil companies and the oilfield service companies.

DIRECT EMPLOYEE COSTS

Direct employee costs include hiring and replacement, training, and lost productivity of new employees, as well as recent changes in overall employment as a result of the talent shortage. The employment market, just like any other, is based on supply and demand. When the demand goes up and the supply either stays flat or decreases, prices increase. The workforce crisis affects these costs through two mechanisms: an overall increase in excess demand for talent and an environment of talent poaching among firms. The positions often targeted by talent poachers are petroleum engineers, petroleum geologists, field engineers, and drillers.

The average compensation increase was 25–30% for technical staff in 2006 and up to 60% for highly sought-after knowledge such as completion engineers. Survey respondents indicated that 2006 increased

retention and replacement by 20%. Considering these statistics, it is estimated that direct employment costs increased to more than USD 2.2 billion in 2006 and will climb even higher in 2007. To try to retain experienced professionals, firms have various medium- and long-term incentive strategies to act as "velvet handcuffs." Companies have responded by using selective premiums such as larger salary increases, increased bonuses, equity, and long-term bonuses for highly valued jobs. Across the board, there has been an increase in bonus compensation and salary increases in many companies.

LOST PROFITS FROM LABOR SHORTAGES

The cost to employ these scarce resources is just the tip of the iceberg. Based on three different approaches, it is estimated that lost pretax profits were USD 2–3 billion in 2006.

To validate this calculation, the study used three approaches. First, it incorporated survey respondents' feedback on understaffing coupled with industry standard profit margins and workforce size. The results of this approach were USD 3.6 billion in 2006. The second approach was based on how employee shortages impact project delays. This was estimated to be USD 2.1 billion. A third approach was derived from independent Wall Street equity analysts, who estimate that decreased profits from operational inefficiencies were USD 1.5–3 billion. Based on the various approaches and their ranges, a conservative trend of USD 2–3 billion emerged.

The shortage of qualified employees has forced the industry to resort to alternative recruitment practices such as the use of contractors, consultants, and outside vendors. While these strategies yield favorable results in the short term, they are not sustainable and may hurt the industry in the long run. It is a common trend in the energy sector for executives to retire but stay on as consultants at a higher hourly rate than they earned at retirement. This trend will continue for some time as the industry continues to age.

STRATEGIC OPPORTUNITY COST

Strategic opportunity cost is almost impossible to quantify, but easy to identify when walking the halls of any oilfield service company or integrated producer. It is the lost opportunity from not implementing a savings plan or a new manufacturing process. Our survey responses helped us to compile some insightful results.

Most survey participants indicated that a significant concern was the lack of oilfield executives with experience outside the sector. Less than 10% of energy executives have experience outside the oil patch, compared with 40% for executives with experience outside the industry. While the upstream oil and gas sector has unique challenges that may only be understood by someone with enough experience facing them, it must also be true that the industry can benefit from leadership skills garnered outside the industry as well.

In conclusion, we have attempted a first pass at quantifying the impact of the current workforce crisis on the industry as a whole. Our conservative estimate is a total cost plus loss of more than USD 5 billion in 2006 alone. While this figure may seem relatively small when compared to the total operating costs of the industry, it must be noted we have not seen the full brunt of this crisis. The next decade will see a mass exodus of talent from the industry.

Given the inevitability of growing geopolitical risks and the uncertainty of future supply and demand, a crisis of the industry's own making is a risk it cannot afford. The time to act to quell this risk is now. ❖

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Leveraging Innovative Design Capabilities Through Open Innovation

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Innovation long has been considered separatee and competitive. Punctual success was seen as a means for one particular company to get a (temporary) competitive advantage. In this context, collaboration was not excluded but was confined to safety, quality improvement, and mere coordination. It fell to professional societies, such as SPE, to support knowledge exchanges, ranging from standardization to the diffusion of professional practices through skills communities, networks, handbooks, and journals. Innovation and collaboration appeared contradictory.

Today, however, companies and professional societies are striving for collaborative innovation. Contemporary industrial challenges require taking into account a lot of constraints from various and occasionally new partners, to share competences and common purposes at the industry level, to redesign the value chain, and to acquire external competences. But this "open innovation" raises contradictory issues: Who should be involved, and how? Is the widest network the better? What is confidential? How should one deal with property rights? How should one write a contract on unknown activities and competences? How can people collaborate when there is no known shared value? What is the room left for competition?

This article attempts to clarify these issues. Based on a deep understanding of collective innovative-design reasoning (Hatchuel and Weil 2003), it distinguishes two contrasted forms of collaborations: collaborative road mapping and collaborative exploration, each with different types of activities, organizational principles, objectives, and management tools. It also paves the way to a possible expansion of SPE activities.

COLLABORATIVE ROAD-MAPPING

Recent evolutions in the oil industry have led companies to shift industrywide collaborations from traditional low-speed standardization *following* innovation to

collaborative road mapping to maintain growth and prosperity. This involves higher, repeatedly increased performance (e.g., deeper, higher-pressure, and higher-temperature wells), new constraints (e.g., the environment), new technologies requiring the coordination of several partners on the value chain, wide diffusion of new competences, and tough compromises involving several stakeholders. All these trends imply finer and repeatedly revised mutual adjustment of the oil industry players.

The challenges and advantages of such collaboration can be characterized by analyzing the type of design reasoning involved in such processes. There is a clear

Recent evolutions in the oil industry have led companies to shift industrywide collaborations from traditional low-speed standardization *following* innovation to collaborative road mapping to maintain growth and prosperity.

performance, known and shared at the industry level, and the competencies involved are identified from the beginning. The design reasoning consists mainly of *optimizing* this performance on a broader and more complex field of constraints—the longer the list of constraints, the weaker the risks. This optimization leads to the identification of one single road map shared at the industry level, based on a stable definition of technologies and performances. In cognitive science, this corresponds to a stable ontology, a data model including entity classes and properties used by R&D to design new products, processes, and services.

This collaboration helps to build a broader set of rules (finer, deeper, wider ontology) and, hence, helps each company and the industry at large to reach a better optimum (higher value, lower risk, lower costs). In particular, this road-mapping activity helps to establish clear functional requirements to suppliers at each level of the value chain. By clarifying and sharing relevant goals and competences, it supports the entrance of (competitive) new suppliers; by coordinating technology development choices, it helps to secure a large enough customer base for a small number of well-identified new technologies so that it favors investment. There is a clear area for competition, companies trying to meet roadmap milestones earlier, at lower cost, with better performance and quality level.

One famous example of such a road-mapping activity can be found in the semiconductor industry. This industry has drawn a two-digit growth rate for several decades based in particular on the International Technology Roadmap for the Semiconductor Industry (ITRS). The ITRS consortium supports joint efforts of the main semiconductor manufacturers and their suppliers to follow the famous Moore's law, pacing industry performance (double the number of transistors on a chip every 18 months) and driving and coordinating R&D activities.

Many SPE activities contribute to a "Moore-like" road-mapping. Some forums (on topics such as mud operations) appear as initiatives to build a common road map on a shared industrial issue. Others sound more like a collaborative design of experiments, sharing experience costs to get a good optimum (e.g., sessions on improved oil recovery fluids). Other initiatives consist of exchanging the results of field trials on a widely shared issue (e.g., second-stage field development).

These SPE activities are widely recognized and appreciated in the oil industry. Clarifying the expected outputs of collaborative road-mapping, and their value for participating companies, could strengthen SPE and lead to a more intensive involvement of high-level experts. This analysis suggests improving these activities in three ways:

» Organize the identification of "holes" in an industrial road map. Identify orphan issues, missing partners in a working group, missing expertise in a road-mapping team (e.g., a team focusing on technical aspects but unable to involve business aspects), or a missing time horizon in a road map (e.g., a too short-term oriented road map or, conversely, a road map built only on a long-term scenario).

» Organize a regular update of road-mapping to follow increasingly demanding exploitation conditions.

» Provide the working groups with new tools to enable a more accurate and flexible ontology building process (such as wiki, open source, or open data).

COLLABORATIVE EXPLORATION

This road-mapping collaboration is demanding and challenging. But it can be based on firm ground: there is a clear known and shared value to drive and organize collaboration, and people and competences to be involved can be identified in advance. However, new issues in the oil industry are today requiring paradoxical types of collaborations in which the common interest and collaborating members are not known at the beginning! Competition through intensive innovation actually leads companies to launch explorations on *emerging* value and competencies potential (i.e., *without* justified value and proven feasibility at the beginning). "CO_2 storage" or "70% recovery" are examples of such exploratory situations in which value has to be structured, built, and clarified during the design process and where the required competencies are unknown at the beginning. To explore potential businesses far from their core business, with customers of their customers

or suppliers of their suppliers, with end users, with new technology providers, even outside of the oil industry, companies need to collaborate, however difficult and counterintuitive it might appear (Segrestin 2005).

Some initiatives already exist in SPE, as is exemplified by meetings and technical sections on the issues mentioned above. This challenge also appears in other industries: ITRS was a striking example of collaborative road-mapping, but this advanced industry collaboration to maintain growth and prosperity is at its limits today. Although it is widespread, collaborative exploration is in need of better practices. How could SPE contribute to it?

Theoretically speaking, these situations require *innovative design reasoning,* with value and competence expansion (Hatcheul et al. 2005). Whereas rule-based design depends on a given ontology, innovative design provokes crises of existing ontologies and leads to the creation of new ones (du Castel and Mao 2006). This innovative process is based on several learning phases (prototypes, trials, demonstrations, use analyses, modeling, or, generally speaking, design spaces). All design spaces contribute to shape an overall design strategy. Far from trial and error, this cumulative process creates step-by-step businesses and their related competencies (Hatchuel et al. 2005). A "good" design strategy consists of several *varied, original* alternatives, taking into account *value* and *robustness* criteria.

This theoretical perspective helps to characterize what is expected from SPE collaborative exploration. Whereas collaborative road-mapping aims at maximizing value and minimizing risk, collaborative innovative design aims at *creating* value and *identifying* risks. Collaborative road-mapping consequently encompasses as many partners as possible, whereas collaborative exploration will *progressively aggregate interested partners* depending on the emerging design strategy (emergence of values and risks). Collaborative road-mapping aims at minimizing collective costs, whereas collaborative innovative design *enhances the reuse of knowledge* gained at each step. Collaborative road-mapping organizes the framework of competition, whereas collaborative innovative design *opens new businesses* for future competition.

These theoretical clarifications are likely to enhance SPE activities that are already close to collaborative exploration. It also paves the way for several types of actions:

» Publicize the emerging design strategy to rouse new partners (in particular small and medium enterprises, and companies and research laboratories outside of the oil industry), and prevent the already-done explorations from being lost if the first exploration teams are not interested anymore.

» Make design spaces available that companies alone could not organize. This can take the form of "moon landing projects" (i.e., projects without credible commercial objectives but with promising learning opportunities), or the form of "ontology breaking contests" to make original alternatives appear, or simply the form of demonstrators' promotion.

» Provide tool kits for collaborative innovative design. This can be contract templates to facilitate contractual phases (otherwise complex and full of traps), or innovative design quality criteria, or methods (such as innovative design workshops).

» Enabling financial flexibility by brokering design strategies to raise funds and new partners (e.g., venture capital, corporate venture).

To conclude, an SPE member company dealing with an innovation issue could tomorrow launch two contrasted SPE initiatives in parallel: a collaborative road-mapping initiative to find a satisfying solution with known, given technologies and values, and a collaborative exploration with a small group of potentially interested partners to explore new values and technology potentials. All the SPE explorations would simultaneously strengthen a stable, regularly growing business and the creation of new businesses. ❖

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Bridging the Age Gap

By Cathy Young
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As the more skilled engineering and other professionals in the oil and gas industry approach retirement, the call is going out to develop strategies to keep them engaged in flexible work arrangements and to re-recruit individuals who left the industry in previous years. The plan is to invite them back as an expert resource to assist in the recruitment, training, and mentoring of young professionals, upon whose recruitment and retention the successful future of the industry depends.

If there is one thing the industry agrees upon it is the need to extensively recruit both graduate and experienced hires. In addition, companies are also implementing training and development programs that will fast track new recruits into fully operational employees.

The transfer of knowledge and skills from the experienced generation to new college graduates requires organizational commitment, strong development and coaching programs, and sophisticated training capabilities. However, theory is one thing and practice another. In a recent study highlighting industry resource constraints, Booz Allen Hamilton notes that, "With little slack in the system, senior employees are

driven to deliver through to retirement, with ever less time to transfer their knowledge. … As overstretched companies are forced to do more with less, on-the-job training, mentoring, and coaching have virtually become a thing of the past. … Managers explained the challenge of giving staff development the appropriate time and attention when 'permanently in operational crisis mode.' " This is hardly the kind of environment conducive to empowering Generation Y and fast tracking their development to operational autonomy.

Cathy Clonts, whose online portal AlumniInTouch.com hosts a number of oil and gas industry alumni communities, sees an opportunity for retired and former industry professionals to play a continuing role in the oil and gas industry. "In our communities, we have several hundred individuals who have indicated their interest in training new recruits, coaching and mentoring, doing technical work, and sharing knowledge," she said. "There exists a ready and easily contactable pool of seasoned industry professionals who are willing to support the hiring and retaining of young talent and support their entry into the industry." Members of the service indicate their availability for short-term and permanent opportunities in consulting and project work, training, mentoring, and interim management. "Our objective is to broaden the pool of resources by targeting individuals who left the industry and might not have considered opportunities for returning. This includes individuals who took a career break for family reasons, individuals who left the industry in downturns or following acquisitions, and those who took early retirement. Many individuals are financially secure, but as they are in their early 50s, they find they want the intellectual stimulation offered by returning to the industry," Clonts said.

Our objective is to broaden the pool of resources by targeting individuals who left the industry and might not have considered opportunities for returning.

Those with critical knowledge and skills are a precious resource deserving of investment and consideration post-departure. Evidence suggests that critical industry knowledge stays current even up to 10 years after leaving the industry, which leaves one giant pool of talent from which to draw.

Joe Ross, a former project manager, said he used personal contacts to fill key short-term roles while resourcing projects but found this a cumbersome process. He believes companies increasingly use portals that list company alumni. "This additional powerful recruitment channel for good staff will enable earlier or more certain project completions, and of better quality," he said.

Long-time SPE member Shaun Hoolahan exemplifies the newly defined retiree. "Before making the decision to retire myself, I conducted a survey of former associates to determine how leaving the industry had affected their lives. Based on their responses, retirement is like a three-legged stool comprised of being financially ready, physically ready, and psychologically ready. Without all three legs, the stool will topple," he said. "For many people, it appeared the third leg was missing, and as a result, they have since re-entered the workforce as either full- or part-time employees or consultants. Rather than waiting for the stool to topple, I decided to form my own consultancy business straight away." As a consultant, Hoolahan travels from home about a third of the year teaching subsurface engineering to new recruits. "Apart from my wife having to be a single parent when I am traveling, the flexibility of being a consultant provides the perfect work/life balance for me," he said. "I thoroughly enjoy sharing my experience and imparting my knowledge to the next generation."

20–30%
Attrition rates for young hires (more than double that of experienced hires)

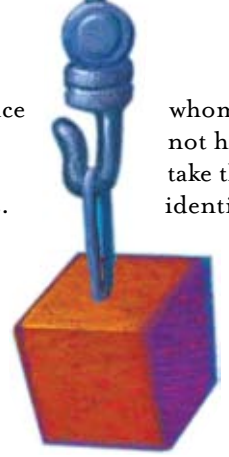
A DIFFERENT APPROACH

To support the training and development of new hires, companies have instituted several programs for graduate and experienced hires. But whether it is the sheer numbers or the differing psyches of the generations, it appears these programs are not all hitting the spot. Attrition rates for young hires are more than double that of experienced hires, as high as 20–30%. Clearly, something more is needed.

Tina Berger, President of Obsidian Technical Communications, a petrochemical consulting company, believes members of Generation Y are very different from the exiting baby boomers. She believes new technology can play a bigger part in training younger professionals, who accept instant messaging and audio and video content as an integral part of life. Most will have experienced online learning in some form while at college, and the path is open for company Web-based training that blends audio, video, and animation in an interactive and appealing format. It is important for companies to realize that these differing training methods are no longer considered inferior. Sometimes, a short animation of a drilling-tool function can be a quicker and more efficient way to share information than a lecturer with a stick of chalk and a board.

While mentors and their recipients were traditionally at the same site, online technology has the potential to transform these relationships. With webcams, Skype, laptops, and palm pilots,

communication has never been easier, and distance is not a barrier to relationship development. Technology advancement enables shorter periods away from the job and tailored training programs. It also affords regular contact with a mentor who may live in a different time zone. The mentor provides a clear path to industry knowledge and skills development as well as the one-on-one relationship craved by young professionals. All these elements are critical in bringing down the unacceptably high attrition rates that are currently undermining the industry's best recruitment efforts.



THE IMPORTANCE OF MENTORING

In the struggle to hire and retain staff, the concept of mentoring itself is being considered more broadly, co-location aside. A mentoring relationship can be a single, long-term relationship; peer to peer across different disciplines; or it may be a series of short-term relationships. Even "speed" mentoring can be useful.

A mentoring relationship can be a single, long-term relationship; peer to peer across different disciplines; or it may be a series of short-term relationships.

"Upon joining BP, I was formally assigned a mentor and this was very helpful," said SPE member Meriem Mokrani. "I found the role of a mentor in my development so useful that I have since asked a number of people to be my mentors as I determined areas where their support, experiences, and network would support my professional growth.

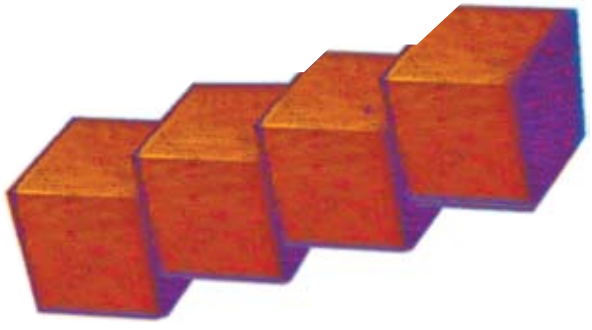
"I define the criteria of a good mentor as inspirational, available, open-minded, and well-networked. Also, a good mentor is someone I feel comfortable talking to confidentially," Mokrani said. "I have always had very positive responses from individuals whom I have asked to be my mentors. These roles do not have to be long term, and I encourage others to take the initiative to approach someone whom they identify as able to positively impact their learning and performance and ask them to serve as a mentor.

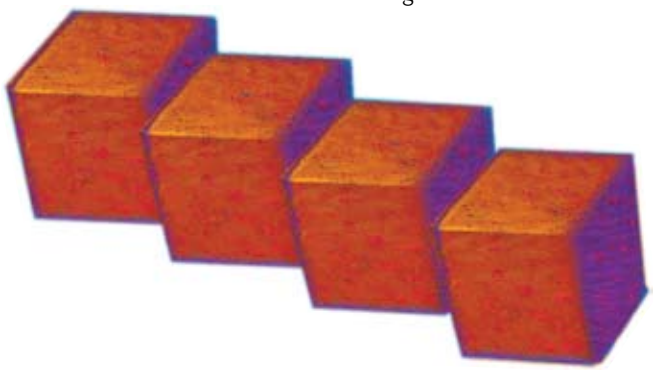
"Conversely, I mentored a summer intern, and when he joined BP full-time, he asked me to be his mentor and we have continued our relationship. I also informally mentor several young professionals. Being a mentor allows me to grow, as it makes me reflect on how to deal with diverse issues and challenges and adopt different perspectives to give good career advice."

But what of intergenerational conflict? The old not understanding the young is as much a part of human experience as breathing. If retirees and employees who are near retirement are to play a greater role in mentoring, knowledge exchange, and training of the incoming workforce, then respect for the experienced generation and understanding the needs and drivers of the younger people entering the industry are essential to the process.

Looking at another industry, perhaps the oil and gas industry can learn another tactic. Procter and Gamble was among the first to institute "reverse mentoring," in which senior managers sought mentors from within the junior ranks of the organization. The idea being that those in their 40s, 50s, and beyond are no longer in touch with the future in the same way that the 20-somethings are. The younger generation has a much stronger link to the technology of the future together with fresh eyes and open minds. Engaging in reverse mentoring offers an opportunity to gain technical expertise and a different perspective. Reverse mentoring for career industry professionals by newer recruits, on a peer-to-peer basis, might extend their desire to remain in the workforce. It would certainly help to foster respect and understanding on both sides of the generation gap.

Innovative recruiting, flexible work opportunities, and mentoring programs clearly have roles to play in meeting future business needs. Creative use of these opportunities may well provide the edge to effectively prepare incoming engineering and oil and gas recruits for the realities of the industry, meet their training needs, cut attrition rates, and contribute to greater workplace equity through intergenerational understanding. ❖





Interview: *John Doran*

Chief Executive Officer, ROC Oil Company

By John Donnelly
T&T Editor

***JOHN DORAN** is chief executive officer (CEO) and the founder of ROC Oil Company. He has more than 30 years of experience in international oil and gas exploration and production, including direct involvement in several corporate expansions, commercial discoveries, and developments in Europe, Africa, the Middle East, and Australia.*

After earning a BSc degree in geology at Leicester University, an MSc degree at Sheffield University, and a PhD degree at Trinity College, Dublin, Doran worked for a number of large multinational E&P companies in Ireland, Libya, Iran, and Norway. Since 1980, he has been based in Australia, initially as Exploration Manager for Sydney Oil, a small Australian independent, before becoming Regional Vice President for the mid-sized US independent CMS Nomeco. In 1987, Doran initiated and managed the effective public listing of Nomeco's Australian exploration assets through a merger with Australian-listed Command Petroleum. As part of this corporate reorganization, Doran became Managing Director of Command Petroleum and held that position until 1996 when he managed the sale of Command to UK's Cairn Energy. Immediately following the sale of Command, Doran established ROC Oil and has held the position of CEO since that time.

Discoveries and developments that Doran has been involved with directly include the supergiant Troll gas field in the Norwegian North Sea; the TAWN field complex, onshore New Zealand; the South East Gobe field in the highlands of Papua New Guinea; the Ravva oil and gas field in the Bay of Bengal, offshore India; the Saltfleetby gas field, onshore UK; the Chinguetti oil field, deepwater offshore Mauritania; and various fields both onshore and offshore Australia, including the Cliff Head oil field in the offshore Perth Basin.

How has your company evolved in its first decade of existence?

Reasonably well. However, that does not really mean a lot in the current climate. Almost everybody in the oil and gas sector could say the same thing. You would have to have been very unlucky not to have done well during the last several years of strong oil prices and positive market sentiment. Over the last 10 years, ROC has gone from a blank page—no assets, no revenue, no employees, no partners, no projects, and no value—to one of Australia's top four or five nondiversified, publicly listed oil companies in terms of oil production and market capitalization, with the former sitting around 10,000 BOPD and the latter around A 1 billion. We also have established an extensive international operating capability. Importantly, the company's workforce growth has reflected its corporate evolution. We now find ourselves with close to 300 employees and long-term consultants representing 21 different nationalities collectively speaking 33 languages and regional dialects. That is one of the reasons why we regard ourselves as an international company.

What is the company's short- to medium-term strategy?

Our strategy, established on Day One, has never changed: ROC is *"sensibly contrary."* We look at what is

there—and try to see what will be. Our particular focus is on unloved/overlooked/challenging assets the merits of which, for whatever reason, may not be immediately obvious to other industry players. We fully realize that if we were simply contrary for the sake of it, the odds would be too heavily stacked against us. Equally, it is true that if we walked the same side of the street as the rest of the industry, we will never succeed because, among other things, our checkbook is a lot smaller than many.

In what geographic areas will you be concentrating in the near term?

Africa, Australia, and Asia. We have worked hard to construct a diverse portfolio. When we first started, that factor worked against us. Some investors thought that diversity was synonymous with lack of focus. The reason we do not seem to be facing that misperception any more is not because we have fine-focused our geographical spread as much as the fact that, in most cases, the countries where we are active are places where we have been for 5 to 10 years. Perhaps, that long-term doggedness gives people comfort that while ROC's portfolio may be wide-ranging geographically it is not the product of a transient, scatter-gun approach. A major advantage of our broad-based portfolio is that we do not need to go outside our core regions for further opportunities—unless they are spectacularly compelling—which is why we see our future as being in Africa, Australia, and Asia.

How is ROC facing the talent shortage in the industry?

While we have to acknowledge that there is a shortage of expertise in the industry, ROC seems to be going through a bit of a purple patch in terms of retaining and recruiting employees. That is not to say that we are in any way complacent about this issue—quite the contrary. When we look down through our operations at the myriad of contracting companies that we work with on our various operations in different parts of the world, the challenge of recruiting and retaining the best and the brightest at the sharp end of the business cannot be ignored. We respond to the challenge in a variety of ways ranging from tangible benefits, such as an employee share option plan that extends to every employee, to managing softer issues, such as establishing a corporate culture that seems to have strong appeal to the type of person we seek to recruit.

How does a company of your size compete with larger operators for talent?

We do not. It is not a matter of competing, as much as providing an alternative corporate environment that appeals to certain personality types. Our recent expansion into China has had many positive knock-on effects, not the least of which is a newfound ability to offer people some sort of international career path, which is unusual for a small independent, although it is a long way from what major oil companies can provide. A key corporate environmental difference is that we try to remove as many layers of people as possible between the individual charged with coming up with an idea and the implementation of that idea. Some people, a lot of people, in fact, like that. We have also done our best to create a corporate culture which does not appeal to people who are into corporate politics or are high-maintenance personnel. In fact, we have been known to state in our job adverts that *"office politicians and prima donnas need not apply."* Depending on who you talk to, that attempt at "truth in advertising" worked a treat or, as one would-be comedian said, *"Is that because you have already got enough office politicians and prima donnas?"*

What kind of retention program does your company have?

I think our most effective retention scheme is that we try to treat everybody with total respect, regardless of their position in the company. I think most people make their career choices with reference to a triangle with the three points of the company, location, and project—assuming, of course, that their remuneration is competitive. Exactly where individuals place themselves within that triangle varies, but our experience is that if you are a feisty, proactive, independent oil company with flat management, based in Sydney, working on various interesting projects, generally as operator, in fascinating parts of the world, then there is a bunch of people out there who are happy to come on board. The companywide application of the share option plan I mentioned earlier means that, to the best of our knowledge, we were the first foreign oil company to provide a slice of corporate ownership to all locally hired employees in China.

Finally, we have always worked very hard to bring in new people to ensure that the corporate gene pool does not become stale. That cross-fertilization can create a stimulating corporate environment. For example, of the nine senior managers who report directly to me, four have been with the company for less than 15 months. That is great because they have been able to bring their own network and past experiences to bear on what we are doing. That widening of the gene pool is particularly important when you move from a one-man office to where ROC is today.

For your operations in such diverse areas in China and Africa, do you hire primarily locals? If so, what is your training program and what are the challenges there?

We do hire mainly locals. That is a good example of parallel agendas with the relevant government agencies with which we work, a common goal that makes sense to everyone. In some ways, to be blunt, it can be difficult to discharge our full corporate responsibility in a formal training sense because everybody is so busy with the day-to-day stuff. That may be one of the bigger

distinguishing features between a small, hyperactive oil company that is forever being faced with daily challenges and a major oil company that can provide more structured training through courses and seminars, although, of course, people in ROC do attend professional development courses. It is just that they are not as prominent within the company as they are within larger entities. However, in terms of on-the-job training, I think there are lots of people within ROC—including local hires—who are on a very steep learning curve that is, arguably, one of the best forms of training.

How many of your employees in China, your largest presence, are native Chinese? What particular challenges have you faced with employing a workforce in China?
Employee-wise, China is our center of gravity with about 100 ethnic Chinese making up about 30% of the worldwide workforce, the largest single ethnic group within ROC. Quite frankly, we have been very lucky in that regard. Although we have been dealing with Chinese energy companies since the late 1990s, when we came to establish a discreet presence in China in 2002, we did it through a farm-in whereby we acquired a small group of employees and secondees who have turned out to be excellent. Then, in 2006, when ROC acquired Apache China, the size of the company doubled overnight. Literally, with one or two exceptions, the Apache China workforce of approximately 100 employees and secondees decided to join ROC and remain with the operation. In that sense, we have been very lucky. ROC's current workforce in China was, to a large extent, acquired in a pre-packaged form as far as the local employees are concerned and that probably explains why we have not had any serious challenges in that regard.

Most of your staff is between the ages of 25 and 40. Is this unusual for oil industry firms in Australia? What do younger workers find attractive about working for your company?
Yes, it is unusual. If we had had this conversation a few years ago, most of the staff would have been between 40 and 50. Because we have retained almost all of those people, the present age mix within ROC is all the more remarkable. However, as with all statistics, there is background information that needs to be emphasized in case the results are taken out of context. Many of our overseas employees are in support positions and are younger than, say, the guys who joined ROC in Sydney at the outset 10 years ago after they had chalked up 20 or more years' experience with major companies. Therefore, although our age demographic may make ROC a little unusual, it largely reflects our international personnel make-up, which, in turn, reflects the fact that of the dedicated, nondiversified, publicly listed oil companies in Australia, ROC, relative to its corporate size, is the most internationally active and geographically widespread.

How many of these younger workers will stay with your company, or do you face the fact that many of them will move on and you will replenish them with new workers?
Staff will always be mobile. There are a host of reasons for that. Fortunately, as I said, we have not suffered much because we have been blessed with a largely stable core workforce. You have got to take the view that the most important entity in these hire-retain situations is the employee, not the company. That is because companies are inanimate: They have neither a body to kick, nor soul to lose. Therefore, if a company makes a mistake by hiring the wrong person, it does suffer some damage but it is usually only of a bruising nature and corporate life will always roll on regardless. With an individual it is different. A wrong career decision—joining the wrong company or staying with a company too long—can have a profound effect on that person's well-being and future career path. Even though you cannot predict how many people will stay with the company for a long time, our experience is that with this approach to recruitment and retention, it seems that few choose to leave and many decide to join. This outlook may also explain why I cannot recall any occasion when I have not been genuinely happy for those few people who chose to move on because they were moving to something—a company, a project, or a lifestyle—that ROC, at that particular point in time, was not able to provide.

What is the oil and gas industry's image in Australia?
That is a difficult question. Most of the guys like me have been in the industry for too long to give an objective answer. When I try to look at it from a distance, it seems that the industry suffers from the same old misperceptions: It is viewed as being an unpopular environmental villain that is full of companies that are big and arrogant—an image not helped by the fact that people do not like paying high prices at the petrol station. Ironically, there is not a single nondiversified, publicly listed company on the Australian stock market—including Woodside and Santos—that is not pretty small when viewed with a global perspective, while the majority of such companies, including ROC, are absolutely tiny when seen in that context. Certainly, there is not an oil company in Australia that has any reason to be arrogant. ❖

Can the Petroleum Industry Attract and Engage Gen Y?

Bruce Bullock
Director
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The petroleum industry's current shortage of people and the demographic challenges it faces given its older workforce are well known and well documented. The cyclicality, consolidation, and previous downturns in the industry have resulted in an industry with a shortage of people overall and a critical shortage of middle managers in position to succeed aging baby boomers on the senior leadership teams. As Generation Y (or Gen Y) enters the workforce, the industry's challenges have become even more critical. The industry is faced with recruiting a generation of people that is unfamiliar to older baby-boomer managers. Can the industry refresh its talent pool with this up-and-coming generation? It must—the stakes have never been higher.

Gen Y reveals a group of people... driven by different values, different life experiences, and very high expectations.

A look at Gen Y reveals a group of people, nearly as large as the baby boomers, but driven by different values, different life experiences, and very high expectations. Gen Y encompasses those born from the late 1970s through the turn of the century. According to *Business Week* magazine, this group is nearly 80 million strong in the US alone with 1 in 3 non-Caucasian, 1 in 4 from single-parent households, and 3 in 4 from households with both parents working.

A day on a college campus reveals much about this generation. Baby boomers used to spend hours studying in the library or in dorm rooms (among other extracurricular activities). Today, students are just as likely to be found at a Starbucks with a laptop, listening to an iPod, working on their assignments, IMing (instant messaging) classmates, or discussing assignments by cell phone. This generation has grown up with the Web, personal computers, cell phones, and social media. The results are a generation entering the workforce that is very tech-savvy, networked globally with friends and colleagues, and accustomed to instant communication. They tend to be bored rather easily. With technology, they are accustomed to doing everyday tasks anywhere, anytime.

Gen Y has been steeped in a brand-oriented culture from its early years. Again, a day on campus reveals much. Brand-name, fast-service restaurants, usually those providing healthier offerings, have supplanted at least some of the old cafeterias that baby boomers used to complain about. Brand-name booksellers manage campus bookstores. Buildings and rooms carry the names of Fortune 500 companies that have graciously donated time and money to the educational institutions. These trends and others have shaped a generation that the energy industry must now attract.

While the petroleum industry is making strides at adapting to this new demographic, the industry still suffers from the perception of being antiquated and characterized by hierarchical structures, long hours, and unfriendly venues. At Southern Methodist University, we have found that the energy industry, particularly E&P and refining, is an increasingly difficult sell to young graduates. Since 2004, only a handful of our MBA graduates have chosen to pursue full-time positions in the production, refining, or utility sectors of the energy industry. The energy

Overall, young Gen Y graduates:

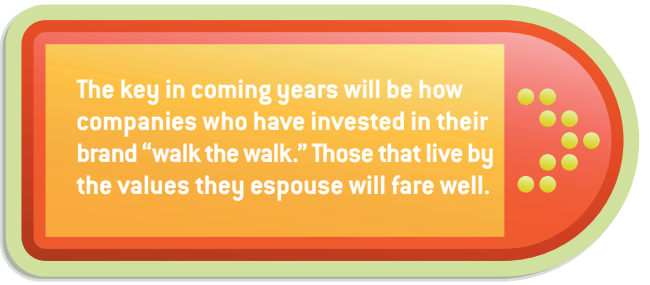
- ★ Seek work with an overriding meaning or purpose
- ★ Seek a work/life balance
- ★ Are driven by job challenges and meaning rather than money
- ★ Volunteer extensively in community-service programs and other philanthropic endeavors
- ★ Tend to be fiercely independent and vocal
- ★ Are skeptical of institutions, often because their parents were directly impacted by industry consolidations and downturns in the 1980s and 1990s
- ★ Value participatory, supportive, and collaborative work environments with employees interconnected through technology and various social and professional networks
- ★ Seek a career path and development program that exposes them to a variety of functions, work experiences, and cultures
- ★ Recognize that they are a valuable commodity and have multiple career options in the marketplace
- ★ Are willing to change employers quickly, but usually only if their needs are not being addressed

finance area, including positions with private equity firms, investment banks, and other financial firms, has fared better. While part of this trend may be attributable to reduced energy-company activity in the Dallas/Fort Worth area, a significant portion is because of a lack of interest in the industry.

So, how does the energy industry appeal to this generation? A closer look reveals that the industry has a stronger hand than most think—but it needs to play it better. The challenges before the industry, the industry's role in everyday life, and some of its previous successes make a compelling case, provided that other aspects of life in the energy industry are addressed.

Job Content. Job content is a major consideration for this generation. According to George Johnson, Assistant Dean for Career Management at SMU's Cox School of Business, "Job content and career potential always outrank salary." The industry's current challenges provide interesting, fast-changing work assignments that are anything but boring. From completing a well at world-record ocean depths to working on a multibillion-dollar offshore project, there is no shortage of interesting, challenging work in the industry. The technology development in recent years is akin to that needed for putting a man on the moon. Given the talent shortage in the industry, a young manager can gain more authority, responsibility, and on-the-job training at a younger age than in perhaps any other industry. Unfortunately, the industry still suffers from a perception of being a dated, low-tech industry with little growth opportunity. The industry is making strides in this regard with on-campus programs and educational initiatives. Challenging and interesting work is perhaps the industry's greatest, but most unrecognized, asset.

Sense of Purpose. Gen Y members seek work with a greater purpose or meaning. They want to feel that they are making a difference. On a daily basis, perhaps no other industry enables as many things in an individual's life—transportation, heating, lighting, electricity, materials, etc. With recent branding



initiatives, the energy industry is making inroads into this area. A number of energy companies and energy service companies have undertaken branding programs in recent years to reflect the greater purpose of the companies' work. The key in coming years will be how companies who have invested in their brand "walk the walk." Those that live by the values they espouse will fare well. Those that ignore them do so at their own risk. A corporate stumble is often heard around the world in a matter of seconds. This generation sees right through slick public relations campaigns.

Career Path and Training. The energy industry was a pioneer in early people-development programs, from rotating assignments for young MBA graduates to technical career ladders. Some of these programs suffered from the cutbacks of the 1980s and 1990s. However, the knowledge base is there, and many of these programs are alive and well. Many of the current senior managers entered the industry in these programs. But a quick look at energy industry websites still reveals a focus on getting people in the door, not where they will go once there. This generation wants to know not only about movement up the ladder, but movement across various functions throughout their career.

Volunteerism. Community service and "service learning" have become an integral part of primary and secondary education. Thus, GenY members have been active in their communities at an early age. Again, the industry should fare well in this regard. Most energy companies have broad volunteerism, matching gifts, and other programs designed to enable employees to give back. Many of these types of programs originated in the energy industry.

Communication. To Gen Y, communication is not so much a skill, profession, or program, but rather

an endemic part of everyday life. This generation has been bombarded with multiple media since an early age. Blogs, wikis, instant messaging, email, cell

The industry needs to retool its communications strategies both internally and externally to reach its intended audience.

phones, text messaging, and other technologies are just a few of the tools that this generation is used to managing simultaneously. Baby boomers grew up with the major networks and large cable news outlets. This generation gets its information from websites, Internet outlets such as YouTube, and other social media, collectively called "new media." The industry needs to retool its communications strategies both internally and externally to reach its intended audience. The days of internal newsletters, water-cooler talk, and bulletin boards have been replaced by instant global communication among a well-networked audience. A quick look at some of the new media websites reflects a lack of accurate, constructive information on the energy industry, despite the fact these are user-driven sites. Contrast this to tech giants such as Google and Microsoft that are omnipresent in new media.

Work/Life Balance. Achieving a work/life balance is difficult in an industry that is operating at capacity. But from Gen Y's perspective, it is essential. Today's graduates are attracted to professions and employers that provide adequate work/life balance. To Gen Y, telecommuting and other programs reflect not only commitment to the principle but the trust in employees that comes along with these programs. Those graduates who wish to leave the Dallas/Fort Worth area, for example, tend to pursue career options in "lifestyle" cities such as Boulder, Colorado, and Seattle, Washington. The industry is making progress with such programs as 9/80 work schedules. However, young graduates get a very different picture from talking to others in the industry. The perception is that the very nature of energy industry work, senior leadership teams whose jobs have defined them throughout their life, and the global aspect of the business all make achieving the balance difficult.

We are seeing some evidence that the industry's efforts are paying off. Interest in the industry in both graduate students and undergraduates is growing. Those who have worked in the industry are in the best position to talk about the prospects in the industry, the rewarding work, and the issues the industry faces. It is essential that the industry appeal to Gen Y. The consequence of losing another generation of workers could be dire. Not only will the industry suffer in its ability to produce the energy the world needs, but there will be 80 million new voters, investors, and community members with no appreciation for the industry whatsoever. That is not a welcome prospect. ❖

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