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The List issue

- The most influential in oil & gas, 18
- Future fields: the next frontiers, 50

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The List issue

Coming next month

40 **OE** celebrates its ruby anniversary in January. As OE gears up for the big 4-0, the magazine will look toward the future of the offshore industry by taking a trip back to the past. Keep an eye out for our annual Global Offshore Market Forecast, plus a behind-the-scenes look back at the history of how Offshore Engineer came to be.

ON THE COVER

Deep thoughts. This month our cover features a "wordle," or word cloud, representing the ideas, technologies, segments and geographic regions that are top of mind for oil and gas personnel each day. As OE enters its fourth decade, what technologies, and market segments will be on your mind? Grab your magnifying glass!

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(check one box only)

- ☐ 01 Executive & Senior Mgmt (CEO,CFO, COO,Chairman, President, Owner, VP, Director, Managing Dir., etc)
- ☐ 02 Engineering or Engineering Mgmt.
- ☐ 03 Operations Management
- ☐ 04 Geology, Geophysics, Exploration
- ☐ 05 Operations (All other operations personnel, Dept. Heads, Supv., Coord. and Mgrs.)
- ☐ 99 Other *(please specify)*_____

2. Which of the following best describes your company's primary business activity?
(check one box only)

- ☐ 21 Integrated Oil/Gas Company
- ☐ 22 Independent Oil & Gas Company
- ☐ 23 National/State Oil Company
- ☐ 24 Drilling, Drilling Contractor
- ☐ 25 EPC (Engineering, Procurement., Construction), Main Contractor
- ☐ 26 Subcontractor
- ☐ 27 Engineering Company
- ☐ 28 Consultant
- ☐ 29 Seismic Company
- ☐ 30 Pipeline/Installation Contractor
- ☐ 31 Ship/Fabrication Yard
- ☐ 32 Marine Support Services
- ☐ 33 Service, Supply, Equipment Manufacturing
- ☐ 34 Finance, Insurance
- ☐ 35 Government,Research, Education, Industry Association
- ☐ 99 Other (*please specify*)_____

3. Do you recommend or approve the purchase of equipment or services?
(check all that apply)

- ☐ 700 Specify
- ☐ 701 Recommend
- ☐ 702 Approve
- ☐ 703 Purchase

4. Which of the following best describes your personal area of activity?
(check all that apply)

- ☐ 101 Exploration survey
- ☐ 102 Drilling
- ☐ 103 Sub-sea production, construction (including pipelines)
- ☐ 104 Topsides, jacket design, fabrication, hook-up and commissioning
- ☐ 105 Inspection, repair, maintenance
- ☐ 106 Production, process control instrumentation, power generation, etc.
- ☐ 107 Support services, supply boats, transport, support ships, etc
- ☐ 108 Equipment supply
- ☐ 109 Safety prevention and protection
- ☐ 110 Production
- ☐ 111 Reservoir
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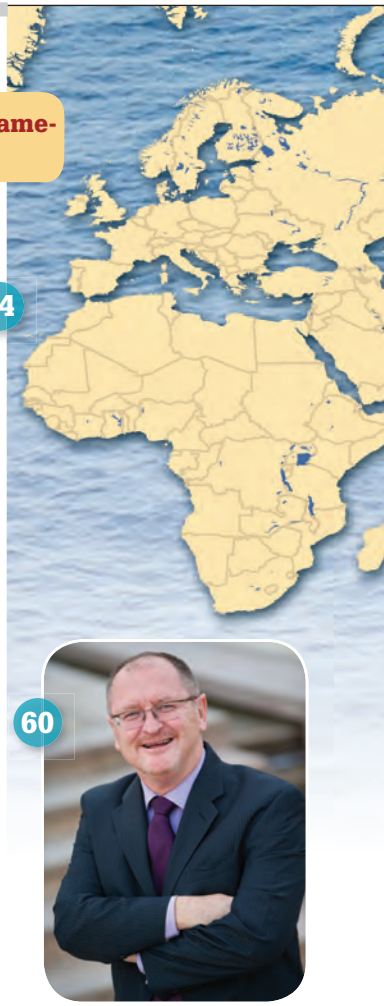

"What is the biggest technology game-changer of the last 10 years?"

OLE JAN DEVELOPS SOFTWARE TO SECURE SAFE OFFSHORE OPERATIONS

No structure is stronger than its weakest part. To avoid disasters in offshore oil and gas field operations, it is essential that the strength analysis is done before the structures are put into operation.

Ole Jan Nekstad, product director at DNV GL, holds a vital part of those analyses. Through DNV GL developed software, he enables the industry to calculate the risk from wind, wave and fatigue impact, something that will determine the safety, lifetime and profitability of the total operation. The software is called Sesam, and is a complete and user-friendly tool for designing and analyzing offshore and maritime structures.

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Online Exclusive

Production efficiency pain & gain

North Sea production rates are an embarrassment, says one of the basin's leading independent operators. Elaine Maslin reports.

Photo from EnQuest.

What's Trending

On deck

- Hess hits at Tubular Bells
- Total: Kashagan production to resume by 2017
- Initial phase FPSO plan for Sea Lion
- BP eyes major new Clair facilities

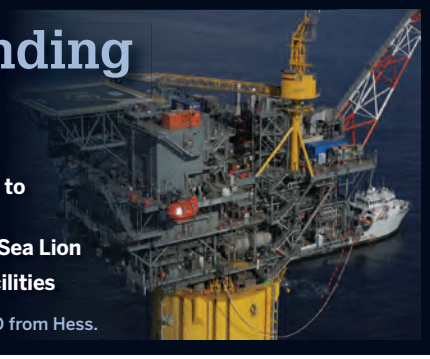

Photo of Tubular Bells' spar FPSO from Hess.

Activity

Halliburton to acquire Baker Hughes

The two oil field services giants agreed to merge businesses in a deal worth US$34.6 billion in stock and cash. The combined company will retain the Halliburton name and headquarters will remain in Houston. The deal is expected to close by 2H 2015.

Baker Hughes' well stimulation vessel *Blue Shark* in Rio de Janeiro.

Photo by Jean Mathiel.

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Voices

Retrospective. The only way forward is to acknowledge what came before. OE asked:

What is the biggest technology game-changer of the last 10 years?

Floating Liquefied Natural Gas (**FLNG**) production vessels have been one of the most transformative technologies in the offshore and deepwater space in the last decade. Currently, four projects are under varying stages of development and dozens of projects are FLNG candidates, including utilizing FLNGs to liquefy pipeline gas from conventional and shale wells in North America. FLNG technology enables previously non-commercial stranded gas to enter the worldwide gas supply without the logistical issues associated with onshore liquefaction plants. Moreover, FLNG facilities competitive with onshore plants, and will be contributing to a more stable and globalized natural gas industry.

Paul H. Hillegeist
President, COO, and Co-Founder, Quest Offshore

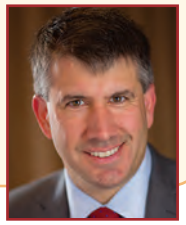
The technology with the most impact has been the **digital oilfield**. Working together, digital control and communications make it possible to monitor critical status information from anywhere in the operation and from wherever you are in the world. Now, we have come to expect having this data at our fingertips. But 10 years ago, operations teams didn't have a cross-disciplinary view of real-time data for production status, rates and delivery information. Armed with these insights, the industry has made great strides in improving the efficiency, safety, reliability and uptime of offshore operations.

Tim Wallaert
Director, Oil and Gas Solutions, Belden

Throughout the past 10 years, the autonomous underwater vehicle (**AUV**) market has seen extensive technology growth. The addition of a high-resolution camera, an enhanced multi beam and a laser bathymetry system has been game-changing for C & C Technologies' AUVs. With the first industry laser on an AUV and our geo-referenced photographs, the AUV is delivering the highest quality data the industry has ever seen for pipeline inspections in a quarter of the time it takes an ROV but at a higher quality and more favorable price.

Jami Cheramie
Vice President, Systems Development, IT Support and Special Projects, C & C Technologies

Advances in **seismic imaging** technology and data processing over the last decade have dramatically improved the industry's ability to locate oil and natural gas offshore. Enhanced seismic survey technologies are especially noteworthy for making possible the discovery of subsalt reservoirs in the deepwater Gulf of Mexico that were previously hidden from view. The Bureau of Ocean Energy Management's recent decision to open the Atlantic Outer Continental Shelf to new seismic surveys makes this an exciting time for the US offshore industry.



Erik Milito
Group Director, Upstream and Industry Operations, API

We are going to need more gas to meet demand. Many cities and industries that will need it are located far from gas fields. Transporting gas by pipeline can be costly and impractical. Floating LNG (**FLNG**) will be an extremely important solution, allowing liquefaction to take place in a facility moored directly over the gas field, before LNG carriers take it direct to market. There are over 800Tcf of discovered gas in water depths of more than 200m. If even a modest proportion of this gas is developed through FLNG technology, the prize is large.

Marjan van Loon
Vice President, Development LNG and Integrated Gas, Shell

Electrical trace heating is certainly one of the most promising technologies starting to impact the SURF segment, as it has the potential to minimize the combined OPEX and CAPEX cost of developing and operating the ever new challenging fields. Electrically trace heated pipe-in-pipe (**ETH-PIP**) in particular is an energy-efficient production system, providing the necessary flexibility to minimize operational shut down, maximize recovery as well as prevent the risk of major pipeline blockage due to wax or hydrate formation. Heating technologies such as direct electrical heating – where electrical current is circulate in the pipeline wall to product heat – have already been implemented successfully on a number of fields in Norway. However, ETH-PIP allows much longer lengths to be heated on a continuous basis, with a much lower electrical power requirement. There is a growing awareness that the electrical trace heating technology, combined with fiber optic temperature monitoring, bring a level of efficiency and flexibility beyond initial expectations, with a real potential to shape field development architecture practices. Having emerged in the last decade, it can be argued that this technology is likely to become a game-changer over the next 10 years.

Laurent Decoret
Vice President, Subsea Technology Development, Technip

Go to OEDIGITAL.COM and give us your opinion on this month's topic!

Colloquy

Nina Rach

Marking the years

Among the notable industry milestones in 2014, organizations commemorated significant anniversaries and acknowledged not just survival, but growth.

Sesquicentennial! – 2014 is the 150th anniversary of the Foundation Det Norske Veritas (DNV) and 1 year since its merger with Germanischer Lloyd (GL).

Centennial! — 2014 marks the 100th anniversary of the adoption of the first-ever international maritime safety treaty. The Safety of Life at Sea (SOLAS) Convention in 1914 was a direct response to the sinking of the Titanic in 1912. The current SOLAS Convention was adopted 40 years ago and the next will be in 2024.

100-year anniversary: ExxonMobil's **Equipment Builder Group**, technical experts and engineers who work with original equipment manufacturers (OEMs) to optimize industrial machinery.

Total has worked in Angola for 60 years. It has twice received OTC's Distinguished Achievement Award for Companies for major projects in Block 17: Girassol (2003) and Pazflor (2013).

The **National Academy of Engineering** (NAE) has been "celebrating 50 years of engineering leadership and service" in the US this year.

50 years: **Petroleum Exploration Society of Great Britain** (PESGB). Read more in the May 2014 issue of OE.

In January 1964, the College of Fisheries, Navigation, Marine Engineering and Electronics opened in St. John's, Newfoundland, and the **Fisheries and Marine Institute** of Memorial University of Newfoundland, now celebrates 50 years (www.mi50.ca)

40 years of North Sea operations: **Aquatic Engineering and Construction** Ltd., an Acteon company.

40 years: **SPE Aberdeen section**.

30 years Gulf of Suez production: **RWE Dea** has produced over 640mmbo from the nearshore Ras Fanar, Zeit Bay and Ras Budran fields since 1984.

30 years in the US: **VAM USA** LLC supplies premium threaded connections.

25 years international marine service: **C-MAR Group** was founded in 1989.

IHS recognizes the 25-year anniversary of the IMO ship numbering scheme.

10 years: England's **Proeon Systems** has designed, installed, and commissioning control and safety systems.

Big Oil – remember when

135 years ago, in 1879, the Pacific Coast Oil Co. was established, and later (1906) consolidated to Standard Oil of California (Socal).

125 years ago, In 1889, Standard Oil (Indiana) was founded as subsidiary of Standard Oil Trust.

90 years ago, in 1924, the French Compagnie Francaise Des Petroles (CFP) was founded, and assumed the French shares of Turkish Petroleum Co.

80 years ago, in 1934, Anglo-Iranian and Gulf Oil Corp. established Kuwait Oil Co. as a 50-50 joint venture, and Sheikh Ahmed granted KOC a 75-year concession.

75 years ago, in 1939, the Iraq Petroleum Co. (IPC) established the Abu Dhabi Petroleum Co. Ltd. (ADPC) to hold its Abu Dhabi concession.

70 years ago, in 1944, California-Arabian Standard Oil Co., a joint venture of Socal and Texaco, changed its name to Arabian-American Oil Co. (Aramco).

60 years ago, in 1954, Standard Oil of Indiana merged with Pan American to form American Oil Co. (Amoco).

Also in 1954, the Zapata Offshore Oil Co. was formed by Bill Liedtke, John Overby, and George Bush (and consolidated into Pennzoil only 9 years later).

Across the pond in 1954, the Anglo-Iranian Oil Co. Ltd. was renamed British Petroleum.

55 years ago, in 1959, a exploration joint venture between Shell and Esso, called N.V. Nederlandse Aardolie Maatschappij (NAM), discovered the Groningen gas fields in the Netherlands.

Also in 1959, the Texas Oil Co. purchased the Paragon group of companies and adopted the name "Texaco."

50 years ago, in 1964, Petroleum Exploration, Inc., and Altair Oil and Gas merged to form Mesa Petroleum Co.

45 years ago, in 1969, BP gave up its leases in Alaska, in exchange for 25% equity in Standard Oil Co. of Ohio (Sohio).

40 years ago, in 1974, Enterprise de Recherches et d'Activities Petrolieres (ERAP) began onshore and offshore exploration in Iran. Two years later, it changed its name to Elf Aquitaine Group.

30 years ago, in 1984, Socal bought Gulf Corp. and formed Chevron Corp. Also in 1984, Texaco acquired Getty.

25 years ago, in 1989, the *Exxon Valdez* oil tanker went aground in Prince William Sound, Alaska, spilling crude.

20 years ago, in 1994, Occidental Petroleum completed its acquisition of Placid Oil Co., which was founded by Texas oil tycoon H.L. Hunt. OE

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Megaprojects: Mega headaches

A megaproject is one that costs more than US$5 billion to develop. They stretch a company's capabilities to their limits, especially in the harsh climates like the Arctic or in ultra-deep water.

In 2000, oil companies took on seven megaprojects, while in 2012; they took on 37 megaprojects – a fivefold increase in over a decade, according to the Wall Street Journal.

The UK think tank Carbon Tracker Initiative (CTI) recently compiled the world's 20 costliest oil projects under construction, with a combined price of $90.6 billion. Nine are in Canada, eight are oil sands projects in Alberta, the rest are either deepwater or Arctic projects.

These projects are expensive to develop, requiring huge supply chains, needing expensive shipping, massive transport networks and thousands of workers.

64% of projects face cost overruns and 73% of projects report schedule delay.

Why are megaprojects critical for the world's energy supply? The easy-to-reach oil ran dry long ago or is in the hands of state-owned companies like Saudi Arabia or Venezuela. Major oil companies have to spend more money to produce less oil. And many of these projects take longer than expected to build and exceed budgets.

Plans to pump oil using man-made islands in the Caspian Sea could cost a consortium that includes Exxon and Shell $40 billion, up from the original budget of $10 billion.

Among the challenges and issues being faced are:

1. Project complexity
2. Completing projects on time and on budget
3. Cost control
4. Rising labor costs
5. Safeguarding dividends
6. Environmental concerns
7. Production lower than expected
8. Investment needed to improve production efficiency
9. Increasing service costs
10. Exchange rate fluctuations
11. Underlying economic conditions affecting project viability
12. Need for collaboration on projects

EY's (Ernst & Young) report titled "Spotlight on oil and gas megaprojects" says that despite the importance of project performance, a high percentage of megaprojects fail to deliver on time or meet approved budgets, with 64% of projects facing cost overruns and 73% of projects reporting schedule delay.

Oil and gas price increases during the past decade have masked many of the consequences of megaproject overruns, but this trend is unlikely to continue. If the industry is to secure the required investment to supply future energy demand, it must delivery improved performance in the delivery of its capital projects, especially megaprojects.

Among the internal areas of failure identified by the EY report are poor procurement of contractors, poor contractor management, and ineffective project management. We believe that improvements could be made by delegating certain aspects of the project, such as automation and electrical systems, to the technology solution provider.

This does not mean that an operator or the principal EPC contractor loses any control. In fact, it could enhance their position by enabling them to focus more on the aspects of the construction at which they are skilled, while allowing the supply chain to handle day-to-day technical integration.

The concept of a main contractor status is something that has been at the disposal of the industry for many years. However, it is essential that the contractor is chosen carefully. As the EY report points out, "selection of contractors through which an organization engages with its third parties are key to project success, because poor selection decisions have significant consequences."

A contractor needs to have the resource and global reach if their engagement is to be profitable. Quality clearly matters, as EY identifies: "Frequently, we see decisions based too heavily on cost, with insufficient emphasis placed on quality, despite the known impact of quality on project cost and schedule performance later in the project life cycle."

The EY report also points out the impact of the human capital deficit on a project. As a result of labor shortages companies are struggling to secure the capabilities, capacity and expertise required to effectively manage their most challenging projects. Using, for example, a main automation contractor or main electrical contractor approach, can help plug these skills gaps, which are even scarcer on the engineering front.

One approach is to use a technology company with a broad portfolio to manage the risk. Provided such a company has a project management capability, the company can act as a MAC/ MEC and integrate the technology with a lower risk to cost and schedule. As technology evolves at a rapid pace, this option becomes ever more attractive. OE

Will Leonard is the Head of Marketing for ABB's Chemical, Oil and Gas business in the UK & Caspian region. Will has a dual honors degree in Business and Law at Keele University. He has worked in the industry for the past 10 years.

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Global Briefs

A BOEM increases Chukchi predictions

The Bureau of Ocean Energy Management (BOEM) is predicting a higher exploration and production scenario than before for the Chukchi Sea Lease Sale 193. The supplemental environmental impact statement (SEIS) predictions are based on a better understanding about existing geologic structures in the region as well as improved information on the potential development activities of industry operators, BOEM said.

Subsequent legal challenges and federal court decisions remanded the sale back to BOEM for further analysis. Earlier this year, The US Bureau of Safety and Environmental Enforcement issued a suspension of operations for all Chukchi leases issued in Lease Sale 193, which stops the lease term from running while BOEM completes this supplemental environmental review. The suspension remains in effect until BOEM completes its environmental review, as directed by the court.

B Pemex to build LNG plant

Pemex will develop a US$6 billion gas liquefaction facility on the Pacific coast to enhance its export opportunities to Asia. The company said that it is aiming for a 2020 start date.

The plant would transport natural gas produced in the Gulf of Mexico through the Isthmus of Tehuantepec for process and exportation to Asia and Oceania, Pemex said. The facility will be the second phase of a planned $1.4 billion investment in petroleum-related infrastructure in the Isthmus of Tehuantepec in a project called the Transoceanic Belt.

C Petrobras plans Lula seismic

Petrobras plans to install a permanent 4D seismic monitoring system at the 1500sq km Lula field, in the pre-salt Santos basin. The company requires environmental approval from the Brazilian Institute of Environment and Renewable Natural Resources, before it begins to install nodes on the seafloor.

By comparing seismic data recorded at different times, it's possible to better understand the spatial distribution characteristics of reservoirs. This will allow Petrobras to define the best conditions and production options at Lula, by providing information about pressure variation and fluid saturation while the field is producing. Petrobras has already installed similar systems in other areas of the Santos basin and at the Jubarte, Roncador, East Albacore, Barracuda, and Caratinga fields, in the Campos basin.

D Karoon spuds Kangaroo-2

Karoon Gas Australia spudded the Kangaroo-2 appraisal well in Block S-M-1165, the first well in the current Santos basin exploration and appraisal drilling campaign, offshore Brazil. The company says that the appraisal well is designed to confirm the size of the oil column, the presence and size of a possible gas cap, reservoir continuity and properties, and flow rates for the Kangaroo oil discovery.

The well is located about 300m updip from Kangaroo-1 and will test a thick reservoir sequence observed in all surrounding wells. Karoon expects to reach total depth in December 2014, using the *Olinda Star* semisubmersible drilling rig. Karoon is in a joint venture with Pacific Rubiales Energy Corp. (35%) for five wells.

E Biggest UKCS round yet

The UK Government offered 134 licenses, covering 252 blocks, in the 28th offshore licensing round. Statoil, Total, Nexen, and EnQuest have the largest haul of operated licenses offered. A large number of smaller, new entrants have also been offered licenses including Arenite Petroleum, EnCounter Oil, and Fyrd Energy.

Those seeking to use alternative extraction methods are also listed. Underground coal gasification firm Cluff Natural Resources has been awarded five licenses as operator. Reach Coal Seam gas has one license.

A further group of applications will be decided later, after environmental assessments, but this looks like being one of the biggest rounds ever in the five decades since the first licensing round in 1964, the UK Government said.

F Golden Eagle in production

Nexen produced first oil on the US$3.3 billion UK North Sea Golden Eagle Area Development (GEAD).

The development is producing about 18,000bbl/d and is expected to ramp up to 70,000bbl/d in full production next year. A total of 15 production wells and six water injection wells will eventually be drilled from the GEAD facilities, in blocks 20/1S, 20/1N and 14/26a, 70km northeast of Aberdeen.

The project includes the Peregrine and Solitaire fields. Nexen is operator of GEAD with 36.54% interest, alongside partners Maersk

Oil North Sea UK (31.56%), Suncor Energy UK (26.69%) and Edinburgh Oil and Gas (5.21%).

G BP eyes new Clair facilities

BP is assessing a further phase development on its west of Shetland Clair field, which could see another new, large central processing facility built in the field. The next phases of development at Clair are likely to require an additional central processing facility, with topsides weighing around 14,000-18,000-tonne, and with 60-100,000b/d capacity. The move will seek widely spread areas of the estimated 7-8 billion bo originally in place.

BP, evaluating subsea and heavy duty jackup and wellhead tower technologies, says the facilities could require investment totaling between $10-15 billion.

H Ophir inks FLNG deal

Ophir Energy selected Excelerate Energy to lead a consortium of technology providers to build Africa's first newbuild open seas FLNG project. The consortium is expected to include Korea's Samsung Heavy Industries and US-based engineering consultancy firm Black & Veatch.

The project will see the development of Ophir-operated assets in Block R, containing some 3.4Tcf estimated mean recovered resources, in 600-1950m water depth, in the southeastern part of the Niger Delta, offshore Equatorial Guinea, close to Nigeria.

Excelerate's selection was agreed through a memorandum of understanding signed between the EquatoGuinean Ministry of Mines, Industry and Energy (MMIE), national oil firm GEPetrol, which holds a 20% stake in the license, Ophir (80%), and Excelerate.

I ConocoPhillips pulls plug on Kamoxi

ConocoPhillips will plug and abandon the Kamoxi-1 exploration well as a dry hole after drilling to a total depth of 22,660ft, offshore Angola. Kamoxi-1 is located in Block 36 in the Kwanza basin.

According to ConocoPhillips, an after-tax charge of approximately US$140 million net to the company will be recorded to dry hole expense in the 4Q 2014.

J Impact wins West Africa license

The Agence de Gestion et de Coopération entre la Guinée-Bissau et le Sénégal (AGC) awarded African-focused Impact Oil and Gas a new exploration license covering the AGC Profond block, located offshore, in the Senegal Guinea Bissau Joint Development Zone.

The offshore AGC Profond license is located in a proven petroleum area west of the Dome Flore and Dome Gea oilfields, adjacent to Impact's Block 4B, offshore Guinea-Bissau. It covers approximately 6700sq km, in water depths ranging from 1000m to more than 3000m.

The initial term of Impact's license lasts for three years and increases Impact's total license holding offshore Africa to more 100,000sq km.

Impact is the operator with 85% interest, with partner Enterprise AGC S.A. (15%).

K Mubadala continues at Manora

Mubadala Petroleum completed drilling at the MNA-05 development well and began drilling at the MNA-07 and MNA-08 wells on the Manora Field, in the northern Gulf of Thailand, using the Atwood Orca jackup rig. JV Partner Tap Oil said that platform commissioning at Manora is underway and nearing completion. In late September, Tap Oil said that first oil would be pushed back due to a combination of poor weather and setbacks in platform commissioning. Mubadala operates Manora with 60% interest along with partners Tap Oil (30%) and Northern Gulf Petroleum (10%).

L CNOOC makes Bohai discovery

CNOOC Ltd. made a new discovery at Jinzhou 23-2 in the north part of Liaodong Uplift of Bohai with an average water depth of about 10m. The well Jinzhou 23-2-3 was drilled and completed at a depth of 1097m and encountered oil and gas pay zones with a total thickness of 68.4m. The oil production of the well was tested around 260b/d.

M KPOC celebrates first Kebabangan gas

The KPOC joint venture achieved first gas from the Kebabangan gas field, approximately 60 mi offshore Sabah, Malaysia.

KPOC is drilling Kebabangan with Jamstec's deepsea vessel *CHIKYU* in about 450ft water depth. Production scheduled to begin as pipeline capacity becomes available, which will initially use six wells with gas exported using pipeline to the Sabah Oil and Gas Terminal in Kimanis.

ConocoPhillips is expecting to add approximately 60,000boe/d to its production volumes by 2017 with project startups in Malaysia. The company's overall plan is to deliver an annual 3-5% production and margin growth.

The field is operated by KPOC, a joint operated company with ConocoPhillips Sabah Ltd. and Shell Energy Asia Ltd. each holding a 30% interest with Petronas Carigali Sdn Bhd (40%).

The Kebabangan cluster asset comprises four non-associated gas fields: Kebabangan, Kamunsu East, Kamunsu East Upthrown, and Kamunsu East Upthrown Canyon, located in water depths ranging from 120-1200m, about 125km off the Sabah coast.

N Ichthys LNG gets RSS tower

The Inpex-operated Ichthys LNG project is moving forward with the installation of a 6500-tonne riser support structure (RSS) tower at the Ichthys Field. The deepwater construction vessel *Aegir* conducted installation operations at the Ichthys field, located in the Browse basin, off Western Australia.

According to Inpex, the RSS is the largest subsea structure ever laid on the seabed. When the arch is placed, the structure will stand 110m off the seabed. The completed RSS will be a physical, fixed support for flexible risers and dynamic umbilicals.

The Ichthys LNG project is scheduled to begin production at the end of 2016. It will have an initial capacity to produce 8.4mtpa of LNG, 1.6mtpa of liquefied petroleum gas, and approximately 100,000b/d of condensate at peak production.

Inpex operates the Ichthys project with 66.7% interest with partners Total (30%), Tokyo Gas (1.575%), Osaka Gas (1.2%), Chubu Electric Power (0.35%), and Toho Gas (0.42%).

O Pryderi-1 comes up dry in Browse Basin

CalEnergy's Pryderi-1 well off Australia will be plugged and abandoned as a dry hole, according to joint venture partner IPB Petroleum.

The exploration well is located in the Browse basin in WA-424-P in 75m water depth. The *Stena Clyde* semisubmersible drilling rig reached a total depth of 694m, where no moveable hydrocarbons were encountered.

IPB says despite some residual oil shows encountered while drilling, the target reservoir at Pryderi is interpreted to be water-bearing. Further analysis is pending.

P Rosneft completes East Siberia seismic

Rosneft concluded seismic data acquisition on the East-Siberian-1 Block in the offshore area of the East Siberian Sea. The company carried out the seismic data survey independently with R/V *Orient Explorer*, with the amount of 2D work totaling 2000km. All work was carried ahead of schedule. The geologic data acquisition was implemented by Rosneft subsidiary RN-Shelf-Far East.

Contract Briefs

Wood Group Kenny wins CCS gig

Wood Group Kenny won the front-end engineering design (FEED) for the subsea and pipeline element of the Peterhead Carbon Capture and Storage (CCS) project in Aberdeenshire, UK. The scope of the six-month contract includes: developing a landfall solution at the Peterhead Power Station; design of a new carbon dioxide (CO2) export pipeline from Peterhead Power Station to a subsea tie-in with the existing Goldeneye pipeline; and, a new subsea intervention valve (SSIV), including controls system and tie-in spools.

McDermott wins service duo

McDermott International, Inc. won a transportation, installation and pre-commissioning contract from a subsidiary of Petronas, for the Bukit Tua development project in the Ketapang block of East Java, Indonesia.

This new contract concerns the BTJT-A jacket, its related topsides and subsea pipeline tie-in spools. Additionally, McDermott will undertake the pre-commissioning of the related export and infield pipelines. The offshore campaign is expected to be completed by end of 1Q 2015.

In November, McDermott also won a three-year contract to transport and install pipelines and umbilicals for the Champion and Ampa fields, offshore Brunei, for Shell. Work will be executed through 2017.

RWG wins Chevron work

Chevron Thailand E&P awarded Rolls Wood Group (RWG) a contract to service Rolls-Royce industrial gas generators operating at four separate offshore production facilities located in the Pattani Basin, 120 mi from Thailand's southern coastline.

The five-year, multi-million dollar contract includes technical and engineering support, field service, repair of spares and major overhaul of Chevron's varied fleet of 11 Rolls-Royce gas generators.

JDR in Ravn umbilical contract

JDR is to design and manufacture a hybrid power steel umbilical for Wintershall Noordzee's Ravn field development in the Danish North Sea. Delivery is scheduled for 3Q 2015.

The 18.2km-long umbilical will provide power and control; connecting a new platform to an existing platform for long-term well testing off of the Danish coast. Additionally, JDR will provide the subsea hardware as well as life-cycle support through their Global Service division.

Aveon wins Egina job

Nigeria's Aveon Offshore has been awarded a contract by National Oilwell Varco Nigeria for the fabrication of Egina offloading buoy as part of the package for the Egina oil loading terminal contract for Total Upstream Nigeria. The contract, which was awarded in March 2014 for the fabrication of a 900-ton offloading buoy, includes the fabrication of the 700-ton buoy hull, installation and integration of a 200 ton turret and the launching and pre-commissioning of the completed buoy. The project will be executed at the Aveon Offshore's 240,000m sq fabrication yard in Rumuolumeni near Port Harcourt. The sailaway of the buoy is scheduled for 2Q 2017. ■

The most influential people

Who have been the movers and shakers in 2014? OE looked to the global offshore oil & gas industry to select the VIPs (very important players) in our 14 in 2014 list, presented here in no particular order.

14 most influential of 2014

Name	Title/Industry	Country
Rex W. Tillerson	ExxonMobil, Chairman & CEO	USA
Maria das Graças Silva Foster	Petrobras CEO	Brazil
Igor Sechin	Rosneft President & Chairman	Russia
Khalid A. Al-Falih	Saudi Aramco President & CEO	Saudi Arabia
Enrique Peña Nieto	President of Mexico	Mexico
Sir Ian Wood	Former Wood Group CEO	UK
Alex Kemp	Economics professor	UK
Cory Gardner	US Senator-elect	USA
Martin Landrø	Geophysics professor	Norway
Charles Sparks	Drilling risers researcher	France
Jane Cutler	Former NOPSEMA CEO	Australia
Helge Lund	Former Statoil CEO	Norway
Patrick Pouyanné	Total CEO	France
Helge Hove Haldorsen	SPE President & Statoil's vice president of strategy and portfolio for North America	USA/Mexico

C-suite

Rex W. Tillerson ExxonMobil Chairman and Chief Executive Officer Rex W. Tillerson is a native Texan who attended the University of Texas at Austin and joined one of Texas' most famous oil and gas companies in 1975. Even in a state famous for its larger-than-life oilmen, Tillerson has managed to make a name for himself.

As the former vice president of Exxon Ventures (CIS) Inc. and president of Exxon Neftegas Ltd., it was in Russia that his leadership helped ExxonMobil to secure a strong foothold in a country that is home to some of the world's largest oil and gas reserves.

This position was due in no small part to two major cooperation agreements with Russian state-owned Rosneft (headed by another entrant on this list, Igor Sechin), and to the high-profile ExxonMobil Neftegas-operated Sakhlain-1 oil and gas project off the northeast coast of Sakhalin Island.

Rex W. Tillerson
Photo: Greater Houston Partnership / David Brown

In the process, Tillerson managed to become of one the few North Americans to forge a strong business relationship with President of the Russian Federation Vladimir Putin, who awarded Tillerson the Order of Friendship in 2013.

When ExxonMobil began exploratory drilling on the Universitetskaya-1 well in the Kara Sea on behalf of joint venture partner Rosneft in August, Putin said: "ExxonMobil is our old, reliable partner, and we greatly value our relationship."

When hydrocarbons were found during that drilling campaign, the US government gave ExxonMobil a deadline extension to pull personnel and shut down operations within the country as part of the newest package of sanctions issued by the US Department of the Treasury.

ExxonMobil was the only companies to be swiftly dealt a deadline extension by the US Department of Treasury to close Russian operations.

Tillerson is a vocal proponent of ending the US export ban on crude and LNG.

Speaking in October at an event in Houston, he said that the US was in an "era of energy abundance," and that nulling the ban could flood the US with immediate short- and long-term benefits. In discussing domestic production, he noted that "by itself, Texas ranks as the number eight oil producer among the world's top ten producers of crude oil," he told the crowd. "Of course, the rest of them are countries."

The Exxon chief is a member and leader of several industry organizations. He is a member of the executive committee and a former chairman of the American Petroleum Institute.

He is also a member of the Society of Petroleum Engineers and a trustee of the Center for Strategic and International Studies. He is a member of the National Petroleum Council, an honorary trustee of the Business Council for International Understanding, and a member of the Emergency Committee for American Trade. In 2013, Tillerson was elected to the National Academy of Engineering.

Maria das Graças Silva Foster Photo: Petrobras News Agency

Maria das Graças Silva Foster

Petrobras chief executive officer Maria das Graças Silva Foster – referred to by some as Brazil's "Iron Lady of Oil" – famously worked her way from a Brazilian favela to the top of Petrobras.

She began her 31-year career with the Brazilian national as a chemical engineer, and was named CEO on 13 February 2012.

Graças Foster, a close friend to Brazilian President Dilma Roussef, is currently helming a company with close to 90,000 employees present in 17 countries that rakes in more than US$9.1 billion net profit. However, Graças Foster's Petrobras intends to be one of the top five integrated energy companies in the world by 2030, with as sustainable average output of 4MMbo/d from 2020-2030. She is currently leading the company through the initial phases of its 2030 Strategic Plan and the 2014–2018 Business and Management Plan.

In her career, Graças Foster has also served as the CEO of other Petrobras subsidiaries, and is the chairwoman of the Board of Transportadora Brasileira Gasoduto Bolívia-Brasil, of Transportadora Associada de Gás, and a member of the Boards of Petrobras Transporte, Petrobras Biocombustível and Braskem.

She is also the former Ministry of Mines and Energy's secretary for Oil, Natural Gas and Renewable Fuels from January 2003 to September 2005.

Igor Sechin
Photo from Rosneft

Igor Sechin is the president, chairman of the management board, and vice-chairman of the board of directors of Russian state-owned Rosneft, the world's largest publicly-traded company.

Born in Soviet Leningrad (renamed St. Petersburg), he studied languages at the Leningrad University. He is one of Putin's closest allies, with a friendship that has lasted decades, and is commonly considered to be the second-most powerful men in Russia, after the president himself.

According to a 20 June 2010 Reuters article naming Sechin "Russia's energy tsar," both he and Putin rose through the ranks of the Kremlin together.

Sechin served as Putin's deputy prime minister and, before that, Putin's chief of staff.

His standing with Putin is what landed him on the US Department of the Treasury's Specially Designated Nationals list, as the US government were targeting those that were seen as being part of the president's "inner circle." Sechin has worked around Western-imposed sanctions by strengthening ties with the East: China, in particular.

As the deadline approached for Western companies to close operations and withdraw from Russia, Rosneft and partner ExxonMobil announced they hit hydrocarbons in the northernmost well in the world – the Universitetskaya-1 well in the Prinovozemelskiy license in the Kara Sea, 250km off the Russian coast in the Arctic.

Sechin said that the field would be named Pobeda (Russian for "Victory") and extensively thanked the company's Western partners and service companies in a statement. Rosneft estimated the structure to have 338Bcm of gas and more than 100 million tonnes of oil.

Khalid A. Al-Falih is the president and CEO of Saudi Aramco, the state-owned oil company of Saudi Arabia.

The company manages the largest proven oil reserves in the world, with 3.4 billion bo of production for 2013, which the company says equates to 1bbl for every 8bbl of the world's production. Saudi Aramco also oversees 288.4Tscf of gas.

Khalid A. Al-Falih
Photo from Aramco Services

Over a 30-year career, he worked through the ranks of the company, holding positions such as executive vice president of operations and senior vice president of gas operations and industrial relation.

He was named president and CEO on 1 January 2009. He was also president of Petron Corp., a joint venture with the Philippine National Oil Company.

He also serves as a member of the Saudi Arabian Supreme Council of Petroleum and Minerals Affairs, chaired by the Custodian of the Two Holy Mosques, King 'Abd Allah ibn 'Abd al-'Aziz Al Sa'ud. He also advocates for social programs and education.

The firm announced the 2013 deepwater Al-Haryd oil discovery in the Red Sea in its June annual report, inching up its total number of discovered fields to 121.

It recently expanded into fuel oil derivatives, also known as paper, trading and the petrochemicals sector.

Economics, regulation, and government

Enrique Peña Nieto
Photo from presidencia.gob.mx

Enrique Peña Nieto is the president of Mexico, a member of the PRI (Institutional Revolutionary Party) who transformed Mexico's energy economy with the passage of the country's energy reforms.

Prior to the energy reforms and his secondary legislation, Mexico's national treasure had only one customer, one explorer, one producer and one refiner: state-owned Petróleos Mexicanos (Pemex), itself inexorably tied to treasury funds and in need of streamlining and rejuvenating.

General Lázaro Cárdenas served as Mexico's president from 1934-1940. According to the US Department of State's Office of the Historian, on 18 March 1938, Cárdenas expropriated all international companies' oil by asserting Article 27 of the Constitution of 1917, wherein Mexico claimed rights to anything below the ground, and nationalized the natural resource.

Prior to this, Shell subsidiary Mexican Eagle Company accounted for more than 60% of domestic oil production. American-owned oil firms including Jersey Standard and Chevron predecessor Standard Oil Company of California accounted for around 30% of total production.

Distrust of international companies helped foster nationalization long past when it remained good for the country. Following nationalization, International companies reeled at the country. Bans were instituted, and diplomatic relations were broken. Oil would remain nationalized until Peña Nieto staked his candidacy on the reforms.

On 13 December 2013, more than 75 years after it was nationalized, energy reforms passed in Mexico.

The PRI and opposition party PAN presented a united front against Mexican leftist party PRD, and passed the bill by a vote of 95 to 28 in the Mexican Senate. The lower chamber of Mexico's Congress, the Chamber of Deputies, followed suit, voting 353 to 134 in favor of the reform.

"The number, depth and significance of the reforms approved

by Congress in one year is really encouraging and reflects the modernizing spirit that now lives in the country," Peña Nieto said upon the bill's passing.

Months later, the reforms and secondary legislature were signed into law by Peña Nieto on 12 August 2014.

"It is a great achievement of Mexican democracy. (These) are structured reforms that will free the country from the shackles that have prevented it from developing faster," he said at the time.

Mexico became open for business, and Pemex began signing non-binding agreements with some of the world's largest companies: Chevron, Eni, ExxonMobil, BHP Billiton, among others. The country plans to host an offshore bid round in 2015, with the newly-bolstered regulator, the National Hydrocarbon Commission, granting Pemex a great deal of its submitted wish list in Round Zero.

However, the rest of his presidential candidacy might be viewed, his indelible mark on Mexico's energy sector cannot be disputed.

Sir Ian Wood
Photo from Ian Wood.

Sir Ian Wood – After more than 45 years helping to build and then lead engineering and services firm Wood Group into a multi-billion dollar stock market listed outfit, the recently retired Sir Ian Wood this year went one step further.

His report, UKCS Maximising Recovery, widely called the Wood Review, elevated the former CEO and chairman to a leadership of the industry.

The report came at a critical time. The UK North Sea has been facing something of an existential crisis. The industry has been described as being at a crossroads, facing declining production, poor exploration results and an ever increasing cost-base. Meanwhile, capital spending has hit record levels.

A tax-hike, followed by a string of tax concessions, put the industry in the headlines from 2010, and this year the Scottish independence referendum put the industry squarely in the public gaze.

Sir Ian's report, commissioned by the UK Government to address the basin's future, was welcomed by industry, industry bodies and government.

Many of its recommendations, including a proposal to create a new regulatory body for the UKCS, have been put into action. The Oil & Gas Authority (OGA) was created within months of the report and will be based in Aberdeen. The review also made Sir Ian a key voice in the independence referendum – while he remained neutral on independence, he spoke out about reserves numbers, on which estimates varied widely during the pro and anti-independence campaigns.

Sir Ian's heritage was in the North Sea fishing industry. His grandfather founded Wood & Davidson, a ship repair and marine engineering firm. Sir Ian joined the family firm, then called John Wood & Son, in 1964. In the 1970s, Wood Group was quick to move into the oil and gas industry, picking up a contract for the Shell Brent field in 1979, and establishing Wood Group Gas Turbines the same year. In the 1980s the firm started operating in the US and Middle East. The 1990s saw further growth, acquisitions and partnerships, before the firm floated on the London Stock Exchange in 2002. The firm now operates in 50 countries, with more than 40,000 employees and some US$7 billion sales.

Professor Alex Kemp
Photo from University of Aberdeen.

Professor Alex Kemp has been tracking the industry since its inception. A professor in petroleum economics at the University of Aberdeen, Scotland, he has not only published the official history of the North Sea last year, he has also advised governments across the world on their petroleum taxation regimes. He was made an OBE in 2006 for services to the oil and gas industries.

Cory Gardner
Photo from Cory Gardner.

Cory Gardner – A champion for the Keystone XL pipeline, Gardner serves on the House Committee on Energy & Commerce. After drafting bills related to energy independence and offshore drilling, Gardner authored and sponsored HR6, the Domestic Prosperity and Global Freedom Act, which the US House of Representatives passed on 24 June. HR6 aims to fast-track the process to export US LNG to allies. Among other actions, the bill will place a 30-day deadline on the Department of Energy to issue a final decision on applications to export LNG following the completion of an environmental review.

Gardner has made clear his stance that exporting LNG would benefit the US economy and weaken the perceived stranglehold that conflict-heavy exporters like Russia and Iran hold over consumers in Europe and elsewhere.

"The crisis in the Ukraine has underscored the potential for US LNG exports to shift geopolitics and increase global energy security. By acting now, we can send a clear signal to our allies that a stable and secure energy supply will be an available alternative to meet their energy needs," the Republican-led US House Energy & Commerce Committee said.

During the US November mid-term elections, Gardner, a vocal proponent for US energy independence, became Senate-elect Cory Gardner for the state of Colorado. He will be sworn in to his new position on 3 January 2015.

Following this successful campaign run, on 4 November, the Washington Post named him the candidate of the year, specifically noting his focus on energy and the economy.

Technology

Martin Landrø
Photo from ONS/Killian Munch.

Martin Landrø – 4D seismic technology for mapping, production management and monitoring reservoirs has been one of the key geoscience developments in the past 10 years.

One of those leading its development has been Martin Landrø, an applied geophysics professor in the Norwegian University of Science and Technology (NTNU)'s Department of Petroleum Engineering and Applied Geophysics.

His research into 4D seismic technology started in 1996. "Time-lapse" or 4D seismic makes it possible to compare results

from seismic 3D surveys carried out with time intervals, making it possible to see changes in the reservoir over time.

Landrø was a coordinator on the EU-project ATLASS (analysis of time lapse seismic data) and the project lead to the first trials of 4D seismic on the Gullfaks field. Statoil estimates that use of 4D seismic on the Gullfaks field has generated value creation of more than US$971 million.

Since 2009 Landrø has been the lead on a research project concerning improved mapping and monitoring of hydrocarbon reservoirs.

Landrø has a master of science from NTH (Norwegian Institute of Technology) and he earned a dr. scient. degree in physics in 1986. His scientific career started in 1986, while he was working for SERES, which was a major research collaboration within use of seismic data.

From 1993 to 1996, he worked as a researcher in SINTEF Petroleum, and from 1996 to 1998, he worked as a geophysicist in Statoil. Landrø has also been a visiting professor at the Colorado School of Mines in the US (2005-2006).

Charles Sparks
Photo from Charles Sparks.

Charles Sparks –This year, Charles Sparks, who leads research into the mechanical behavior of drilling risers at France's IFP Energies nouvelles (IFPEN) was recognized for his work.

More than 30% of the world's oil and gas production comes from subsea zones. But, in the 1970s, the behavior of drilling risers and the vibration phenomena to which they were subjected were still not fully understood.

The safe design of the equipment needed for offshore drilling and production required major technological innovations as well as a good understanding of the phenomena at play.

Sparks, who earned a master's degree in Mechanical Sciences from the University of Cambridge, has studied and worked on risers since the mid-1970s, with 29 years at IFPEN until his retirement in 2003. At IFPEN, he ran many projects devoted to different kinds of riser, including carbon fiber composite risers. Drilling riser technologies developed by IFPEN, particularly in the 1970s and 1980s, went on to represent a major advance for offshore drilling.

Sparks' research resulted in some significant publications:

- Sparks, C.P. 1980 The mechanical behavior of marine risers - mode of influence of principal parameters. Journal of Engineering Technology. ASME

- Sparks, C.P., Cabillic, J.P., Schawann, J.C. 1982. Longitudinal resonant behavior of very deep water risers. Paper OTC 4317, presented at the Offshore Technology Conference, Houston.

- Sparks, C.P. 1984. The Influence of tension, pressure and weight on pipe and riser deformations and stresses. Transactions of ASME. Journal of Energy Resources Technology.

HSE

Jane Cutler became a force for safety in Australia as the inaugural CEO of the National Offshore Petroleum Safety and Environmental management Authority (NOPSEMA), Australia's independent regulator for OHS, well integrity and environmental management of the offshore petroleum industry.

Her tenure at NOPSEMA, which ended earlier this year, saw her oversee a new environmental management regime for

Quick stats

OE's at-a-glance guide to offshore hydrocarbon reserves and key offshore infrastructure globally is updated monthly using data from leading energy analysts Infield Systems (www.infield.com).

New discoveries announced

Depth range	2011	2012	2013	2014
Shallow (<500m)	105	75	72	52
Deep (500-1500m)	25	23	19	21
Ultradeep (>1500m)	18	37	33	12
Total	**148**	**135**	**124**	**85**
Start of 2014 date comparison	151	135	98	-
	- 3	-	26	85

Note: Operators do not announce discovery dates at the time of discovery, so totals for previous years continue to change.

Reserves in the Golden Triangle

by water depth 2014-18

Water depth	Field numbers	Liquid reserves (mmbbl)	Gas reserves (bcf)
Brazil			
Shallow	13	564.25	1,060.00
Deep	17	2,621.00	2,815.00
Ultradeep	48	13,895.25	19,133.00
United States			
Shallow	21	105.55	344
Deep	22	1,570.11	1,714.57
Ultradeep	27	3,410.50	3,730.00
West Africa			
Shallow	158	4,659.97	21,570.05
Deep	46	5,601.50	6,550.00
Ultradeep	16	2,055.00	1,610.00
Total	**368**	**34,483.13**	**58,526.62**
(last month)	(382)	(34,458.13)	(58,334.62)

Greenfield reserves

2014-18

Water depth	Field numbers	Liquid reserves (mmbbl)	Gas reserves (bcf)
Shallow	1172	45,163.57	738,895.77
(last month)	(1194)	45,061.36)	(765,596.08)
Deep	152	12,228.98	71,319.00
(last month)	(160)	(12,427.98)	(100,235.27)
Ultradeep	101	19,465.15	55,470.00
(last month)	(105)	(19,550.15)	(56,787.00)
Total	**1,425**	**76,857.70**	**865,684.77**

Pipelines

(operational and 2014 onwards)

	(km)	(last month)
<8in.		
Operational/ installed	41,131	(40,897)
Planned/ possible	24,683	(24,820)
	65,814	(65,717)
8-16in.		
Operational/ installed	79,879	(79,249)
Planned/ possible	50,448	(50,522)
	130,327	(129,771)
>16in.		
Operational/ installed	91,827	(91,751)
Planned/ possible	48,024	(48,055)
	139,851	(139,806)

Production systems worldwide

(operational and 2014 onwards)

Floaters		(last month)
Operational	282	(281)
Under development	44	(41)
Planned/possible	351	(351)
	677	(673)
Fixed platforms		
Operational	9,276	(9,258)
Under development	133	(134)
Planned/possible	1,422	(1,431)
	10,831	(10,823)
Subsea wells		
Operational	4,626	(4,575)
Under development	357	(380)
Planned/possible	6,698	(6,616)
	11,681	(11,571)

Global offshore reserves (mmboe) onstream by water depth

	2012	2013	2014	2015	2016	2017	2018
Shallow	5,407.34	23,581.06	31,310.29	42,264.94	28,922.33	45,956.92	27,179.23
(last month)	(5,984.58)	(23,457.06)	(45,196.80)	(33,604.85)	(29,744.12)	(44,846.62)	(26,838.16)
Deep	2,791.02	484.3	3,952.06	5,247.02	3,882.06	4,944.12	6,768.69
(last month)	(2,791.02)	(484.30)	(4,155.36)	5,337.00	(3,851.57)	(5,267.44)	(11,479.56)
Ultradeep	737.15	2,932.94	2,749.62	1,869.95	4,470.91	13,584.66	6,569.81
(last month)	(737.15)	(2,932.94)	(2,758.62)	(1,869.95)	(5,162.70)	(12,930.01)	(6,840.86)
Total	**8,935.51**	**26,998.30**	**38,011.97**	**49,381.91**	**37,275.30**	**64,485.70**	**40,517.73**

13 November 2014

Jane Cutler
Photo from Jane Cutler.

Australia, described as the "world's first objectives based environmental management regime"

The new regime was sparked largely by the 2009 Montara well blowout in the Timor Sea. The Montara blowout prompted considerable debate about the future shape of Australia's offshore petroleum industry, including the requirement for an independent professional regulator

Cutler was CEO of NOPSEMA's predecessor, the National Offshore Petroleum Safety Authority, at the time and oversaw its transformation into NOPSEMA.

The chemical engineer by training has 30 years' experience in the petroleum and financial services industries, including posts at Woodside Energy, BHP Petroleum and Esso Australia.

But, it has been since 2009, when she became CEO of the National Offshore Petroleum Safety Authority (NOPSA) that she has made her real mark on the industry.

According to the Australian Petroleum Production & Exploration Association's CEO David Byers: "This was a considerable achievement for Australia and a credit to her leadership and professionalism.

Cutler holds a Bachelor of Engineering degree and Master of Environmental Studies and Master of Business Administration.

"Ones to watch"

Helge Lund Photo by Ole Jørgen Bratland – Statoil.

Helge Lund – Statoil's loss is BG Group's gain, was the mantra when it was announced that Statoil CEO Helge Lund had resigned in order to take over the UK-based group.

Lund has been Statoil's CEO since 2004, overseeing its market capitalization growing from US28.7 billion to over $76.1 billion. Meanwhile, BG Group has been without a CEO since Chris Finlayson, who had been in the post about a year, resigned in April.

Analysts Investec said: "In terms of global industry leaders, it is hard to imagine a more suitable candidate and the chairman should be congratulated for landing such a big fish. This is no hagiography; BG still faces challenges, but we believe it has a better chance of addressing them with Lund on board."

Prior to his 10 years as CEO of Statoil, Lund was CEO of Aker Kvaerner, an industrial conglomerate with operations in oil and gas and shipbuilding. He previously also served in the roles of Deputy CEO and Chief Financial Officer at the pharmaceutical division of Hafslund Nycomed, an industrial conglomerate.

Patrick Pouyanné
photo from Total - Philippe Zamora

Patrick Pouyanné had been tipped to be the man to take over Total when charismatic CEO Christophe de Margerie, or the board, decided his time was up. But, Pouyanné's thrust in to the limelight came earlier than planned when de Margerie was killed in a plane crash at Moscow's Vnukovo Airport on 20 October.

Tributes flooded in to de Margerie, but, for Total, the focus had to be on

putting in a new leader. Pouyanné was appointed two days after the crash, with Thierry Besmarest brought in as chairman to support Pouyanné until the end of 2015.

Until 22 October, Pouyanné was President of Refining & Chemicals, a role he had held since 2011, and a member of the Executive Committee since 2012. He graduated from the École Polytechnique and was an Engineer of the French Corps des Mines. He's held roles in the French Industry Ministry and was a technical advisor to the Prime Minister from 1993-1995 and chief of staff to the Information Technology and Space Minister from 1995-1996. He joined Total in 1997, becoming Senior Vice President, Strategy, Business Development and R&D in Exploration & Production in 2006.

Helge Hove Haldorsen
Photo from SPE Aberdeen.

Helge Hove Haldorsen is the sartorially minded 2015, the Society of Petroleum Engineers president.

He is currently vice president of strategy and portfolio for Statoil Development and Production North America, based in Houston, but, in addition to his SPE role, Haldorsen is also going to be leading Statoil's interests in Mexico soon. His move with Statoil to Mexico comes at an unprecedented time for the Mexican oil industry, as moves to break state oil firm PEMEX's long monopoly on exploration and production finally come into play.

Speaking about the North Sea industry in Aberdeen earlier this year, Haldorsen said Aberdeen had pioneered global offshore harsh environment exploration, but that it will need to "innovate its socks off" to maximize the North Sea's remaining potential and remain competitive globally. He said the industry needed to "invent E&P 2.0."

"I do not think we are running out of oil, but we are going to run out of cheap easy oil," he continued. "Oil prices are flat, costs are going up, by a factor of four since 2001, so we have a problem. We have to adapt. We need innovation."

Before joining Statoil, Haldorsen worked for Norsk Hydro in various roles, including chief reservoir engineer, vice president technology and competence, vice president exploration and research, senior vice president international exploration and production, and president Hydro Gulf Mexico. He has also held positions at BP, Standard Oil of Ohio, and ExxonMobil. He was a second lieutenant in the Royal Norwegian Navy and a professor of Industrial mathematics at the University of Oslo. He earned an MS in petroleum engineering from the Norwegian Institute of technology and a PhD n reservoir engineering from the University of Texas at Austin.

Also nominated:

Bill Edgar, chairman of the Society for Underwater Technology. On honours graduate in engineering, he has been president of the Institution of Mechanical Engineers. He has held roles as managing director of Seaforth Engineering, which built the original Underwater Training Center at Fort William, Scotland, and the National Hyperbaric Centre, in Aberdeen. Edgar has also been Group Director of the John Wood Group, responsible for the engineering and production facilities division, and was chairman of the J.P. Kenny Group for 10 years. He is a past chairman of the Offshore Construction Association.

Oonagh Werngren is operations director at industry body Oil & Gas UK and president of the Petroleum Society of Great Britain.OE

Rig stats

Worldwide

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	110	98	12	89%
Jackup	425	364	61	85%
Semisub	182	159	23	87%
Tenders	34	22	12	64%
Total	751	643	108	85%

Gulf of Mexico

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	31	29	2	93%
Jackup	90	70	20	77%
Semisub	28	23	5	82%
Tenders	N/A	N/A	N/A	N/A
Total	149	122	27	81%

Asia Pacific

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	14	10	4	71%
Jackup	116	102	14	87%
Semisub	37	28	9	75%
Tenders	25	14	11	56%
Total	192	154	38	80%

Latin America

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	27	27	0	100%
Jackup	9	6	3	66%
Semisub	34	34	0	100%
Tenders	2	2	0	100%
Total	72	69	3	95%

Northwest European Continental Shelf

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	1	1	0	100%
Jackup	51	49	2	96%
Semisub	45	43	2	95%
Tenders	N/A	N/A	N/A	N/A
Total	97	93	4	95%

Middle East & Caspian Sea

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	1	1	0	100%
Jackup	108	95	13	87%
Semisub	3	3	0	100%
Tenders	N/A	N/A	N/A	N/A
Total	112	99	13	88%

Sub-Saharan Africa

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	30	29	1	96%
Jackup	26	21	5	80%
Semisub	17	15	2	88%
Tenders	7	6	1	85%
Total	80	71	9	88%

Rest of the World

Rig Type	Total Rigs	Contracted	Available	Utilization
Drillship	6	1	5	16%
Jackup	25	21	4	84%
Semisub	18	13	5	72%
Tenders	N/A	N/A	N/A	N/A
Total	49	35	14	71%

Source: InfieldRigs

14 November 2014
This data focuses on the marketed rig fleet and excludes assets that are under construction, retired, destroyed, deemed non-competitive or cold stacked.

TOP Discoveries

The biggest oil and gas discoveries

With help from experts Infield and Gaffney Cline & Associates, OE compiled a list of the biggest oil and gas discoveries in the last 12 months, and of the last 10 years.

Top oil discoveries of the last 12 months

Country	Field	Operator	Operator Group	Discovery Date	Water Depth (m)	Oil Reserves MMBBL	Gas Reserves BCF	Condensate Reserves MMBBL	Condensate Estimate	Oil Production Rate BPD	Gas Production Rate MMCFD	Condensate Production Rate BPD
USA	Keathley Canyon 093 Gila	BP Exploration & Production Inc,	BP	12/18/13	1494	300	300	0	0	40,000	60	0
Brazil	Pitu (BM-POT-17) (1-RNS-158)	Petroleo Brasileiro S.A.	Petrobras	12/17/13	1731	100	0	0	0	30,000	0	0
Norway	Snilehorn	Statoil Petroleum AS	Statoil	11/11/13	282	60	60	0	0	32,000	35	0
USA	Mississippi Canyon 782 Dantzler (Rio Grande)	Noble Energy Inc	Noble	12/4/13	2006	60	60	0	0	20,000	20	0
Norway	Skavl (Johan Castberg South)	Statoil Petroleum AS	Statoil	12/9/13	349	30	30	0	0	10,000	12	0
Trinidad	Galeota TGAL	Trinity Exploration & Production Ltd,	Trinity	12/9/13	30	30	0	0	0	10,000	0	0
Norway	Askja East & West	Statoil Petroleum AS	Statoil	1/2/14	110	23	40	0	0	8000	30	0
UK	Liberator	Dana Petroleum plc	KNOC	11/22/13	116	12	0	0	0	5000	0	0

Top gas discoveries of the last 12 months

Country	Field	Operator	Operator Group	Discovery Date	Water Depth (m)	Oil Reserves MMBBL	Gas Reserves BCF	Condensate Reserves MMBBL	Condensate Estimate	Oil Production Rate BPD	Gas Production Rate MMCFD	Condensate Production Rate BPD
Tanzania	Mronge (Block 2)	Statoil Tanzania Ltd.	Statoil	12/5/13	2500	0	2000	5	1	0	300	1000
Egypt (Mediterranean)	Notus (El Burg)	BG Egypt	BG Group	1/1/14	90	0	1800	0	0	0	300	0
Malaysia	Sintok/Sirih (SK-320)	MDC Oil & Gas (SK320) Ltd.	Mubadala	12/13/13	100	0	800	0	0	0	200	0
Israel	Tamar SW (Med)	Noble Energy (Mediterranean) Ltd.	Noble	12/4/13	1647	0	700	0	0	0	240	0
Malaysia	Teja (SK-408)	SapuraKencana Petroleum Berhad	SapuraKencana	1/1/14	85	0	450	0	0	0	100	0
USA	Keathley Canyon 093 Gila	BP Exploration & Production Inc.	BP	12/18/13	1494	300	300	0	0	40,000	60	0
Brunei	Kempas (CA-2)	Petronas Carigali Sdn Bhd	Petronas	12/8/13	1600	0	300	0	0	0	100	0
Indonesia	Ratu Gajah	Premier Oil Natuna Sea B.V	Premier	1/1/14	80	0	225	0	0	0	80	0
UK	Pharos	Dana Petroleum plc	KNOC	11/17/13	38	0	200	0	0	0	60	0

Source: Infield Systems

The year's top oil discovery: Gila (Gulf of Mexico)

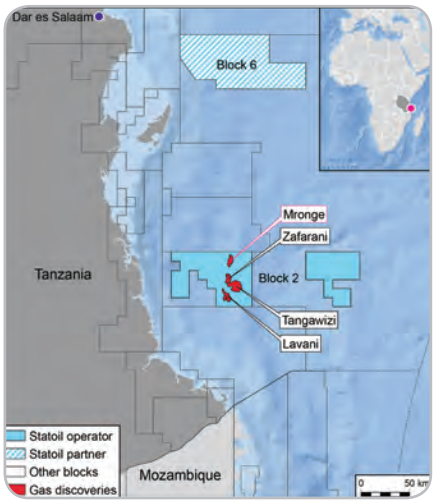
In December 2013, BP, and partner ConocoPhillips, celebrated a find at the deepwater Gila prospect in the US Gulf of Mexico. The well penetrated multiple Paleogene-aged reservoir sands. Gila was drilled by Seadrill's semisubmersible rig *West Capricorn* to a total depth of 29,221ft. Infield places the discovery at 300MMbbl of oil reserves and 300 Bcf of gas reserves. The Gila discovery resides in Keathley Canyon Block 93, about 300mi southwest of New Orleans, in 4900ft of water. BP holds 80% interest in Gila while partner ConocoPhillips holds the remaining 20%. Gila sits 25mi west of BP's 2009 4-6billion bo Tiber discovery in Keathely Canyon block 102.

Transocean's *West Capricorn* drillship is capable of operating at 10,000ft water depth and drilling down to 37,500ft.
Image from Seadrill.

Aerial views and onboard the drillship *Discoverer Americas* off the coast of Tanzania in September 2013.
Image by Paul Joynson-Hicks/AP/Statoil

This year's top gas discovery: Mronge (Tanzania)

Also in December 2013, Statoil, along with partner ExxonMobil, touted a fifth discovery in offshore block 2, off Tanzania. The Mronge-1 well contained 2-3 Tcf of natural gas, by Statoil's estimations, bringing total in-place volumes to 17-20 Tcf in Block 2. Drilled by Transocean's *Discoverer Americas* drillship, the Mronge-1 well discovered gas at two separate levels. The main accumulation is at the same stratigraphic level as proven in the Zafarani-1 well in Block 2. The Zafarani-1 discovery was made in 2012 and was a play opener for the block. Statoil operates the licence on Block 2 on behalf of Tanzania Petroleum Development Corporation (TPDC) with 65% working interest. Partners ExxonMobil Exploration and Production Tanzania Ltd hold the remaining 35%.



Map of Statoil-operated Tanzanian discoveries in offshore Block 2.
Image from Statoil

Biggest discoveries of the last 10 years

No end in sight for giant conventional discoveries

Despite the developments in unconventionals over recent years, giant conventional oil and gas fields continue to be discovered around the world. Over the past 10 years, eight of the top 10 discoveries have been offshore and have been transformational in opening completely new plays. This brief overview outlines these key project developments.

The top 10 discoveries of the last 10 years ranked in terms of their in-place resource volumes, are summarized in **Table 1** (see overleaf) and located in **Figure 1**. Values are expressed in barrels of oil equivalent (boe) to be able to directly compare oil and gas resources; in-place volumes have been used as these figures tend to be more widely quoted and for the as yet un-appraised and undeveloped fields, recovery factors are unknown.

What is interesting to note is their

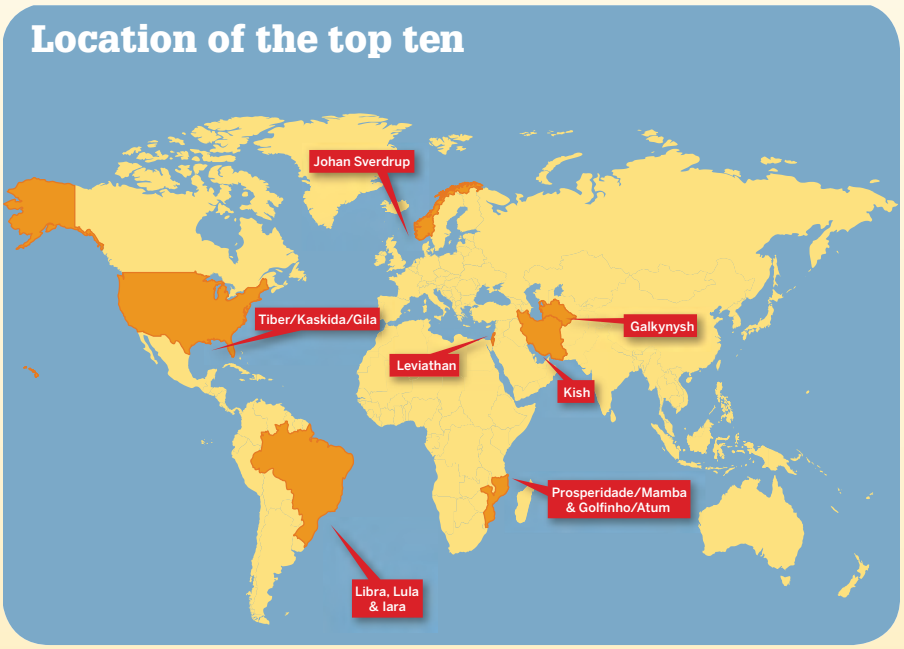


Figure 1. Source: Gaffney, Cline & Associates.

Top 10 discoveries of the last 10 years

	Field Name	Date	Operator	Region	Water Depth	Principal Reservoir	Main H/C type	Quoted volumes	Best estimate In-place resources Bboe
1.	**Galkynysh -**	2006	CNPC	Turkmenistan	Onshore	Jurassic Carbonates	Gas	462-745 Tcf	103
2.	**Libra**	2010	Petrobras	Brazil	5500-8000 ft	Cretaceous Carbonates	Oil	26-42 Bbbls	34
3.	**Lula**	2006	Petrobras	Brazil	~7000 ft	Cretaceous Carbonates	Oil	5-8 Bboe (recoverable)	28
4.	**Prosperidade / Mamba**	2010	Anadarko /Eni	Mozambique	~5400 ft	Tertiary Sandstone	Gas	103 Tcf	18
5.	**Iara**	2008	Petrobras	Brazil	~7400 ft	Cretaceous Carbonates	Oil	3.5 Bboe (recoverable)	15
6.	**Kish**	2005	NIOC	Persian Gulf	Onshore (Kish Island)	Permo-Triassic Carbonates	Gas / cond	66Tcf + 946 MMbbl	13
7.	**Golfinho/ Atum**	2012	Anadarko	Mozambique	~3400 ft	Tertiary Sandstone	Gas	15-35 Tcf (recoverable)	7
8.	**Tiber/ Kaskida/Gila**	2006+	BP	US GoM	~4100 ft	Lower Tertiary Sandstone	Oil	6+ Bboe	6
9.	**Johan Sverdrup**	2010	Lundin	Norway	400 ft	Jurassic Sandstone	Oil	1.8-2.9 Bboe (recoverable)	4
10.	**Leviathan**	2010	Noble	Israel	~5500 ft	Tertiary Sandstone	Gas	19 Tcf	3

Table 1: Top 10 discoveries (2004-2013), both on- and offshore, based on publicly quoted resource volumes, standardized to in-place boe. Quoted volumes are in-place unless otherwise stated. Source: Gaffney, Cline & Associates.

wide geographic distribution and that they comprise new plays in both already proven basins and in new petroleum provinces. Seven are located in deepwater, one on the shelf and two on land.

By far the most significant discovery since 2004 is the Galkynysh gas field (previously named Yolotan) onshore Turkmenistan. Over 100km long and with gas initially in place (GIIP) estimates ranging between 462 and 745 Tcf this discovery dwarfs all other finds, being the world's second largest gas field. Despite the gas being sour (combined 8-14% of H_2S + CO_2 impurities), the first phase of development was completed in 2013, with a capacity of 30 Bcm (over 1Tcf) per annum for export by pipeline to China.

The pre-salt in the Santos Basin, offshore Brazil, provides the fields in second, third and fifth places. Since the first discovery in this play by Petrobras in 2006, (Lula, original name Tupi) there have been high levels of activity and a number of giant accumulations, including Libra and Iara, have subsequently been discovered. Development of these fields have utilized enhanced oil recovery (EOR) techniques from the start, including water alternating gas CO_2 flood (WAG-$CO_{2)}$ injection. Whilst more than doubling Brazil's hydrocarbon resource base, the success of this play has led to pre-salt plays being actively pursued across the other side of the Southern Atlantic in Angola, Congo and Gabon.

Huge gas discoveries in the Rovuma Basin offshore Mozambique take fourth and seventh places in the rankings and are a new play and basin opener. Operated by Anadarko (Area 1) and Eni (Area 4) drilling activities have achieved phenomenal success with up to 150 Tcf already discovered. Commercialization is principally dependent on liquefaction and export, although many additional gas utilization options are also being considered. However, equally significant is that the results in Mozambique have opened up the whole of the East African offshore although individual discoveries are smaller, Tanzania has already confirmed up some 35 Tcf of gas in place.

Very significant discoveries in the Ultra-high pressure and high temperature (HPHT) of Gulf of Mexico (Tiber, Kaskida, Gila) and a normally pressured giant find in Norway (Johan Sverdrup) have confirmed new plays in established basins and perhaps encourage a fresh look at some of the world's more mature basins. However, the other discovery in the above list, which was part of a true game-changing basin opener, was the Leviathan gas field offshore Israel. Operator Noble, with the Leviathan and Tamar in Israel and a subsequent Cyprus gas discovery has put the eastern Mediterranean firmly on the map for the industry. OE

***Jeremy Berry** serves as global business development director at Gaffney, Cline & Associates. His primary technical strength is in the geosciences. Berry has an in-depth understanding of sub-Saharan Africa.*

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TOP 5

Top achievements in drilling technology

Top 5 drilling achievements	
1.	Better understanding of pore pressure and fracture gradient
2.	Improvements in drill pipe technology for wells over 30,000ft (md).
3.	Improved downhole drilling tools
4.	Drilling fluids
5.	Cementing technologies

List provided by Dr. Neal Adams, adjunct faculty and research associate in petroleum engineering at the University of Houston.

OE spoke with experts from Halliburton, Hess and Weatherford to answer the question: "What have been the top achievements in drilling technology in the last five years?"

Hess Corp.

Today's search for energy often involves accessing multiple reservoirs with a single wellbore to economically produce hydrocarbons. Complex drilling and completion challenges must be managed to deliver a completed well with a reliable life expectancy. Developing new enabling technologies continues to be an important part of enhancing production and improving well delivery economics.

For example, multi-zone stimulation and sand control are required to deliver the value at one of Hess Corp.'s Gulf of Mexico offshore projects. The cost and complexity of remedial stimulation of these subsea wells requires the stimulation is done right the first time. Value is maximized when all zones can be delivered with a single trip multi-zone system. After evaluating several commercial systems for the ultra-deep completion, a new design for the casing size is underway and will be tested on land prior to offshore use.

In the onshore world of the Bakken in North Dakota, it was evident early in development that Hess needed multi-zone completions to be successful. Plug and perforation could deliver the number of zones, but not the efficiencies needed to satisfy well economics. We worked with vendors to design, test and deliver sliding sleeves to increase the number of completed zones to 18 to 40, instead of the 8 to 10 previously available. Hess takes learning like this and applies it globally. For example, technology developed for the Bakken is used to complete offshore wells in Denmark to further maximize well value.

Drilling methods continue to evolve to create wellbore for environments with pore pressure and fracture gradient issues resulting in tight drilling windows. Hess uses enabling technologies such as underbalanced, managed pressure, and air drilling with low rheology drilling muds and cements to improve wellbore pressure control in more than half of our current projects. Another example of improved drilling methods is on-command expandable reamers for hole enlargement to help reduce equivalent circulating density during drilling and casing installation. The latest generations of rotary steerable tools improve our ability to more precisely place wellbores to maximize production with better reliability and reservoir evaluation telemetry.

Equipment reliability is a cornerstone of drilling and completion performance. Hess' quality assurance program partners with contractors to align objectives and expectations to create a clear plan for controlled equipment deployment in the field. Continuous improvement methodology ensures the overall service delivery processes are actively assessed for opportunities based on industry performance data. This approach ensures reliability can be planned into the business while managing the reactive aspects inherent in well operations.

Operators face the challenge of engineering and integrating these capabilities into a well design for operations teams to deliver. A robust well delivery process organizes the technical work and leverages past learning to find the best engineering solutions to maximize the value of the well.

The Tubular Bells development in the Gulf of Mexico. Photo from Hess Corp.

Matthew Isbell *serves as a drilling optimization advisor at Hess, specializing in drill bits and drilling optimization. He holds 26 drill bit patents and has published 23 technical papers. Isbell has held a number of drilling technology roles in R&D, field engineering, marketing and managerial roles.*

XBAT azimuthal sonic and ultrasonic LWD. Image from Halliburton.

Halliburton

The drilling industry has seen two major inflection points in the last five years – proliferation of horizontal drilling linked to the growth of unconventional drilling and accessing complex reservoirs in deeper water environments. Both of these challenges have guided the key technology developments and applications.

The first major inflection point was the advent of horizontal drilling required to economically exploit the unconventional resources and the consequent development of drilling systems that were efficient, able to deliver high dog leg wellbores and highly reliable to avoid multiple trips into the wellbore. An additional feature has been systems that can drill the entire well trajectory in one run i.e. avoid downhole drilling assemblies that are specific to a hole section. This major development can be summarized as the High Dog Leg Rotary Steerable Drilling systems provided by various major service companies. The need for efficiency has also led to a resurgence of drilling mud motors (positive displacement motors), including customized high performance basin specific mud motors.

A related development has been the need for drill bits that are matched or aligned with these new drilling systems and a number of new drill bits have emerged especially for the high dog leg efficiency drilling.

The next major development has been the drive to acquire information in drilling time and not post drilling. This has led to the increase in measurements while drilling/ logging while drilling which in turn has supported well bore integrity and well bore stability during drilling operations. The most notable achievement has been the sonic and high resolution imaging LWD systems.

Another major development in the drilling world has been the move to complex geologies and Deepwater prospects where maximizing reservoir recovery through placing wells in the best spot has been challenging. A major sweep of developments in well placement tools (Geosteering tools) and planning tools has helped the industry make a step change in well economics. This is an area of continued rapid development where the reservoir models will evolve in real time as the well placement tools observe reservoir horizons.

The last and probably highest impact trend is moving from drilling tools to performance based matched drilling systems. A system involves the drill bit, the drilling bottomhole assembly (BHA) and the fluids (the mud system). This integrated approach has allowed the service providers to match the best systems, leverage on past knowledge and add a common consolidated planning platform, with technical experts to help reduce risk to the operators. The integrated drilling systems approach projects have in most cases outperformed standard discrete product-based projects. The integrated drilling systems will eventually lead to automated systems in the near future with access to global lessons learnt and technical expertise as well as address the critical industry need to reduce rig site personnel.

***Akshay Sagar** is the global business manager for Drilling and Drilling Engineering Solutions for Halliburton (Sperry Drilling). Akshay looks after the Drilling Engineering Solutions (DES) group – Sperry's latest integrated service offering. He also looks after the Directional Drilling portfolio and strategy and future roadmap. He received a Bachelor of Technology with a concentration in civil engineering from the Indian Institute of Technology in New Delhi and an MBA from the Rotterdam School of Management in Holland.*

Weatherford

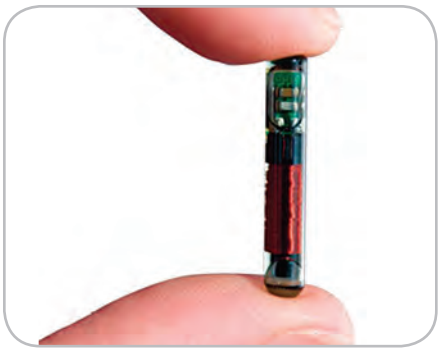
As drilling operations keep moving to deeper waters and more remote reservoirs, conventional means of downhole tool activation are unable to keep pace. Mechanical actuation via ball drop, shear pins or push-pull mechanisms means that tools may only be opened or closed one to two times before the entire bottomhole assembly (BHA) must be pulled to replace the equipment.

Weatherford has called on its 80-year history of providing high-performance drilling tools to address the limitations of mechanical actuation. One area of focus is the development of drilling tools that are activated and controlled via radio frequency identification (RFID). Programming and pumping small RFID tags downhole to control equipment in the BHA provides several benefits to well construction, chief among them the ability to activate and deactivate a tool multiple times and on demand. The tool can thus remain in the hole for much longer than tools controlled by mechanical means, which improves drilling efficiency and lowers rig costs.

Weatherford's RipTide RFID drilling reamer, for example, is the industry's first high tech, intelligent underreamer. Fitted with RFID technology, this drilling underreamer is capable of being activated and deactivated on demand multiple times while tripping or drilling. The ability to control when the premium PDC cutter blocks are deployed during borehole enlargement operations is key to increasing drilling efficiency.

The JetStream RFID circulation sub builds on the success of the RipTide. With its RFID-activated circulating valve, the JetStream features essentially unlimited opening and closing capability, without the need for flow-restricting mechanical actuation devices such as ball seats. This provides full-bore pumping and improved hole cleanup at higher annular velocities.

Most recently, Weatherford introduced the RipTide RFID Rathole Killer, an underreamer based on the RipTide RFID technology but designed for placement between the BHA's measurement-while-drilling (MWD) tools and the rotary-steerable system (RSS). Unlike the conventional RipTide reamer that is placed above the MWD assembly, the Rathole Killer is opened and closed via pump-cycle activation to underream the rathole section of the well. The tool's



RFID technology. Photo from Weatherford.

position in the BHA allows for a significantly shorter rathole (to just a few meters above the RSS), without having to trip out of the well for a dedicated cleanout run.

These deepwater-proven technologies are actively being deployed in high-profile wells where performance, reliability and innovation are required. And because these tools contain pressure sensors, they can be actuated via pump cycle, a major benefit in deepwater and long-lateral wells that limit the effectiveness of ball drop-activated tools.

These tools also have the capability of recording drilling data via onboard accelerometers, pressure transducers and temperature sensors, making them from intelligent measurement and control devices. Weatherford continues to develop RFID-enabled versions of other tools that are currently mechanically activated, thus revolutionizing their use for drillers' most demanding applications. OE

Eddie Valverde *is Weatherfords's global product line manager, Performance Drilling Tools. He joined Weatherford in 2009 as Global Product Line Manager where he has spent the last five years developing and commercializing RFID enabled downhole drilling tools. He graduated from Stephen F. Austin State University, Nacogdoches Texas, in 1995. He began his oilfield career with Smith International and held various positions including International Sales Manager, Product Line Technical Specialist, and Regional Operations Manager.*

Chevron's deepwater bet

By Elaine Maslin

Deepwater is a big play for Chevron – one which comes with challenges that the super major is working hard to overcome.

According to Craig May, managing director Chevron upstream Europe, Chevron's deepwater production, which includes a broad portfolio of projects from heavy oil to sub-salt, "big gas" and LNG, will almost double by the end of the decade.

Technology, he says, will be key to enabling projects, but also reducing costs, he says, and while new technologies had already pushed boundaries, to continue pushing the deepwater envelope, more need to continue to be developed, not least in drilling and completion.

"Technology is enabling deep water development by making the impossible possible and the possible less expensive," he said during a deepwater-focused prevention in Aberdeen in October.

"Records continue to be set around the world as the industry explores deeper prospects. We have moved from bigger to smarter developments and we need to continue to be smarter. Technology needs to deliver cost reductions to create a future for field developments and improve competitiveness on existing assets."

May says Chevron's deepwater technology vision spans from "the top to the bottom," from dry tree solutions to seismic imaging.

Subsea imaging, drilling and completions, subsea systems, floating production facilities and safe operations, are some of the key areas Chevron is working on, says May.

Transocean's drillship *Discoverer Deep Seas*, which drilled at Chevron's Tahiti prospect. Image from Chevron - Statoil ASA

Dual gradient in deepwater

Looking at drilling specifically, Chevron's drilling efficiency program has been looking at dual gradient drilling, May says.

"Dual gradient drilling is a great example of where the impact of water depth on mud weight is eliminated by placing the mud pump on the sea floor. So this removes the riser effect and is essentially like drilling the well on the sea floor," he says.

Chevron is currently using dual gradient drilling technology in its exploratory drilling. "The dual gradient drilling technology creates a step-change in our safety exposure by simplifying the well designs and reducing the drilling bundle," May says.

"Benefits include fewer casing runs, as well as larger casing at the reservoir depth, which gives us more completion options. Advanced drilling efficiency initiatives have helped reduce drilling times and therefore explosive times in the Gulf of Mexico Wilcox trend from over 160 days in 2004 for Chevron's Jack number 1 well to 80-90 days per well by 2009, so quite a significant prize."

Clever completions

Technology is also helping to optimize completions and significantly reduce the cost, May says.

In the Gulf of Mexico, where the lower tertiary reservoirs have low permeability, achieving high fracture rates requires fracture stimulation, he says. "Thick intervals require 3-5 frac packs."

In 2007, Chevron teamed up with Halliburton to design and build a new system – an enhanced single trip multi-zonal completion system. It is a downhole completion system, which includes a Schlumberger insider perforating gun to minimize shock and debris, that enables Chevron to stimulate and gravel pack thick multiple completion zones in a single trip.

The completion challenges in a lower tertiary trend are the combined reservoir pressures, and 1400ft interval lengths, May says. Yet, using this system has enabled Chevron not only to be more efficient, but also save costs.

"Halliburton's enhanced single trip multi-zonal completions are an example of deploying a new technology that took early vision, early commitment and early partnership nearly 10 years ago," May says. "After the Jack and St. Malo discoveries in 2003 and 2004, we realized we would need a step change in our completion practices to reduce the cost.

"So far we've used that single trip system on four completions, we've seen savings of approximately $150 million, when compared to the conventional completion methodology," May says. "We've successfully executed the technology for both the cased hole and openhole systems, and we verified that we've had quality completions through a drill stem flow test on two of the completions, one in Jack and one in St. Malo."

Intelligent well completions providing zonal control and sand face monitoring offer further potential. They can help sustain and improve recovery factors on secondary and enhanced oil recovery projects, May says.

Chevron successfully installed intelligent well completions on subsea wells on its Gulf of Mexico Tahiti project. "Next, we want to install these on lower tertiary completions with their even higher reservoir pressures," May says.

Dry trees - lower drilling costs

Dry tree concepts could also save cash and make drilling and intervention easier and cheaper he says. Chevron is working on two dry tree semisubmersible concepts, with Kvaerner and HOE, to bring such benefits.

"Compared to current wet tree systems, dry tree systems can improve reservoir management and reduce well intervention, resulting in increased rates and recoveries," May says.

According to DeepStar's database, for Gulf of Mexico Miocene developments, dry trees can offer a 5% incremental recovery, or in some cases, as much as a 20% incremental recovery, "which is a very significant prize," May says.

"Incremental recovery in Wilcox reservoirs is estimated as a bit lower at 3-5%, but this is still a very significant prize. This is a result of the lower well costs, which enables more wells to be drilled, with tighter well spacing, and also provides lower costs for infield interventions."

"Chevron leads the industry in maturing two promising dry tree semisubmersible concepts," May adds. "Semisubmersibles do not have the payload restrictions of the Spar, or the water depth limitations posed by a tension leg platform. Direct access to wells will limit dependence on mobile offshore drilling units. Quayside integration would reduce costs and schedule risks."

The dry tree semi could be a technical enabler, when large payload and water depth are required, perhaps a commercial enabler for marginal fields when increasing recovery rates and reducing costs associated with drilling, completion and intervention of subsea wells are key to commercialization, he adds.

Reducing costs

Records continue to be set around the world as the industry explores deeper prospects, May says. "Costs need to be reduced," May says. "Using technology to reduce the time it takes to achieve completions is helping Chevron.

"We have moved from bigger to smarter developments and we need to continue towards smarter. Technology needs to deliver cost reductions to create further for field developments and improve competitiveness on existing assets. Producing assets will need less complex incremental technology with immediate impact. We need to look out at what other industries are doing and overcome resistance to things 'not invented here.' In areas where intellectual property is less sensitive or the price is so large it is to everyone's advantage to work together." OE

TOP 5

The biggest projects

OE asked Infield Systems to provide insights on today's biggest offshore oil & gas projects.

What makes a mega-project in the offshore oil and gas industry? Is it the cost? The size of the reservoir? The number of people or man hours involved? Or how long it will produce for? Any which way you look at today's mega-projects, they are big, and they are getting bigger, especially for international oil companies.

Infield Systems set out the top five global offshore projects current under development by capital spending, and the top 10 offshore field developments by reserves on stream. Compare the two and you get a very different picture.

The demographic differences between the two are stark. Four of the top 10 biggest fields by reserves on stream, including the top four, are in the hands of national oil companies. The top four are three phases of one field, South Pars, owned by the National Iranian Oil Company. The top eight of the 10 are all in shallow water.

For the offshore projects currently under development, all but one project is in more than 200m water depth, increasing to 1274m for Statoil's Aasta Hansteen Spar. The projects are dominated by large pieces of offshore infrastructure, be it a concrete gravity based platform offshore Canada (Hebron), a steel jacket supported platform in the North Sea (Mariner) or an FPSO (Prelude and Ichthys). ■

Top five global offshore projects currently under development

(by capital spending)

Field development	Operator	Country	Water Depth-m
Ichthys	Inpex	Australia	230
Hebron	ExxonMobil	Canada	93
Prelude	Shell	Australia	200
Aasta Hansteen	Statoil	Norway	1274
Mariner	Statoil	UK	110

Top 10 offshore field developments under development

(by total reserves on stream)

Field	Operator	Country	Water Depth - m	Total reserves
South Pars (Phases 13-14)	NIOC	Iran	65	6489.15
South Pars (Phases 15-16)	NIOC	Iran	65	6489.15
South Pars (Phases 17-18)	NIOC	Iran	65	6489.15
Qatar North Field Barzan Project (Phase 1)	Qatar Petroleum	Qatar	55	3128.8636
Perla (Gas Phase) (Cardon IV Block)	Eni	Venezuela	60	2397.748
Point Thomson (Beaufort Sea)	ExxonMobil	USA Alaska	5	1786.745
Arkutun Dagi (Sakhalin 1)	ExxonMobil	Russia (Sakhalin)	35	1482.132
Sihil (Main Phase)	Pemex	Mexico	70	1395.0358
Iracema North (Lula NW) (BM-S-11)	Petrobras	Brazil	2234	1282.088
Gorgon Central (WA-2-R) (Greater Gorgon Area)	Chevron	Australia	250	1253.352

Mega-projects: mega spending

Offshore oil and gas mega projects are increasing in scale and cost. Some 41% of ExxonMobil's 2015 capital spending for projects under construction in 2015 is likely to be directed to one project alone. Neda Djahansouzi, Energy Researcher, Infield Systems, takes a look at the top five projects, by capital spending, in 2015.

Infield Systems profiles the top five most capital intensive offshore oil and gas projects currently under development, Infield Systems expects these to comprise the Ichthys, Hebron, Aasta Hansteen, Prelude and Mariner fields.

Ichthys (WA-285-P)

Located in the Browse basin, offshore Western Australia and targeting 12.8Tcf of natural gas and 527MM bbl of condensate, in waters just 230m deep, the Ichthys field is deemed a giant field. Operator Inpex and its partners are currently aiming for a 2016 start-up, with gas to be exported via an 889km subsea pipeline to onshore processing facilities in the Northern Territory, while condensate from the field will be pumped to an FPSO.

Infield Systems' forecasts suggest that expenditure, in 2015, on the Ichthys field is likely to be 39.5% greater than any other global fields currently under construction. With 92.8% being invested in the floating platform facility and the remainder directed towards the SPM element of the project.

Like most operators, Inpex is looking to cut the escalating costs of its projects

and has therefore recently farmed out 1.2% of its stake to Kansai Electric Power, following a similar deal in June to sell 2.625% to CPC. Once finalized, Inpex will hold 62.245% operatorship, alongside Total (30%), Tokyo Gas (1.575%), Osaka Gas (1.2%), Chubu Electric Power (0.735%) and Toho Gas (0.42%).

Hebron

ExxonMobil's Hebron oil field in Canada will require the highest level of fixed platform expenditure in 2015. The field will be developed using a gravity-based structure, designed to provide production and accommodation facilities. Infield Systems projects that 41% of ExxonMobil's Capex for projects currently under construction in 2015 is likely to be directed towards Hebron, revealing the scale of the project.

The Hebron oil field is 350km offshore Newfoundland in 93m water depth. The field is estimated to produce 705MM bbl and Infield Systems forecasts first oil by mid-2017. ExxonMobil owns a 36.3% stake in partnership with Chevron (26.6%), Suncor Energy (22.7%), Statoil (9.7%) and Nalcor (4.9%).

Three consortia are currently bidding to secure a major topsides integration contract for Hebron's gravity-based structure. Amec has teamed up with Black & McDonald, Wood Group PSN with GJ Cahill, and Kentz has partnered with Kiewit and Kvaerner, in order to meet the province's stringent local content requirements.

Aasta Hansteen

Due on stream in 2017, Aasta Hansteen is the deepest field development on the Norwegian Continental Shelf (NCS) and will use the world's largest spar platform to be installed at 1274 water depth. The Aasta Hansteen discovery is 295km offshore Norway and contains an estimated 1.35Tcf reserves.

The Aasta Hanteen project is currently the most expensive in Europe, due to the relatively high cost of the platform and associated infrastructure. Consequently, Statoil recently sold part of its stake to Wintershall in order to help reduce risk and cost. Statoil remain the operator of Aasta Hansteen with a 51% stake. Wintershall hold a 24% stake, with other partners including OMV (15%) and ConocoPhillips (10%).

Infield Systems remains cautious in its profitability projections for the project, after the recent shelving of the Zidane, Linnorm and Kristin gas export projects. Profitability will be dependent on new discoveries.

Prelude (WA-371-P)

The Prelude natural gas field was discovered by Shell in 2007 and contains 3Tcf. It is in the Browse basin, offshore Western Australia, in 200m water depth. The field is operated by Shell, with a 67.5% stake, along with Inpex (17.5%), KOGAS (10%) and OPIC (5%).

The relatively small size of the field and the remote location led Shell to choose to invest in one of the world's first FLNG facilities. The *Prelude* FLNG facility is being built at Samsung Heavy Industry's Geoje Island shipyard in South Korea. Once complete, it will be 488m-long, 74m-wide, weighing more than 600,000-tonne, and is expected to produce 3.6mtpa of LNG per annum to meet growing demand in Asia.

As FLNG technology is still in its infancy, the project is forecast to be extremely capital intensive.

Mariner

The Mariner heavy oil field is in the northern section of the UK North Sea and in 110m water depth. Statoil operates the field, with a 65% interest, with partners Nippon Oil (28.9%) and Dyas (6%).

Due to the heavy oil in the field, Statoil chose to develop it using a production, drilling and quarters platform based on a steel jacket, tied-back to a floating storage unit. Infield Systems expects production from Mariner to start in 2017. The piled platform is likely to demand a 95.5% share of this project's Capex in 2015; almost 50% of which will relate to its installation, while the remainder will be invested in the procurement and construction of the fixed platform. A mere 4.5% of Capex is directed towards the floating storage unit, with capital expenditure on this element of the project expected to extend to 2017. OE

***Neda Djahansouzi** is Energy Researcher at Infield Systems. She joined the company in March 2014 and is responsible for updating Infield's Energy Database and supporting the Business Strategy and Transaction Services department. Neda holds a first class BSc. (Hons) degree in Management with Marketing from the Robert Gordon University.*

The mighty Johan Sverdrup

A new and exciting chapter has opened in the history of the Norwegian Continental Shelf. Meg Chesshyre reports.

Statoil has a tight development program for Johan Sverdrup, targeting first production from the giant oilfield by the end of 2019, with a pre-drilling phase starting in 2018.

The field, sitting on the Utsira High in a mature part of the Norwegian North Sea, is the largest offshore oil find in Norway for 30 years. With estimated reserves of 1.8-2.9 billion boe, it has a production horizon beyond 2050. It is expected to produce 550,000 - 650,000 boe/d when fully developed,

The impact of this massive project on Norwegian industry and society "cannot be exaggerated," says Statoil's senior vice

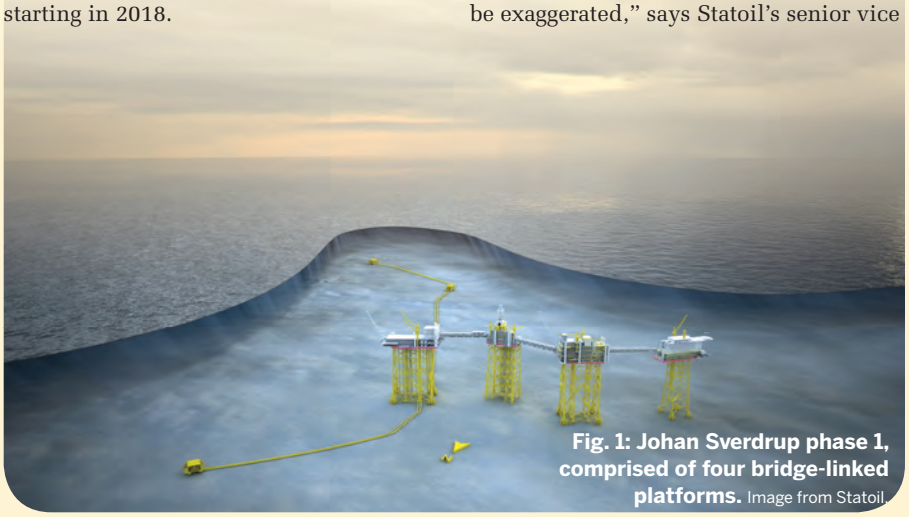


Fig. 1: Johan Sverdrup phase 1, comprised of four bridge-linked platforms. Image from Statoil

president for the Sverdrup development Oivind Reinertsen. "It represents a new and exciting chapter in the history of the NCS." Total investment will range between NOK100 billion and NOK200 billion, and operational costs for phase 1 will be from NOK3 to NOK5 billion per year. The investment in phase one is put at NOK100 – 120 billion alone.

The Johan Sverdrup field extends over about 200sq km, an area about half the size of Greater Oslo. "We have an ambition for this field to produce up to 70% of the oil in place," says Reinertsen.

The Johan Sverdrup discovery was made in 2010, (originally named Avaldsnes) and 2011, (Aldous Major) by Lundin and Statoil, respectively, in an area where oil activities on the Norwegian Continental Shelf started. The fields are situated in the two old production licenses 1 and 7, first awarded in 1966 and 1972. The first exploration well drilled on it back in 1967 was the second exploration well ever drilled on the NCS.

The water depth, at only 120m, means that the field can be developed using cost-efficient jacket solutions. Water injection will be the primary drive mechanism, with gas lift as artificial lift.

Aker Solutions received a framework contract from Statoil in December 2013, to provide engineering services, procurement and management assistance (EPMa) for as many as 10 years at Johan Sverdrup. The contract includes front end engineering and design (FEED) work building on concept studies Aker Solutions carried out last year. Aker Solutions has assembled one of its biggest engineering teams ever, involving 400 employees in Oslo and London, to deliver the initial plans for the engineering and design phase.

The final FEED report is slated for delivery before the end of the year [2014] and will be used by the field partners to make a final investment decision for the first phase development. A plan for development is then expected to be submitted in February 2015 to Norwegian authorities for approval. The next stage, after approval, will be detailed design and procurement services. Aker Solutions' contract with Statoil has an EPma option for the development's first phase and additional options for work in later phases.

Fig. 2: Core sample at Johan Sverdrup.
Photos from Annette Westgard, Statoil.

Fig. 3: Core samples at Johan Sverdrup.

Fig 4. Core sample at Johan Sverdrup.

Multiple phase development

Johan Sverdrup will be developed in multiple phases. This first will consist of a field center with four bridge-linked processing, drilling, riser and accommodation platforms (Figure 1). These will be designed to allow for future expansion. The reservoir is at a depth of 1800-1900m.

The oil handling design capacity of the process platform will be 315,000 boe/d divided into two trains and gas capacity 6Mcu m/d. The processing system includes three stage separators, gas dehydration and gas recompression equipment, gas export compressor, gas-fired heaters, produced water processing equipment etc. The topsides will measure 100m x 25m and will have a dry weight of 23,000 tonnes.

- The riser platform will be a combined riser/utility platform, providing water and chemical injection, oil and gas export, and field power, which can be used for future tie-ins. The platform will be designed for a total of 45 risers and J-tubes as well as 10 caissons. The topsides will be supported on an eight-legged jacket structure. The topsides will be 125m x 30m, and the dry weight will be 19,000 tonnes.
- The drilling platform will also provide well bay, production and injection manifolding functionality. The topside will include a module support frame, drilling support module and drilling equipment set. Ancillary equipment includes two platform cranes and supports for bridges to the riser and process platforms. The platform is based on a 4 x 12 well slot configuration, giving 48 well slots in total. The topside dimensions will be 40m x 83m with a dry weight of 15,000 tonnes.
- The living quarters platform (LQ) will provide 450 cabins and serve as the field center (control room) for operations and telecommunications. It will contain workshops/stores and provide emergency power and other utilities for the field. The main mustering stations, equipped with nine lifeboats, will be located on the LQ. A permanently stationed search and rescue helicopter will be based here. The topside dimensions will be 85m x 28m and the dry weight 16,500 tonnes. There will be three trussed-structure bridges of various lengths (80-120m).

In June this year, under a newly-signed five-year agreement, Kvaerner was given a letter of intent to engineer and build the jackets and piles for the riser and drilling platforms, with delivery in summer 2017 and spring 2018, respectively. The engineering is being performed at Statoil's offices in Oslo and the structures will be built at Kvaerner's Verdal yard. The field will be operated by electrical power generated onshore. ABB has the FEED study for the power plant and National Oilwell Varco for the drilling equipment. Kongsberg is performing FEED for safety and automation systems and IKM Ocean Design for the infield pipelines.

Oil will be exported to the Mongstad terminal by a 275km, 36in pipeline and gas to Kårstø via a 165km pipeline which will tie into Statpipe. Pipelay is scheduled for 2018.

Johan Sverdrup is in blocks 16/2, 16/3 (PL501, PL 265) and 16/5 (PL 502). The partners in three production licenses are: Statoil, Lundin Norway, Petoro, Maersk Oil and Det norske oljeselskap. It is the result of discoveries by Lundin on the Avaldnes prospect and Statoil on Aldous Major in 2010 and 2011. OE

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TOP TRENDS

EnQuest workers in the North Sea.
Photo from EnQuest.

Optimizing options

Late life production optimization is hard, but interesting, according to those tackling the issue. Elaine Maslin provides an overview of recent trends.

As natural production rates wane and assets start to age, optimizing production rates offshore becomes a key challenge for operators, not least in the North Sea.

Some 50% of UK North Sea facilities are at or beyond their design life. Barrels of oil are getting harder and more expensive to extract and the basin has seen production efficiency rates fall from an average 81% in 2004 to 60% in 2012, according to figures from the Department of Energy and Climate Change (DECC).

According the production efficiency task force, led by industry/government group Pilot, in 2013, individual operator production efficiency rates ranged from 35% to 90% (the higher rate achieved by Apache North Sea, which is on track to reach 94% in 2014).

According to North Sea independent EnQuest's North Sea president Neil McCulloch, the industry should be "shocked, depressed and embarrassed" by the low average rate.*

But, the emerging trends on how operators approach optimizing production operations on their assets diverge, Offshore Network's Offshore Production Optimisation conference heard in Aberdeen in November.

EnQuest, whose production efficiency rate is in the top quartile of the Pilot production efficiency task force rankings, is focusing on investment, empowering asset "owners," then sharing results.

On the other hand, Nexen Petroleum UK, a CNOOC subsidiary, has focused on organizational change, recently introducing an across-discipline and across-asset approach in its business, following initial efforts focused solely on its Buzzard facility.

Meanwhile, oil major BP is using its computing power to employ a system modeling and optimization approach, which is calls its Modeling-Based Optimization System (MBOS) program.

Offshore Norway, Germany-headquartered operator Wintershall has increased production on Brage through investment, in the asset, but also on seismic and infill drilling. It is now looking to see where is can improve its maintenance program.

EnQuest

EnQuest has invested and is continuing to invest in its assets, which it took over in 2010, as well as drilling new wells, according to McCulloch. Last year, as a result, EnQuest achieved 83% production efficiency across its North Sea portfolio. In 2014, year to date, it is 90%.

"Despite the age of our asset base (about two thirds of EnQuest's assets are beyond their design life), we've maintained a largely flat operating cost over four and a half years," McCulloch says. Since taking over the Kittiwake platform in March this year, the firm has more than doubled production and halved operating costs per barrel, he said, with more still to come from the asset.

"We believe that high production efficiency is no accident," McCulloch says. "Part of it is capital investment. We invest and we see the results. It is also an intense focus on operational delivery and results. It is a relentless focus in operations and projects, on things such as production efficiency and life extension. Every day offshore the out-put production is a result of all the inputs. It is how the operators and their supply chain go about their daily business – hourly, weekly, yearly. We all have to look at that. One of our philosophies is minimizing waste and controlling our costs and also fundamentally maintaining the integrity of our assets, that's

extremely important to us."

EnQuest has seen 84% production growth on the Thistle platform since it took the facility, and a tranche of others including the Heather platform, in 2010, from a Lundin and Petrofac joint venture.

First, production from Thistle, which is 275mi north east of Aberdeen, in 161.5 water depth, was in 1978, with a planned 25-year operating life. Up to the end of 2013, Thistle had produced 10MMbbl. EnQuest has since added 20MMbbl of reserves to Thistle through drilling and a late life extension project, McCulloch said.

The project, called LLX, saw £170 million spent extending the facilities on Thistle, shooting new seismic, reactivating the drilling rig and investing in the well stock. The firm also invested in making sure electrical submersible pumps got reliable power and brought the platform's controls systems "into the 21st century."

When EnQuest acquired Thistle it was producing about 3000bbl. Enquest increased that to about 18,000 and now it is at about 10,000, McCulloch says. "Ninety percent of that production is from wells we have done something with – whether it is an intervention, a workover or a new well or if we have added an ESP," McCulloch says.

EnQuest is planning to the same on its Heather, from which it has just completed the first couple of workovers in about 10-11 years.

Nexen

Nexen has been using the Choke model, set out by BP in SPE paper 36848, to capture losses data and move forward to improve efficiency. The choke model looks at four main elements – reservoir, wells, plant and export systems, says Dennis Johnston, production engineer, Nexen.

Part of the problem, Johnston says, is that operators do not always understand their efficiency rates. How operators assess what they are doing to reduce losses is not always clear either, with no real system to close loops on losses identified, other than action-based systems, with loss entries often not reviewed diligently and different shifts having different views.

Nexen has been investing in its surveillance and extracting more data, as well as building digital oil fields to help process the data, to better understand its losses. Nexen is also performing more process trials, to determine capacity where it is uncertain what is possible.

But, the firm is also adapting its organization. "Mostly we have the tools and technology to optimize production better. But we are not using it in the best way," Johnston says. "We have set up a new multi-disciplinary optimization group, which is coming into effect right now, fully focused on measuring losses and how to optimize them across assets. It is a reorganization in Nexen, moving from asset-based support groups to functional support groups."

Nexen is also developing a step-up culture for staff to "own barrels," he says. "Quite often people don't recognize they can influence barrels can be added," Johnston says. Nexen is also focusing on competences and training. Control room operators have been rotated through a gas lift awareness course, for example. "We also have an opportunity register. Investments that might debottleneck operations and across asset and discipline, such as well intervention," Johnston says.

BP

BP also has a multidisciplinary production enhancement team, but it has gone a step further, creating a modeling-based system optimization program, which it calls MBOS, to improve optimization.

"In 2013 we set the challenge, are we optimized? We needed to do something differently," says Gillian Goby, production enhancements team leader, BP.

"The first step was to enhance the tool set we had and the final step was to find new ways of working," she says. "The application itself is automated, creating a simulation every week, as a minimum, as well as when it is needed. The simulation shows teams what the optimum production could be on the asset, this is then compared to the actual output, and the gap identified and actions drawn up to close the gap. You have to be skilled to build MBOS application, but for the end user it is easy to use."

"We do now have a tool to measure if we are optimized," she adds. "We believe we are optimizing production by 1-4%. MBOS is also good for modeling 'what if' scenarios and more and more engineers out-with the immediate team are coming to us with these."

Wintershall

Wintershall, like EnQuest, took over an asset that had already been producing for a number of years. The firm took over operatorship of the northern Norwegian North Sea Brage platform, its first operated producing asset, in 2013.

The firm initially focused on investment, debottlenecking, and technical integrity on Brage, says Alv Bjørn Solheim, technical director and deputy managing director, Wintershall. Work included infill drilling, but because drilling from the Brage facilities was restricted to within 9300m, the firm is assessing a subsea template for new production wells in the north of the field.

Drilling would then be via a rig in the field and the one of the Brage facility, Solheim says. Wintershall shot new seismic over the area this summer and will look to start execution phase in 2016, with marine operations in 2018, and first oil in 2019. But, the new subsea template project will be dependent on project economics, which are marginal, he says.

Control systems on Brage also needed changing and work to "shape-up" the platform needed to be done. Longer term, "We want more collaboration, gluing together the onshore and offshore via video conference and modern technology, Solheim says.

"We are also looking into the maintenance system, all the critical maintenance that we have and the frequency of the maintenance. It was put in place in 1993, or even 1992, when the platform was built, and has not been looked at since then. "Late life is a hard life but it is also exciting." OE

EnQuest's Kittiwake platform in the North Sea. Photo from EnQuest.

FURTHER READING

Read "Production Efficiency Pain & Gain" on OEDigital.com.

Production optimization trends

We asked production optimization specialists their views on the latest trends in the area. Skills comes high up the list. Elaine Maslin sets out the results of our survey.

Topside activities are currently the biggest challenge to production optimization in the North Sea, according to production optimization industry personnel.

However, staff skills and knowledge shortages come a close second, according to the poll, carried out by Offshore Engineer and event organizer Offshore Network.

Moreover, more than half of those surveyed said that the greatest short-term impact to production optimization would be better offshore operations management program.

More than a third of those who responded to the survey said the biggest challenge was topsides activities, with just under a third saying staff skills and knowledge was the key challenge.

The difficulties around getting new technology accepted was also cited as a challenge.

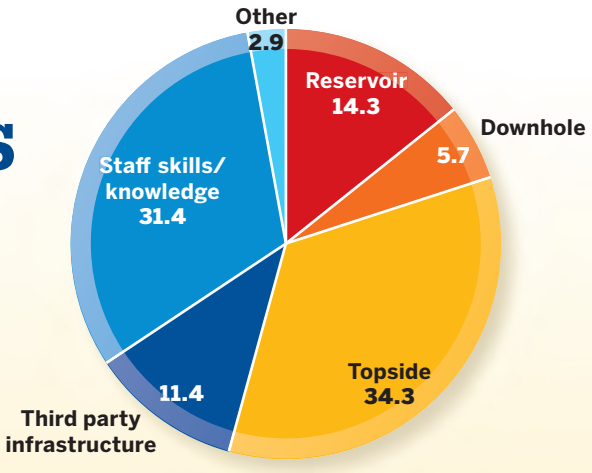
Nearly half of those asked said the greatest short-term impact to production optimization would be better offshore operations management program. A fifth said technologies, such as artificial lift or enhanced oil recovery methods, would bring the greatest short term impact.

When it came to making a longer-term impact on production performance, choices were more evenly spread. A 28% majority said capital investment would have the biggest long term impact, 20% and 17%, respectively, cited better offshore operations management, and better reservoir management and technology, such as artificial lift and EOR. In addition, respondees suggested greater standardization to make improvements more economically viable and tax cuts for older fields.

Asked how the industry could make better use of data, delegates suggested the following:

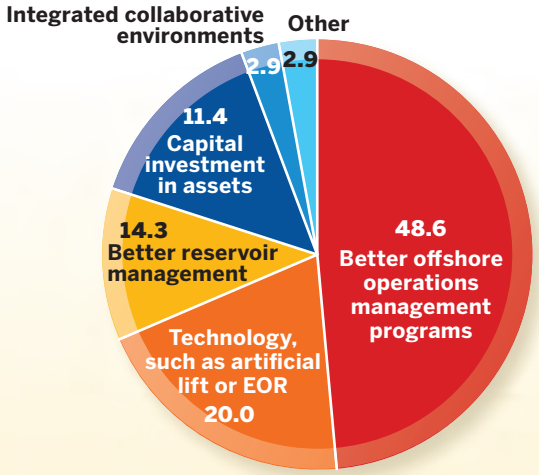
- Less reliance on mass data collection and more outcome-focused analysis, I.e. trending and collating data to improve uptime and efficiency of plant and equipment
- Use of real-time data to prevent downtime.
- Giving more time to production engineers to create new tools
- Better collaboration and transparency between operators about the infrastructure they share and on sharing successes
- Close-loop instruments and process feedback
- Use standard products, which are more easily available, and making them and related data easier to analyze instead of requiring specialists.
- Collect all essential data into an

Table 1 – Biggest Challenge



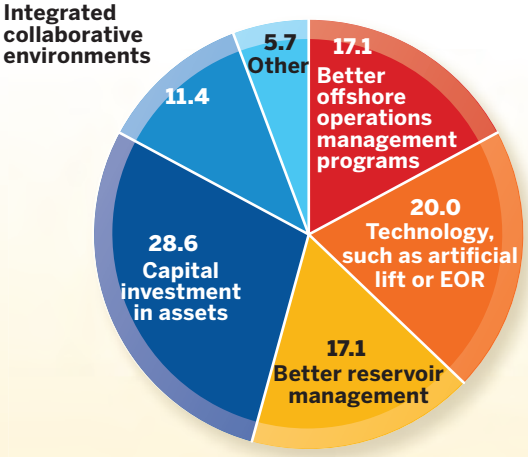
What are the biggest challenges for production optimization today?

Table 2 – Biggest short term impact



What will bring the biggest short term and long term impacts to production optimization?

Table 3 – Biggest long term impact



What will bring the biggest short term andw long term impacts to production optimization?

information management system and use it to optimize the maintenance system.

- Build data acquisition and surveillance into asset business plans - and stick to it.
- Root cause analysis and a fix forever approach.
- Collaboration with equipment vendors through remote access
- Upgrade platforms to take this technology
- Training on how to better integrate, understand, and use the data already collected.
- Introduce an integrated "engineering-production" condition based monitoring system for best optimization
- Cross functional collaboration

While training was high on the list of what delegates saw as the biggest short term challenge to production optimization, it is an area where many have already been focusing much attention.

Asked what they have been doing already to improve production optimization, many said better investment in technology and management training, as well as increased graduate intake and training and focus on skills retention.

Many asked said they are also looking to technologies, such as intelligent completions, sand control technologies, PI ProcessBook, heat exchanger optimization, and other improved downhole technology,

Other areas being addressed include the subsurface and cover repeat seismic surveys and increasing injection fluids and use of polymers to enhance production, as well as focusing on well integrity management and root cause analysis.

Investment has also been a key area, with some addressing obsolescence issues on their plant, upgrading facilities, and increasing offshore bed-space, such as BP's Magnus and ETAP renewal campaigns. Process management has also been under the spotlight for conference delegates. Process flow and quality management efficiencies, remote analysis to maximize production and minimize downtime, and production surveillance and downtime analysis, were all cited by delegates as areas they have been working on. OE

The future of subsea technology

OE spoke with experts from Aker Solutions, GE Oil & Gas, and FMC Technologies to determine what subsea technologies will be key for the industry in 10 years' time? Here's how they responded.

Aker Solutions

Offshore oil exploration will continue to push boundaries over the next decade. There will be an increased emphasis on harsh environments, deeper waters and more complex reservoir structures. This will coincide with a need to increase oil recovery, reduce operating and capital expenditure and extend the life of existing fields. This creates a paradox as we seek to advance technology while also reducing costs.

Aker Solutions has been anticipating these challenges for some time. We have chosen to invest significantly in creating advanced subsea production systems – a suite of tools for maximizing oil recovery through the life of a field. These tools range from seabed booting systems capable of enhancing existing subsea infrastructure to key technologies that will enable complete automated subsea facilities.

A vision for the future: advanced subsea production systems. Photo from Aker Solutions.

One such solution is subsea gas compression technology. The first subsea gas compression system is on schedule to be fully operational in 2015 at Statoil's Åsgard field. The implementation of this technology is estimated to generate an additional 280MMboe from Åsgard's satellite reservoirs. Moving forward, we will develop next generation gas compression technologies that will be more compact and scalable.

Maximizing recovery is also a key focus for our subsea production alliance with Baker Hughes. The alliance seeks to combine Aker Solutions' subsea capabilities with Baker Hughes' in-well expertise to deliver integrated technologies that will significantly enhance recovery at

GE Oil & Gas

The oil and gas industry is experiencing tremendous transformation with the emergence of the "Industrial Internet"—a place in which the physical and analytical worlds come together. The industrial world, where GE has operated for more than 100 years, is being digitized and reshaped by software and big data analytics, opening up new levels of productivity for oil and gas customers, especially those operating offshore.

Software coupled with expertise-driven services will play a critical role in helping oil and gas companies achieve improved outcomes, including improved safety, maximized production, better reliability, availability and efficiency—and ultimately get more value out of their equipment.

Today, we are seeing machines more connected, with more data being collected and analyzed. Looking forward, the industry will look to create even more value from this data, with better analytics, scaled beyond the asset level to encompass the operations of an entire enterprise.

The industry will look to Industrial Internet technology that connects data across the value chain and eliminates data silos. With a connected enterprise, data-driven insights relating to operations and maintenance can be made available faster and to a much broader audience, resulting in the ability to deliver technical expertise and operational support globally. Better and quicker decision-making will drive reduced downtime and lower operational expenses across the enterprise.

GE is helping customers begin this journey today with a solution called Unified Operations, which gives oil and gas companies an enterprise visualization and interaction layer for asset and operations optimization. It delivers critical information from all equipment, across various facilities and locations. With that visualization the software provides actionable insights and allows users to quickly connect with a network of experts.

As more subsea power, processing production and controls-related infrastructure

subsea fields.

The industry will require more efficient and simplified well access and intervention as subsea fields get older. This must be delivered without compromising safety and well integrity. Aker Solutions has developed a multi workover system capable of intervention work on any tree, regardless of manufacturer or age, to help extend the life of subsea fields.

We will over the next 10 years see a broader range of advanced subsea production systems, further integration of subsea and in-well technologies and simplified intervention systems. The technologies being developed today will address the key challenges the subsea industry faces now and in the future. OE

***Hervé Valla** is senior vice president of research, innovation and technology strategy within Aker Solutions subsea business. A qualified mechanical engineer from Ecole Nationale Superieur des Arts et Metiers in Paris, he joined the oil and gas industry in 1990 as a process engineer for topside platforms and moved into the subsea sector two years later.*

Following international experience across Europe and West Africa mainly with Technip, Valla joined Aker Solutions subsea controls business in 2007. Later, as project director he was responsible for several major tenders in Angola, Nigeria and Congo before moving to his current post in January 2012.

is gradually shifted from the surface to the seabed, such remote monitoring, diagnostics and optimization technologies will be crucial to the offshore oil and gas industry's success in the years ahead. OE

***Ashley Haynes-Gaspar** is the general manager of Software & Services for GE Oil & Gas. Prior to this role, she was chief marketing officer of GE Oil & Gas and also served time as chief marketing officer of the Measurement & Control division. She joined GE after graduating from the University of Florida with a B.S. in marketing and statistics.*

FMC Technologies

The past 50 years of technology development in the subsea industry was all about enabling safe access to reserves in challenging environments of deepwater, arctic, high pressure and high temperature reservoirs. We have designed and deployed systems that can drill and complete wells in water depths of over 3000m with pressures at the seabed over 15,000psi. While the next 10 years will certainly see us pushing the envelope of water depth out to 4000m, and upping the pressure and temperature capabilities of subsea equipment to 20,000psi/400F and beyond in order to access new discoveries, the main focus of technology development will be centered on reducing the capital cost of developing offshore fields and ensuring that the flow of hydrocarbons from these fields is maximized and uninterrupted during the producible life of the field.

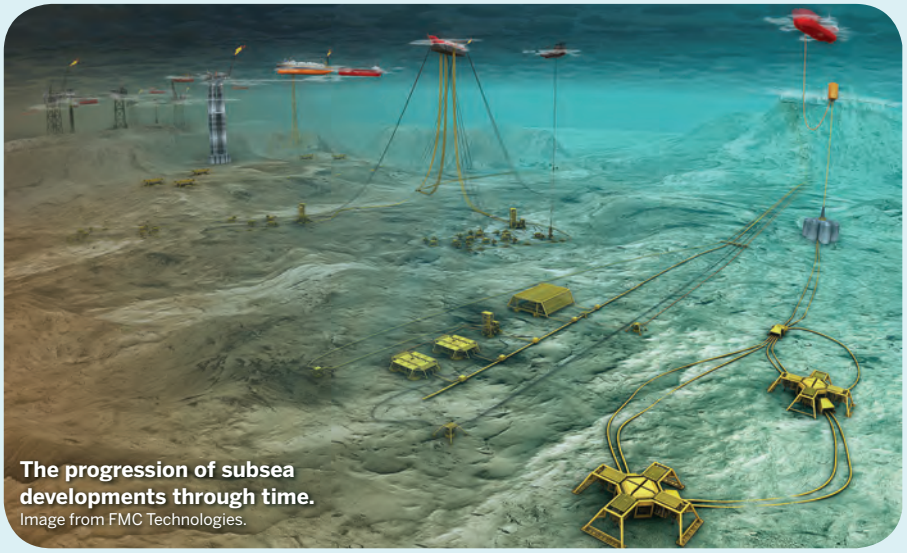
In order to reduce capital costs, it will be necessary to develop a suite of seabed equipment and flowline interconnects that can be installed utilizing lower cost vessels. This will involve changing our thinking on field architecture to eliminate extraneous subsea structures, and simplify essential equipment. Developments in materials technology will be necessary to produce light-weight structures that can be handled by non-specialized vessels or rig cranes. It will also involve the development of technologies that will remove equipment from the decks of floating production vessels and place it on the seabed. Over the next 10 years, we will be relocating separation equipment, water injection systems, power distribution and drive systems, and many other modules to the seabed, minimizing the size and cost of floating structures and eliminating topside conversion costs for brownfield developments.

To maximize the flow of hydrocarbons and extract the most from the reservoir, technologies in flow assurance, thermal management of flowlines, multi-phase boosting, subsea produced water purification and monitoring, subsea separation and re-injection of CO_2, and low-cost well workover technologies must be developed.

To ensure that all the above technologies work in harmony to produce the optimum results, there will be a major focus on developing software platforms and automation technologies that will enable the control and monitoring of these complex subsea systems, and provide the field operations personnel the ability to control and adjust the field parameters, analyze data, and determine maintenance requirements from anywhere on earth.

We've come a long way from the days of divers and handwheel valves. The next 10 years will see a shift in how we view subsea systems and the incredible range of technologies we'll apply to keep the subsea industry viable and competitive. OE

***Bradley D. Beitler** is the vice president, technology, at FMC Technologies. He held the previous position of director of technology for FMC Technologies since 2006. In 2001, Beitler was appointed director of business development. Before joining FMC in 1994, Beitler earned his MBA in marketing and strategy from Pepperdine University in 1983, and received a B.S. in engineering from California Polytechnic State University in San Luis Obispo in 1976.*



The progression of subsea developments through time.
Image from FMC Technologies.

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EXCITING Technologies

In with the new: **Subsea innovations**

Claudio Paschoa compares two new compact ROV-operated systems for seabed geotechnical drilling by Forum Energy Technologies and Helix Energy Solutions.

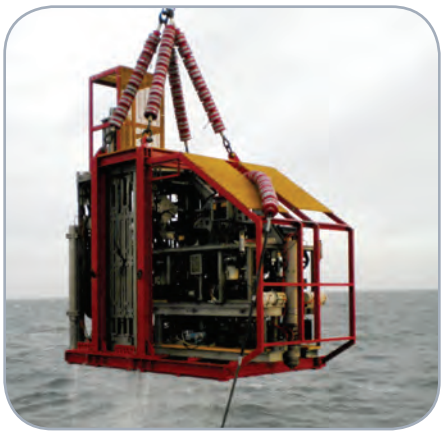
New compact ROV-operated machinery for seabed geotechnical drilling, coring and sampling are being developed for deepwater operations. This new form of geotechnical drilling combines work class ROV systems with compact drilling systems. Two companies, Forum Energy Technologies and Helix Energy Solutions, are leading the way in the development of this technology.

An advantage of taking the coring and sampling rig to the seabed is to minimize deck operations and a decrease in deck footprint. This dramatically reduces the inherent risks associated with these types of activities, while at the same time greatly reducing costs, by taking the traditional drilling rigs with their high dayrates from the picture.

The rig itself can be very compact, easy to deploy, operate and recover without the need of specialized and expensive surface vessels or platforms, and once deployed, they are free from the influences of sea state conditions and vessel/platform motions during sampling operations. However, the surface deployment of the systems, are still dependent on sea and wind state.

Forum Energy Technologies has employed its Rovdrill 3 system worldwide. This is Forum's third generation Rovdrill system, which is composed of a purpose-built drilling unit controlled by a WCROV Rovdrill. Designed and built as a collaborative effort between Perry and GEMS (Geotechnical Engineering and Marine Surveys) engineers, Rovdrill has a proven capability to perform applications for offshore geotechnical investigations and mineral explorations.

Forum's Rovdrill 3 system. Image by Forum Energy Technologies.



Helix's ROVdrill Mk 2. Photo by Helix Energy Solutions.

Rovdrill provides many advantages over standard drillship operations, as it is compact, easy to deploy, operate and recover. Forum's Rovdrill can be operated from a variety of ROV systems and vessels of opportunity without the need of specialized and expensive surface vessels or platforms. It also has the advantage, according to Forum, of being capable of operating in all seabed environments with multiple, interchangeable rig foundation options. This flexibility may help in optimizing core sample quality. Rovdrill is capable of operating in water depths up to 4000m. The coring/sampling depth is a standard 90m, but is expandable to 200m.

A different concept is proposed by Helix Energy Solutions, which fundamentally attaches the ROV to an extremely compact subsea coring and sampling rig. Helix's system, the ROVdrill Mk. 2 actually places the ROV and the rig inside a cage. Helix Energy Solutions Group, Inc.'s robotics subsidiary, Canyon Offshore Ltd. (UK), which has an extensive fleet of proven trenching equipment and ROVs, is responsible for the ROVdrill Mk.2 systems and operations.

The ROVdrill Mk. 2 can be used for geotechnical site investigation recovering samples down to 50m below the seabed and carrying out cone penetration testing (CPT) to over 120m. The system also allows for a fully automated seabed operated drilling module capable of carrying out a range of coring, sampling and in situ tests. It is launched as a conventional work-class ROV system from a DP2 vessel, albeit the combined weight of the ROV and drilling unit and its linear disposition may limit its maneuverability. However, this may be balanced by the fact that currents won't affect the ROV's operation.

The self-contained system is capable of drilling and testing with full real-time monitoring of the operation, via cameras and subsea sensors. ROVDrill's tool racks are configured to provide a total of 14 tool slots, with each slot able to carry 3 tools, for storing as many as 40, 3m long tools for various applications. The ROVdrill Mk. 2 system can be deployed from any suitable DP vessel. However, differing from Forum's Rovdrill 3, it cannot use a ROV of opportunity as its ROV and the subsea geotechnical drilling rigs are interconnected. Both the Forum Rovdrill and Helix's ROVdrill MK. 2 are deepwater operations-capable. OE

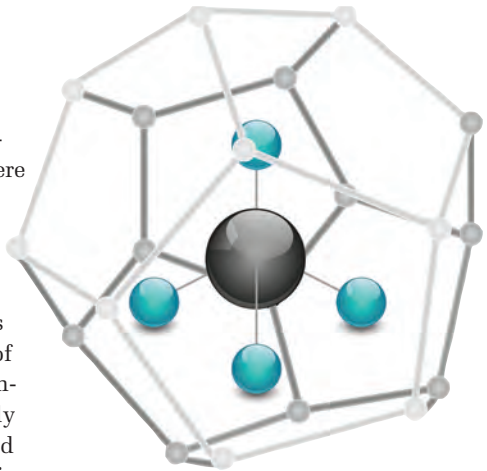
Applying offshore class experience to subsea mining

by Sudheer Chand, ABS

Scientific drilling confirmed the presence of natural gas hydrates on the North and Central American continental shelves in late 1970s and early 1980s, but it was only recently that researchers began to seriously assess methane hydrate development. One compelling reason for the focus on methane hydrates is the estimation that reserves could be as great as hundreds of thousands of trillion cubic feet, which is a larger hydrocarbon resource than all of the oil, natural gas and coal resources of the world combined. Although the industry is in the early stages of development, it is clear that if these reserves estimates are accurate, methane hydrate production has the potential to make a significant global impact.

While the reasons for pursuing methane hydrate production are obvious, there are very serious technology challenges that must be overcome before production can take place safely. The US Department of Energy (DOE) methane hydrate program was created to address some of those concerns. The objective of the program is to develop tools and technologies that will allow environmentally safe methane production from arctic and domestic offshore reservoirs. Not surprisingly, R&D is the foundation of the program. The DOE is conducting studies to understand the physical properties of gas hydrate-bearing strata and modeling this understanding at the reservoir scale to predict future behavior and production. Much of the work is being done collaboratively. The DOE is bringing pioneering minds from around the world together to move this technology forward while concurrently focusing efforts on academic studies that address the effects of subsea mining activity on the environment.

Classification society ABS has been associated with subsea mining since the earliest days of development, classing one of the first subsea mining vessels in 1973. Because one of the goals of a classification society is to identify industry needs and emerging technologies that have the ability to open new frontiers, today, the organization is investing in gaining a greater understanding of methane hydrate development, extrapolating years of accumulated oil and gas experience to these challenges.



This model of methane hydrate illustrates how the large central methane molecule is enclosed in frozen water such that the water molecules completely surround the methane.

ABS Consulting, an ABS Group company wholly owned subsidiary of ABS, worked recently with one vessel owner on specifications for a mining vessel, carrying out a risk assessment for a consortium on methane hydrate production flow test operations with the goal of identifying significant hazards and associated risks related to operational interruption. Concurrent with the ABS Group work, both the ABS Singapore and Shanghai Engineering Offices are carrying out design review of multiple mining vessels. OE

***Sudheer Chand**, ABS Director, Corporate Offshore Technology in Houston, has more than 30 years of broad industry experience, encompassing shipbuilding and repair and filling the roles of chief engineer and surveyor. In his present position, he researches emerging technologies and their potential role in future offshore oil and gas operations.*

Chand holds degrees in Naval Architecture and Marine Engineering from the University of Michigan, Ann Arbor, USA and an Unlimited Chief Engineer's License from the Board of Trade, UK.

Repsol HEADS for safety

By Jose Vicente Solano Ferrandez, HEADS Project Leader, Repsol

As demand for oil and gas increases and shallow plays mature, operators are having to look deeper and further offshore. Drilling in more capricious environments has highlighted the importance of safety measures that can quickly and accurately identify problems remotely using automated technology. Until now, however, technology has lacked the sensitivity and specificity in detecting the early onset of oil spills.

Recognizing the need for an intelligent solution that could locate even the smallest of oil spills, Repsol and Indra joined forces to develop a pioneering technology known as HEADS (Hydrocarbon Early and Automatic Detection System). The system can automatically detect hydrocarbon leaks in the sea, with a response time of under two minutes.

HEADS uses a number of detection sensors that are capable of activating alarms without the need for human intervention. Additionally, the combined use of infrared images and radar can maximize reliability while automated processes allow for constant monitoring without the intervention of a human operator, minimizing the risk of error. Radar detection is based on the difference in the roughness of the water surface when hydrocarbons are present. The infrared camera detects the variations in temperature between water and hydrocarbons, due to differences between the properties of the two substances.

The technology boasts a 90% spill detection rate, compared with an average of 65% for existing systems. The associated computer has artificial intelligence, giving it the ability to teach itself while monitoring for spills, which increases its effectiveness over time.

This automatic "hybrid" system can also operate in complete darkness making its effectiveness greater wherever it is deployed, and can detect spills of as little as ten liters. HEADS is not only conceived as an upstream application, but can also be useful for ports, harbors and installations where large volumes of hydrocarbons are stored or managed.

The challenge of managing and mitigating risks will continue to increase as offshore operators explore more remote and complex reservoirs. However, advances in technology such as HEADS are helping firms gear up to this reality and advance their efforts to tackle these challenges. OE

TOP 12

Off the deep end

GlobalData analyst Gregory Bosunga takes a look at the ten most challenging pipelay jobs around the world.

McDermott subsea construction vessel *NO102* installed umbilicals totaling 65mi with other related subsea structures for Jack/St. Malo. Image from McDermott International.

The most challenging pipelay projects are located in the ultra-deep waters of the Gulf of Mexico and Brazil, where fields can range from 1524m (5000ft) to 2956m (9700ft), such as Perdido in the Gulf of Mexico. Distances to shore can also reach 380km (230mi), such as the Cabiúnas field in Brazil.

Additionally, the seabed surface of pipeline routes to existing networks can be extremely irregular, meaning that geophysical surveys have become increasingly important as a means of identifying areas where significant lengths of unsupported pipeline must be minimized in order to avoid pipeline failures. Some of the engineering challenges involved in laying the pipelines are related to high hydrostatic pressures, cold temperatures, and darkness. The selected route must also avoid obstructing the infrastructure of existing facilities and comply with regulations aimed at minimizing the negative impact on

Most challenging

As development gets deeper, so does pipelay operations. OE asked some of the leaders in the field what they see as the most challenging aspects of deepwater pipelay.

EMAS AMC

C. J. D'Cort, CEO

Oil and gas fields are moving further offshore in remote locations such as the Gulf of Mexico and Brazil deepwater field developments, i.e. in water depths in excess of 2000m.

These new field developments have long transit times from established port facilities and logistical support centers, hence, rendering certain traditional construction vessels to perform the work over a long duration offshore.

Therefore, high-specification and self-sufficient construction vessels are more favorable, such as the *Lewek Constellation* (reel lay and heavy lift) and the *Lewek Centurion* (S-lay), performing multiple scopes of work with limited or no support from other construction vessels.

Pipeline design engineering is challenging in deepwater, as pipeline systems will often have issues in terms of wall thickness, thermal insulation requirements, high temperature and pressure requirements, and seabed bathymetry conditions, in terms of pipelines for allowable freespans, etc. Therefore, optimization of pipeline systems is essential to allow commercialization of future field developments.

However, these pipeline systems, such as pipe-in-pipe, have to be installable with pipelay vessels that can handle top tensions in excess of 700-ton. Also suppliers have to supply high-specification pipeline components that can handle high internal and external pressures and temperatures, etc. These requirements, at times, require a good control of quality in terms of the allowable design range of pipeline components for deepwater and durability.

High temperature and pressure pipeline can also be challenging in terms of allowable controlled lateral expansion of the pipeline, including pipeline walking. This can be resolved by laying the pipeline in "snake lay," to reduce the risk of lateral buckling and the size of the expansion jumpers. This can be established with over-bending and under-bending the pipelines during pipelay through the reel-lay vessel's straightener, i.e. inducing pipeline snake lay configuration on the

12 most challenging pipeline projects

Pipeline Project/ Field Project	Max Water depth (ft)	Length (mi)	Commodity	Associated Field	Status	Associated Country	Install Year	Associated Field Operator
Perdido (GoM)	9701	8	Oil	Great White, Silvertip and Tobago	Producing	United States	2009	Shell
Stones (GoM)	9586	13	Oil	Stones- FPSO	Under Development	United States	2013	Shell
Chinook (GoM)	8877	11	Gas	Cascade -Chinook	Producing	United States	2009	Petrobras
Lucius (GoM)	8755	144	Oil	Lucius	Under Development	United States	2011	Apache
Lucius (GoM)	8755	209	Gas	Lucius	Under Development	United States	2011	Apache
Cascade (GoM)	8250	52	Gas	Cascade -Chinook	Producing	United States	2009	Petrobras
Cabiunas	7346	236	Gas	Lula (Tupi Caramba)	Producing	Brazil	2014	Petrobras
Jack - St Malo	7040	137	Oil	St Malo	Under Development	United States	2010	Chevron
Jack – St Malo	7040	152	Gas	St Malo	Under Development	United States	2010	Chevron
Aracati- Lubnor	7034	73	Gas	Carcara	Producing	Brazil	2012	Petrobras
Cabiunas–Reduc (Gasduc III)	7000	113	Gas	Marlim Sul	Producing	Brazil	2010	Petrobras
NaKika (GoM)	6940	19	Gas	Fourier	Producing	United States	2005	Shell

the subsea environment.

Most of the ultra-deep pipelines are laid using the J-lay method. The traditional method for installing offshore pipelines in relatively shallow waters is commonly referred to as the S-lay method, named because the profile of the pipe as it moves in a horizontal plane from the welding and inspection stations on the lay barge, across the stern of the lay barge, and onto the ocean floor forms an elongated "S." A comparatively new method for installing offshore pipelines in deeper waters is the J-lay method, so-called because the configuration of the pipe as it is being assembled resembles a "J." Most of the ultra-deep pipelines are laid using the J-lay method, which is more costly and technically challenging than the S-lay method. OE

Gregory Bosunga *is analyst, Americas onshore upstream research for GlobalData. Gregory has a M.S. in mineral economics from Colorado School of Mines and an MBA and a Master of Project Management from the Keller Graduate School of Management.*

seabed for controlled lateral expansion.

Risers can also be challenging to install, as they require high-specification pull-in equipment, such as large pull-in winches or chain jacks, to overcome the loads for a second end pipeline pull-in. This also requires platforms to handle high hang-off loads, which can be governing for these types of riser, i.e. flexibles, steel catenary risers or steel lazy wave risers.

Pipeline end terminations (PLETs) or Inline Ts (ILTs) can also be challenging to install, heavy duty valve assembly, corresponding connectors, anchor flanges, etc., will be required in deepwater. This normally results in heavy duty PLETs or ILTs with large mudmats that have to be installed from a pipelay vessel. The *Lewek Constellation* is able to install large PLETs weighing in excess of 100-ton and *Centurion* has versatile A-frame that can be used to install large PLETs.

Handling pipelines under high tension requires a considerable amount of planning and engineering. Therefore, installation aids, pipelay equipment, such as tensioners and corresponding tensioner pads, are configured to the appropriate pipeline being installed. Reels and hang off clamp system inserts have to be engineered to handle the nominal and dynamic loadings that will be encountered during the offshore pipelay campaign.

EMAS AMC's newbuild *Lewek Constellation*, which is having its multi-lay tower installed at Huisman's yard, Rotterdam, in November. Image from EMAS.

DNV GL – Oil & Gas

Asle Venås, Segment Director Pipelines

The main challenge related to pipelines in deep and ultra-deep waters is the high external pressure that may cause the pipeline to collapse. This potential failure mode is normally dealt with by increasing the pipe wall thickness. At large water depths, this will require very costly thick-walled pipes, which in turn are difficult to manufacture and also to install due to the weight.

When a pipeline is installed, it is exposed to high bending in the so-called sag bend close to the seabed. In deep water, high external overpressure may, especially in combination with this bending, increase the risk of pipe cross-section collapse. In addition to increasing the wall thickness the collapse resistance may also be increased by improving the line pipe characteristics through manufacturing procedures with improved material characteristics, resulting in a more perfectly round pipe as well as improved collapse resistance.

However, when solving the collapse challenge by increasing the wall thickness, two new challenges occur; the manufacturing challenge caused by the heavy pipe wall and the challenge relating to the holding (tensioner) capacity during installation. Due to the heavy, thick-walled pipe and long section of the pipe from the vessel to the seabed, the required tension or holding capacity restrict the number of available installation vessels.

Both these additional challenges limit the maximum pipe diameter at different water depths. Below 1000m, the wall thickness increases almost linearly with the water depth and pipe diameter. At the same time, the ability to manufacture line pipes decreases according to the pipe diameter and the tensioner capacity requirements increase. This means there are some practical limits for the maximum pipe diameter to be installed at different water depths.

In addition to the wall thickness and weight, deep water can also provide challenges with respect to seabed intervention, geo-hazards, buckle detection, pre-commissioning, surveys and inspections, hydrates as well as any repairs needed.

McDermott International

Tony Duncan, Executive Vice President, Subsea

Despite a fluctuating oil price, the experts predict growth in the subsea market and continued opportunities for expansion into new frontiers. The challenge for any contractor such as McDermott is to be in a position to win a share of the contracts. That means having a combination of the right people, relevant assets, innovative technology and ability to work in remote locations.

As projects become more complex, contractors will need to be able to handle deepwater umbilicals, install heavy structures and handle ever increasing top tensions making future assets such as the *DLV2000* essential to the industry. Without vessels such as the *NO102*, a truly deepwater enabler for flexibles and umbilicals, and the *DB50* with its specialized deepwater lowering system, McDermott could not have completed projects such as the recent Jack and St Malo in the Gulf of Mexico.

Each project has its own distinctive challenges which often require unique solutions and innovative technology. One such innovation is the creation of the world's largest forged specialty valve for the Ichthys project offshore western Australia. Six 42in valves have been designed and created for the project; each one measures approximately nine meters high and weighs more than 100-tonne.

Assets and technology alone do not make a successful project, particularly in emerging countries where new opportunities are opening up. A successful approach requires a contractor to be experienced in investing and sensitively developing the necessary onshore infrastructure, and building local participation by employing and growing local talent. By taking this approach, projects can have a real and positive transformational change.

Allseas' pipelay vessel, the *Solitaire*. Image from Allseas.

Allseas

Edward Heerema, Allseas' founder

Challenging aspects are the high wall thicknesses of pipelines and risers, which are driven by external deepwater collapse pressures.

Pipeline end termination structures and in-line structures in deep water are complex with their valves, connector assemblies and other equipment, operated by remotely operated vehicles.

Deepwater risers are subject to environmental loadings which affect their fatigue lives, leading to strict welding criteria. OE

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The next frontier

OE spoke with experts from CGG and Ion Geophysical to ascertain where the next frontiers of future offshore oil and gas exploration will be located. These areas are certain to blossom over the next five years. Here's how the experts answered.

CGG

For a geoscience company like CGG, a new frontier is promising if it satisfies several criteria in terms of attractiveness. These criteria include the geology of the oil system in place, the local statutory and fiscal context, the political and economic environment and, most importantly, how interested our clients are. Also, by its very definition, a frontier zone is an area that is still relatively underexplored.

If we combine these factors, we see four priority new frontiers, which are, in no particular order:

1. The **Arctic**, which according to a USGS 2008 study, is estimated to contain approximately 13% of the world's undiscovered oil reserves and almost 30% of its undiscovered natural gas reserves, most of which are offshore. The high risk and costs involved in exploiting oil and gas in these regions are nevertheless significant challenges… but are not deterring the oil and gas companies, and we are seeing growing interest and activity in the Arctic seas. The Barents Sea and the Russian Arctic (Kara Sea), two areas in which CGG has been very active, have recently seen the greatest activity. In 2013, CGG conducted a 3D BroadSeis multi-client survey in the Barents Sea to provide new broadband data to assess the region's petroleum potential. Our Robertson Geolab group are also currently acquiring a multi-client surface geochemistry survey to detect seafloor seeps of hydrocarbons in the South East Barents Sea, which has received unprecedentedly high prefunding from major oil industry players.
2. The "**Golden Triangle**" between the American Gulf of Mexico, Brazil and West Africa continues to extend into ever deeper zones. CGG is conducting exclusive and multi-client seismic surveys in all three of these locations. The definition of pre-salt/subsalt reservoirs is a major challenge, requiring both innovative acquisition methods and considerable imaging expertise. CGG has acquired multiple wide-azimuth marine seismic surveys in the region over the last decade and, more recently, developed innovative solutions such as StagSeis, which mobilizes several seismic vessels, to produce but the potential prize of finding a deeper oil window. This is a front and center topic for many regional explorers.

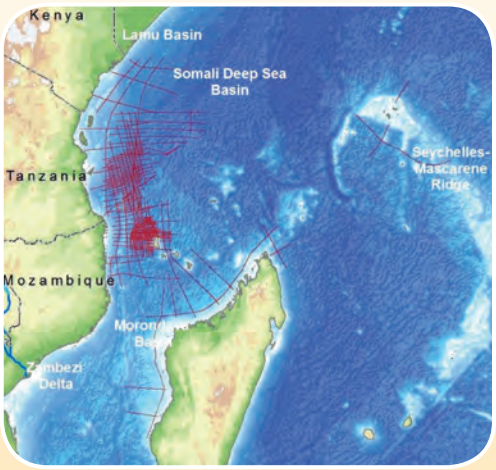
A CGG vessel in Arctic waters. Photo from CGG.

Ion Geophysical

Our only real guide to the future is the past. If we look to the past, we see that exploration frontiers come in many forms. There are true geographic frontiers, areas that have been largely discounted and underexplored, perhaps due to political, commercial or environmental reasons, or simply because trends pointed in a different direction. But there are also more subtle technology-driven frontiers. In the offshore world, advances in drilling technology continuously create new frontiers as we push into deeper water and take on deeper reservoirs with a litany of associated risks related to high pressures and temperatures.

The recent emergence of E&P companies focused on deep plays on the continental shelf of the US Gulf of Mexico indicates the potential for new plays in mature basins. In fact, there are several key areas around the world that are currently experiencing growing interest.

In **East Africa**, massive gas discoveries in Mozambique are creating great excitement – not just about the potential for additional gas discoveries in neighboring Tanzania, Madagascar and the Comoros Islands,



The East Africa offshore margin has revealed enormous natural gas reservoirs, and continues to show promise for oil. Image courtesy of Ion Geophysical.

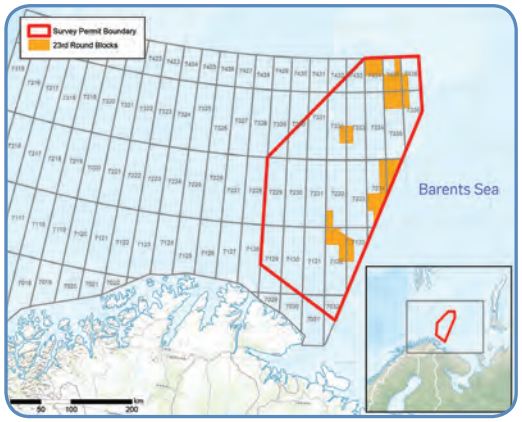
next-generation images of these complex geologies. Initially focused on the Gulf of Mexico, these strategies are now of interest to our clients for application in Brazil and West Africa.

3. **Mexico,** where the recent energy reforms are pushing the country to center stage as a frontier zone for the oil industry's international players, for the first time in over 75 years. A deepwater zone in the southern part of Mexican waters in the Gulf, covering reserves estimated at 3.22 billion boe, will be gradually offered up to foreign and privately owned oil companies over the coming months. With a track record of over 25 years of active operations in Mexico, CGG has in-depth knowledge of all the basins, both in terms of their geological and geophysical characteristics and the best way to conduct seismic survey operations. This means we are ideally placed to support our clients in their efforts to increase exploration success rates and optimize hydrocarbon development and production while reducing costs and related risks.

CGG vessels conducting a StagSeis survey in the Gulf of Mexico. Photo from CGG.

4. **East Africa** has seen considerable renewed interest on the part of international oil and gas companies after major gas discoveries off Mozambique and Tanzania. The announcement by Pancontinental Oil & Gas NL of the first oil discovery offshore Kenya has also heightened this interest.

Oil and gas exploration is very fast-moving and we are of course attentive to other frontier zones, which all present specific challenges relating to their geological and geophysical complexity. As an example, the recent development of deepwater fracturing technologies could lead to the emergence of new frontier zones. OE



Map of Robertson Geolab's multi-client surface geochemistry survey in SE Barents Sea.

Christophe Barnini has served as senior vice president, communications, for CGG since 2013. His scope of activities includes corporate and financial communications, as well as internal communications and business communications with clients. He was previously head of investor relations from 2000 and prior to that he served as vice president, finance, for the Americas, from 1998 to 2000, and held the post of group financial controller from 1996 to 1998. Before joining CGG, he was vice president at IBM Consulting Group from 1991 to 1996.

Other areas of interest in the southern hemisphere include **Australia, Uruguay and Argentina**. There are new basins still to be explored in the northern hemisphere, too.

The east coast of **Canada**, including Labrador and Newfoundland, has recently demonstrated real potential, and the US east coast seems to be finally ready to benefit from real, modern exploration techniques.

In N**orway**, the opening up of the northern reaches of the Barents Sea looks very promising, and recent discoveries in the Kara Sea suggest that the **Arctic** will eventually fulfill the tremendous claims for the area made in recent years.

From a technology perspective, the acquisition of high quality 3D data under ice in the **Arctic** is emerging as a critical exploration need. In fact, 3D is increasingly vital for exploration in all frontier areas. Historically, 2D seismic has been used to define deep basin architecture, with successive 2D iterations utilized to increase grid density per acquisition prior to leasing.

Outside of the most prolific mature basins of the North Sea and the Gulf of Mexico, 3D has been used sparingly for post-award drilling decisions. Today, many frontier areas offer the potential for prolific stratigraphic traps that cannot be well characterized on 2D data. Consequently, the technology curve belongs firmly to 3D seismic; the key to future offshore exploration lies in increasingly efficient and innovative methods in this area. OE

Dave Ridyard serves as vice president of strategic marketing and development for ION's GeoVentures business unit, responsible for the identification and commercialization of new strategic markets for ION's geophysical technologies. He first joined ION (then Input/Output) in 1994, and held roles in data acquisition technology development and multiclient business development. He holds a degree in applied physics and electronics from Durham University in England.

Subsea 7's new heavy construction vessel, under construction in South Korea, is set to make a splash when it joins the company's fleet in 2016. The 160m-long, 32m-wide, vessel includes a new-design, 900-tonne, Huisman rope-luffing, knuckle-boom crane. Photo from Subsea 7.

Going deep and getting heavy

The global fleets are growing – not least in order to cater for new deep water challenges. Fred Tholen takes a look.

The pressure to innovate within the oil and gas sector is intensifying. Exploration and production from deep and ultra-deep water regions are set to increase compared with conventional production plays on the continental shelf. While operators need to maximize volume to make their operations profitable and sustainable, not all oil and gas is viable in shallow water. Meeting future energy demands from offshore oil and gas will depend on those operators who are increasingly looking to extract from reservoirs in deeper waters.

This trend is supported by Douglas Westwood, a research and consulting company, that identified an increase of 67% in deepwater production during the last decade, and is forecasting a further growth of 37% in 2020, which indicates a strong growth prospect.

Water depths are increasing and average tree water depth is now around 800m with indications that this could increase to around 1400m by 2020. In Brazilian waters, operators are reaching vast depths of 3000m and the question for industry is where the technical and commercial limits can be taken next.

So where are these contributing factors likely to have most impact? The geological-plays include areas such as Americas, Brazil, Africa and Asia Pacific and in regions such as Malaysia, Indonesia and India. Mexico is another hotly pursued area after recent changes in legislation now present a serious game play for international companies to set up operations off the coast of Mexico, and where a large part of the challenge is around deepwater drilling.

The challenges of operating in deepwater will inevitably have an impact on designs and requirements of the vessels needed for operating in these regions. Deepwater operations are normally further offshore and require larger and more complex units with increased endurance. There are also different facets of the operations that affect vessel design.

The challenges around deepwater are recognized as driving the design for larger multipurpose support vessels for remotely operated vehicle operations, which are inevitably needed replace traditional diving operations.

Also, with increased water pressure, subsea modules become larger and heavier which require more complex load handling equipment. This increases the size of the vessels used in deepwater operations. In the future, construction vessels with larger crane capacity to support this subsea work will be needed, and the increasing crane lifting capacity will drive the manufacture in larger sized vessels.

Larger load-handling equipment requires more complex structural interfaces with the vessel and can affect the vessel's stability offshore, particularly in adverse conditions – a critical driver of vessel design.

Construction vessels with crane capacity of 250-tonne are fast entering the market and larger vessels with even larger crane capacity, up to 900-tonne, are being designed and built.

Consider also the water depth, which in itself can be challenging for vessel designers. For a subsea crane that is utilizing steel wire rope, the lifting capacity at 3000m water depth is reduced to approximately 50% compared to at sea-level. In other words it is not just the weight of subsea modules that dictates the crane capacity but importantly the water depth. In this area, innovative solutions such as module handling towers and artificial bounce assessments can be introduced.

Pipe laying vessels with deepwater capabilities are able to operate to depths of 2500-3000m, with large pipe storage capacity under construction to meet the increasing industry demand in deep and ultra-deep water operations.

The trends for vessels operating further offshore are generating new design specifications for greater carrying capacity, such as larger deck areas and storage capacity below deck with flexible tank configuration.

Likewise, regulations need to complement the changes and complexities of industry demand which, for example, require larger amounts of chemicals to be transported for supply, well testing and intervention.

Larger quantities of hazardous noxious liquids substances in bulk than the current 800cu m that today is the limit, stipulated in A.673(16), is in debate. The International Marine Organization is tackling this issue head on with a dedicated chemical code for offshore support vessels. When launched, this code will allow for larger quantities to be managed coupled with requirements for increased and robust contingencies around damage limitation and other safety related aspects inspired by the IBC (Dangerous Chemicals in Bulk) code.

With all the technical challenges and different statutory regulations imposed on vessels because of variances in operational challenges and different features, class needs to fulfil an important collaborative role in supporting the operator and industry stakeholders to ensure a sustainable supply chain.

The latest vessel designs responding to a more complex industry include:

Sapura Diamante: Pipe laying vessel


Photo from Royal IHC.

IMO No: 9656187
Shipyard: IHC Merwede NB 728
Delivery: 2014
Ship-owner: Sapura Navegacao Maritime
Length over all: 145.97 m
Breadth: 29.94m
Depth: 13.0m
DP system: DP 2
Total Installed power: 23.040 kw
Speed: 13.6 knots

Pipe tension capacity, dynamic load: 550-tonne
Maximum pipe diameter: 630mm
Pipe storage capacity: 4000-tonne
Main crane capacity: 250mt
Info: *Sapura Diamante* is the first vessel in a series of five vessels.
After delivery, the *Sapura Diamante* will be used to develop deep-sea oilfields of up to 2500metres in Brazilian waters on behalf of Petrobras.

Seven Arctic: Heavy construction vessel

IMO No: 9695353
Shipyard: HHI NB 2654
Delivery: 2016
Ship-owner: Subsea 7
Length over all: 162.3 m
Breadth: 32.20m
Depth: 13.5m
Speed: 15.0 knots
DP system: DP 3
Main crane capacity: 900-metric tonne (AHC)
Main crane operating depth: 2500m

Pipe tension capacity, dynamic load: 325-tonne top tension vertical lay system
Pipe storage capacity: 7000-tonne
Info: *Seven Arctic* is a large heavy construction vessel designed to operate in in deep and ultra-deep waters up to 3000m and in harsher environment.

The vessel is ice strengthened and with winterization features.


Image from Subsea

Fredrik Tholen is Principal Specialist – Global OSV Market Manager. He graduated from the Technical University of Denmark with an as BSc in Naval Architecture in 1989, and started his career with design and construction of submarines at the Swedish Shipyard Kockums, and then later moved on to join Lloyds Register Group.

Tholen has been with Lloyds Register for more than 20 years, working with design support aspects with designers, shipyards and owners in different positions and locations, and recently managing Copenhagen's Technical Support Office.

Charting Norwegian shipbuilding

Alan Thorpe recently visited Norway to see the latest offshore vessel developments, including Ulstein's X-Stern

In 2005, Norway's Ulstein Group introduced the X-Bow to the market, a design feature that increases crew comfort onboard offshore vessels, while giving the opportunity to keep up speed in foul weather or the option of reduced fuel consumption. Currently, close to 100 X-Bow vessels have been delivered or are being constructed worldwide. Now, Ulstein has introduced the X-Stern, which takes a further step in increasing vessel operability.

Scan this entire page with the Actable app to see an X-Stern video animation.

An X-Stern vessel can stay on position in harsh weather with the stern towards waves, wind and current. The new design leads to reduced pitch and wave drift forces, as well as eliminating slamming. Positive effects are reduced power and fuel consumption while on DP, or the possibility of operating in a wider sector with the same power consumption.

The X-Stern has several of the same characteristics as the X-Bow, and additional ice operation capabilities. Its gentle displacement reduces acceleration, pitch and heave, it improves comfort and safety, and the operational window is increased. There will be no sea on deck, and reduced ice buildup in cold climates, due to the stern shape and enclosed nature of the aft deck.

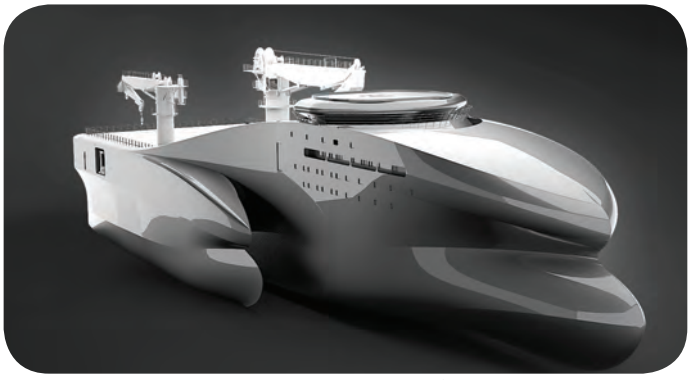
"An innovation process is a long process, in which we work strategically in order to come up with safer, smarter and greener solutions," says Tore Ulstein, deputy CEO and Head of Markets & Innovations in Ulstein. "We discuss operational challenges with our customers, and work on how to transfer these challenges into technical solutions which can be turned into commercial products. The X-Stern is patent-pending in several countries, including the USA and in the EU."

Ulstein's X-Stern design. Image from Ulstein.

Oilcraft offers the twin-bow

Oilcraft is a new company formed by former personnel from Odin during 2013. Since then, the company has formed a joint venture with Norway's LMG Marin and, in February next year will be renamed LMG Oilcraft. LMG Marin has a 100-year history including over 1000 newbuilds.

Oilcraft is now in a position to offer its twin-bow design to shipyards and shipowners, expecting that offshore support vessels will be the first to take up this design. The twin-bow is suitable for single hull and trimarine vessels. Talks are currently underway involving a platform supply vessel with crane and ROV capabilities, and a seismic research vessel (using a trimarine design), this latter design being tested at Norway's Marintek research center.



An offshore construction vessel with an Oilcraft twin-bow. Image from Oilcraft.

There is already a letter of intent involving a series of six seismic research vessels, these vessels having a trimarine configuration. There are also talks underway for a seismic support vessel (trimarine), a 120m-long offshore construction vessel (trimarine) with 3000sq m deck space, and a single hull design for a DP IMR vessel with a 150-tonne deck crane and accommodation of some 90 personnel.

Kleven builds the first LNG-powered PSV for Remoy Shipping

Kleven Verft is currently completing the 92.5m-long platform supply vessel *REM Eir* for Remoy Shipping – the firm's first step into LNG-fuelled vessels. The vessel, designed by Wärtsilä, is a dual-fuel PSV, which will be chartered to Statoil and used in the southern North Sea. The owner received funding for this vessel from the Norwegian Government's NOx fund.

The vessel is powered by a total of four generating sets – two of 1014 ekW and two of 2510 ekW. Additionally, it will have two tunnel thrusters of 1200 kW output each, a 880 kW retractable thruster and two main azimuth thrusters of 2450 kW each. The vessel will have a service speed of 14.7 knots and a deck area of 1090sq m. The fuel oil capacity will be 1150cu m with the LNG tank having a capacity of 230cu m.

The Rolls-Royce UT design celebrates 40 years

This year Rolls-Royce has been celebrating 40 years

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of the UT, the world's most successful offshore vessel design.

However, the UT story continues to develop. The first UT-design anchor-handler equipped with Rolls-Royce' Unified Bridge is destined for the North American market. Ordered by Secunda Canada, this advanced vessel to the UT 782 WP design will also be the first with the distinctive wave-piercing bow in the North America region.

Secunda Canada's co-owner, the Norwegian company Siem Offshore, played a part in the development of the new UT 782 WP design. The vessel has been designed for harsh North Atlantic conditions. Its main role will be the transport of cargo, with ancillary roles including ice management, anchor-handling, emergency towing and fire-fighting, supporting the Hibernia and Hebron fields offshore Newfoundland. This is part of a five-year agreement with options up to 15 years between Secunda Canada and ExxonMobil.

The UT 782 WP will have Clean and Comfort Class notation, an overall length of 87.3m with 20m beam and cargo capacity of about 4000dwt. In addition to the design, Rolls-Royce will supply the fuel-efficient hybrid propulsion system, automation, deck machinery and cargo handling systems. It will be built at the Remontowa shipyard in Poland for delivery in 2015.

Island orders heavy weight

Island Offshore has tapped Rolls-Royce for a large offshore vessel, the result being the UT 797 CX design.

The UT 797 CX will be 123m-long, with 1100sq m deck area, and will be one of the largest vessels in the Island Offshore fleet. It is designed to carry out a variety of offshore work, such deepwater subsea construction and heavy anchor handling. Features include a large moonpool, a 250-tonne offshore crane and remote operated vehicle (ROV) handling systems. The bollard pull will more than 400-tonne.

It will have facilities for 110 people and can also act as an accommodation vessel. Like many of the other Island Offshore vessels of UT design, *Island Victory* will be built by Vard Brevik, with delivery scheduled for 2016.

In addition to its new build riserless light well intervention and inspection maintenance and repair (IMR) vessel, the *Island Performer*, Island Offshore has recently taken delivery of UT 737 CD *Island Pride,* a multi-functional subsea construction vessel designed for worldwide operations. The vessel is outfitted for a variety of tasks, including trenching, subsea handling and survey as well as IMR work. It is well equipped to provide ROV services, and can also act as an offshore supply vessel, and as a rescue and oil spill response vessel as the build is to NOFO standards.

Island Pride has a broad range of DNV GL 1A1 class notations including Comf-V(3) and SPS. It is 103.3m-long with a beam of 21m and deadweight of about 4200-tonne. Deck area is 800sq m and there is a 7m square moonpool. Equipment includes two work class ROVs with launch and recovery systems, capable of working to depths of 3000m. The active heave compensated crane is rated at 130-tonne, and there is accommodation for 90 people.

The diesel electric propulsion system comprises four Bergen engines driving two Azipull thrusters and two side thrusters, for maximum maneuverability and accurate station keeping in DP mode. The vessel is now on its first job working for Maersk Oil as a walk-to-work vessel.

The *REM Eir* under construction at Kleven. Photo from Alan Thorpe.

The *REM Eir.* Image from Kleven.

Fletcher doubles fleet

Two vessels to the popular UT 755 LC design are being built by Norway's Simek for Fletcher Shipping based in Aberdeen, Scotland. The first of these platform supply vessels will be delivered in November 2014, with the second in April 2015. They are the 25th and 26th UT designs built by Simek. Fletcher currently has a fleet of four vessels, all of them of UT design.

Rolls-Royce is supplying all the main systems as well as the design. Fletcher's new vessels will have Clean and Comf-V(3) class notation, indicating a reduced environmental impact and good conditions for the crew due to low levels of noise and vibration.

The UT 755 series is the most successful UT design to date, with more than 188 vessels built or under construction. It fulfils the offshore market requirement for a cost-efficient mid-size platform supply vessel with good stability and a large capacity for cargo on deck and in tanks. OE

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Addressing the changing needs of the offshore industry

The PSV Bourbon Explorer 504 at sea. Photos from Bourbon.

Bourbon's Rodolphe Bouchet explains how the company's new Explorer 500 series shows its commitment to standardization, which offers time and cost savings.

As projects move further offshore and drill deeper, companies need reliable and versatile equipment across the supply chain to ensure projects come in on time and on budget. Where platform support vessels (PSVs) are concerned, this means companies must produce multi-use, economical vessels, with large cargo capacities, high reliability and straightforward, rapid maintenance procedures.

Bourbon addressed these requirements with the design of its latest PSV series, the Explorer 500, which has been built with deepwater offshore operations in mind – especially those in the tropics – and offers similar cargo capacity to larger vessels for mud, fuel oil and fresh water, as well as improved liquids handling flexibility.

Aerial view of PSV Bourbon Explorer 504, a platform supply vessel at full speed at sea.

Built by Sinopacific in its Chinese shipyards, the 500 series fleet will total 20 vessels of which seven were already operational by November 2014. The first vessel of the series, the *Bahtera Permai*, has been operating in Asia since early January 2014. The others are currently employed in Asia and off western Africa.

At 3700 deadweight tonnage (DWT), the Explorer 500 vessels occupy a niche between mid-sized vessels of around 3200 DWT and larger vessels of up to around 4500t DWT. However, where possible, Bourbon has included features more usually found on those larger PSVs. To address greater drilling depths and changing well stimulation technology requirements, the Explorer 500 series has larger mud liquid storage capacity. The vessel can carry 1133cu m of mud in its mud tank, which is around a 50% larger capacity than that found on Bourbon's 3200t DWT vessels and similar to those of larger vessels. It can also carry up to 1118cu m tons of fuel oil and 630cu m of fresh water.

The Explorer 500s also come equipped with special product tanks, capable of holding up to 366cu m as standard. They are designed to carry chemical products and can also be used to load mud with high pollution and safety hazards.

The presence of three separate lines going into the liquid product tanks adds flexibility, allowing easy loading of base oil, drilling mud, brine or methanol in different tanks.

In the past, there was a tendency to keep all liquids in dedicated tanks. However, Bourbon, in common with the wider PSV sector, added flexibility to its tank technology over the years to ensure that tanks can now handle a variety of liquids, if the need arises. This adds to the potential capacity available for some liquids, such as mud.

Light subsea capability

Another development reflecting the changing requirements of the offshore industry is Bourbon's decision to equip every vessel in the Explorer 500 series with the infrastructure necessary to take a crane of up to 50-tonne. This helps make the Explorer 500s flexible multi-purpose support vessels, and easily upgradable to provide ROV support and handle light subsea intervention work. They are also ready to accommodate the High Precision Acoustic Positioning (HIPAP) system to facilitate these operations. The Explorer 500 series has accommodation for 50 people in two main cabins, holding 19 people each, and 12 single cabins, all ranked comfort class 3. The vessel has a large deck space, totaling 714cu m and Class 2 dynamic positioning.

Working as a rescue vessel, the Explorer 500s are capable of rescuing up to 200 survivors in tropical areas. They are graded class 1 for fire-fighting capabilities and also offer oil recovery capabilities. A combined total volume of 1500cu m in the liquid product tanks can be used to recover, store and transfer oil spills using dedicated lines and pumps.

Fuel management gains

The diesel-electric and azimuthal propulsion system allows generator output to vary as required by operational load. Diesel electric powers the vessel in transit, and then works in tandem with azimuthal propulsion when the vessel is using dynamic positioning on site at sea.

Bourbon estimates fuel savings from its diesel electric technology can reach up to 30% compared with traditional mechanical drive propulsion used by offshore support vessels, depending on travel speed and conditions. Based on the current cost of fuel, this can potentially save clients up to $1 million/yr.

In transit, the largest fuel savings compared to traditional propulsion is made by sailing at a steady 8 knots, when around 12% less fuel is used. Meanwhile, one of the largest savings overall is achieved when the PSV is using dynamic positioning at sea, when a fuel saving of up to 25% can be made.

While diesel-electric propulsion is becoming a standard across the PSV industry, Bourbon is one of the few companies to have fitted diesel-electric across its fleet to include shallow-water and well as deepwater vessels.

Standardized technology

Main components on one 500 series vessel are the same on any other vessel in the series, which means operators will not need to re-train crew and less time and money spent on maintenance, because standardized parts can be stockpiled, and then easily installed by technicians.

The benefits of standardization and centralization of maintenance are clear. Bourbon achieved a 94.5% technical availability rate across its fleet in 2013, through optimization of duration of planned maintenance.

The other advantage from this standardized approach is operational safety, which is improved by familiarity with technology among crew members, even when switching from one vessel to another in the series.

The Explorer 500 Series' design, construction and operational management take into account international regulations intended to improve both operational safety and environmental protection. Fuel oil tanks are protected through a double hull.

The Bourbon 500 series offers many of the specifications of larger PSVs in a smaller vessel with lower running costs and proven reliability. **OE**

Roldophe Bouchet is vice president of business management, Marine Services, for Bourbon, a role he has held since 2011. Bouchet graduated from the French Marine Merchant National School in 1997. From 1997-2005, he was an officer and captain on various Bourbon supply vessels in West Africa, North Sea and Antarctic. In 2006, he became QHSE Manager for Bourbon Offshore Surf, in charge of Safety & Quality management, before becoming Affiliate General Manager BINL, BOURBON's subsidiary in Nigeria, in 2008.

Faces of the Industry

December's Faces of the Industry draws us back into the UK oil & gas sector with a focus on OPITO's managing director, John McDonald. He is coming off a successful National Oil & Gas Skills Week, which has heightened oil & gas career awareness across the UK and beyond. John's passion for education and skill development was nurtured during his early career days where he found his inspiration in the classroom and later worked for the Scottish Qualifications Authority to develop education standards. He has taken his zeal for education and learning to pioneer new territory for OPITO, the offshore oil & gas skills organization.

In a recent interview, John shares his unique career story, advice to those at any career stage looking to make the leap into oil & gas and what the offshore industry can do to tackle workforce and safety challenges.

In your early career, what did you want to do?

I originally wanted to be an accountant and actually trained with Schlumberger in my earlier career. However, I realized that accounting wasn't the career path for me, but the training I received has given me fantastic skills which have helped me throughout my working profession.

How did you get into oil & gas?

I started working with the Scottish Qualifications Authority (SQA), the body responsible for the development, accreditation, assessment and certification of qualifications other than degrees. It was this that took me to the Middle East when I was approached to oversee the development of a vocational training body for the UAE government.

My track record on education and skills attracted me to OPITO. As the organization that sets the standards and makes sure they are delivered to the right level, it is a leading part of the huge safety network around the global industry.

It was a huge learning curve for me – how the industry operates and the unique vocabulary. Yet I understand how people learn and the skills agenda at home and overseas, so I could see where I could bring something different to the table.

Were there key turning points in your life– such as key events or experiences–that changed your course in a different direction?

Throughout the 1980's, I was self-employed, which was a great experience and provided another valuable learning curve. During that time I was asked to speak at a careers day at a local school. Presenting in front of such an engaged audience was really invigorating and rewarding so after giving it some thought I made the decision to retrain as a teacher. I was focused on business, economics and computing and spent the next 10 years of my career in education.

While I didn't know it at the time, this was also the start of my journey into oil and gas as it was the road which led me to my role with the SQA.

What advice do you have for those looking to pursue an oil and gas career?

That everyone – not just those already interested in the sector – should keep an open mind.

The UK oil and gas industry is a global success story, responsible for some of the most ground-breaking innovations and technologies the world has ever seen with the skills and expertise honed in the North Sea exported around the globe. For many however, they still believe that a career in oil and gas means putting on overalls and working offshore.

The reality is that just 6% of core roles in the oil and gas industry are based offshore. Whatever your field of interest or expertise, if you work hard, you will find the industry rewards your effort with infinite opportunities to develop.

I would also say don't ever think that you will stop learning. Our industry by definition is always growing, always developing and always breaking new frontiers. It is an endlessly fascinating sector driven by a huge number of passionate and innovative people.

What are some key challenges facing the oil & gas industry from a workforce and skill development perspective?

Looking ahead, there are some interesting trends emerging in the future workforce profile.

The continued impact of the current slowdown in activity, combined with the industry's collaborative efforts to proactively address its skills needs, are having an effect.

Based on local and global

John McDonald

John McDonald was appointed UK managing director of oil and gas skills organization OPITO in September 2013.

Previously the director of international workforce development for OPITO International, where he worked with a number of oil majors and leading on the organization's work in building agreements with governments and industry around the world; McDonald is the former director of the Scottish Qualifications Authority (SQA) where he led the development of new products and services and created new markets in Asia and the Middle-East.

An alumni of Harvard Business School, he has also worked at ministerial level in several countries on capacity building projects in education and training and was a director of ACTVET, the government body charged with creating a vocational education and training system in Abu Dhabi.

market trends such as the anticipated increases in decommissioning activity and the ongoing development of new technologies designed to maximize oil recovery, we expect to continue to see increasing demand in drilling, well appraisals and marine/naval sectors among others; and we anticipate the number of workers spending time on overseas activities to also rise over the next five years.

While a percentage of the North Sea workforce is expected to retire between now and 2019, progress is being made to address ongoing issues, notably with the successful increase in recruitment of apprentices and graduates.

Can you give us an update on OPITO International's vision to roll out common global safety standards? How is that going?

Despite improvements, too many major and minor incidents and accidents are still happening from the Gulf of Mexico to the North Sea, from the Middle East to Southeast Asia.

As a proponent for change, OPITO works all over the world in our drive for the implementation of common global safety standards. These standards are proven to deliver positive changes in behavior leading to a safer workforce, but OPITO can only lay the groundwork. Employers will ultimately drive the long-term, high value change and this needs strong, committed, courageous leadership.

New ways of doing things will only actually happen if people understand why they need to change and the benefit that change will have on them and those who work with them.

Tell us about more about National Oil & Gas Skills week? What are your key objectives?

This is a significant opportunity for the industry to do something really different and powerful to tackle the skills issue head on and we received fantastic support from a wide variety of industry organizations, government bodies and independent companies of all sizes.

National Oil & Gas Skills Week was designed to explore the skills and career pathways within the oil and gas industry across the UK. Targeting a variety of audiences, it took in everything from science, engineering and math events, specialist workshops and careers sessions to debates, interactive challenges and much more at venues across Scotland and England from November 11-14th.

Our hope is that it has provided the avenue for everyone from school pupils, graduates and teachers through to mid-career changers and those returning after a career break to see first-hand what the oil and gas sector can offer. It also gave the industry a platform to celebrate its achievements and for individual companies to showcase what they are doing, the opportunities they offer and the skills they need going forward.

What do you hope to accomplish in your tenure as Managing Director at OPITO? Finally, what kind of legacy will you leave behind?

I want to work collaboratively with the industry to do something about the skills issue. If I can play a successful part in that I'll be a happy person. John aspires to leave a lasting imprint on how the offshore oil & gas sector addresses and improves its workforce, with an eye on upgrading skills and adapting to an ever changing and innovative industry. At the end of the day, it is all about the people in the industry and equipping them with what they need to be successful. When this happens everyone wins. OE

Faces of the Industry will feature individuals who do extraordinary things for the industry and outside the industry. If you would like to nominate someone, please send an email to Kelli Lauletta.

***Kelli Lauletta** is an HR consultant with 17 years experience. She also serves as an editor for OilOnline.com. If you have story ideas please email Kelli at klauletta@atcomedia.com.*

LAGCOE Career Fair offers recruiting climate snapshot

By Kelli Lauletta

Even with the recent dip in oil prices and concerns about rising operational costs, oil & gas companies are still ramping up talent acquisitions in the short term. A positive hiring outlook was a key take-away from the recent LAGCOE (Louisiana Gulf Coast Oil Exposition) Career Fair in Lafayette, Louisiana.

The LAGCOE Career Fair, with more than 1100 job seekers and 28 hiring companies in attendance, offered a snapshot of the recruitment mood. The verdict? The hiring climate remains strong.

Companies at the LAGCOE Career Fair are moving forward with their hiring plans. Angela Cring, LAGCOE executive director said, "The job market is solid. The oil and gas industry has diversified so much, even in the last five years, that there are numerous opportunities."

Whitney Brady, Manager, Oil & Gas Division – Americas at Faststream Recruitment Group said, "While there has been a dip in oil prices that has impacted some companies within the industry, we have not seen a decrease in hiring trends within our client base.

"Since many of the oil & gas projects are ongoing and take several years to complete, companies do not necessarily halt hiring when oil prices fluctuate. Companies are continuing to drill onshore and offshore in the US and continuously seek candidates to fill the hiring needs."

Looking forward, it wouldn't be far-fetched to suggest that if oil prices continue on the downward slope coupled with increasing operations cost then recruitment plans would be curtailed. This may particularly impact contract, rather than permanent positions, as companies try to manage costs.

Dane Groeneveld, regional director-Americas at NES Global Talent echoed the same sentiment.

"It would be fair to say that the larger companies would have predicted a softening in the market, and this combined with the completion of a number of major capex projects, many of which experienced cost overruns, has led to a general environment of seeking cost efficiencies for most of 2014.

"Oil prices do not create immediate responses in hiring plans, but sustained positions lower than the anticipated trend, will naturally take the heat out of the demand," Groeneveld said.

In-demand positions

With the near-term hiring climate looking positive, who can still write their own ticket in the current oil and gas labor market? According to NES Global Talent, drilling supervisors and superintendents are in top demand, while within contract roles, companies are looking for subsea, drilling and completions, HSE and project controls candidates.

"Currently, we're seeing that engineering disciplines are in high demand across

Multiple Opportunities

CSE ICON Inc.

Profile: CSE ICON is a US based consulting, engineering and technology integration services firm focusing on Oil and Gas industry and Utilities Industry. CSE ICON provides services in SCADA, Real time Data Infrastructure, Cybersecurity systems and procedures, Integrated Controls and Measurement and Storage, Servers and Network.
Website: www.cse-icon.com

Multiple Opportunities

Knight Oil Tools

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Website: www.knightoiltools.com

Field Service Supervisor/ Acadiana Area, Louisiana

Oil States Energy Services

Oil States Energy Services is a leader in integrated rental solutions in the oil and gas industry, focusing on servicing clients throughout the well life cycle. We provide equipment to support the well site activities of wireline, thru-tubing, isolation, well-testing, frac-stacks, ball launchers, completion fluids, sand control and production services.
Website: www.oilstates.com/Home-1426.html

Pipe Fitter/Welders/ Morgan City, Louisiana

Fab-Con, Inc.

Fab-Con, Inc. is one of the fastest growing oilfield and marine construction businesses in the Gulf South. With contracts in place with major and independent oil, gas, and energy companies throughout the Gulf, Fab-Con is uniquely equipped to handle the growing and changing needs of the oil and gas industry.
Website: fab-con.net

Diesel & Heavy Equipment Technicians/Various locations-Louisiana

Louisiana Cat

Louisiana Cat is Louisiana's only authorized Caterpillar dealer and a recognized leader among Caterpillar dealers around the world. We've been providing our customers with the highest quality Caterpillar equipment, service and parts since 1928. We are always searching for high energy, ambitious candidates who are ready to join our team.
Website: www.louisianacat.com

Production Operator/ Various Locations

Quality Companies USA (QCP, QPM, & TRACO)

Quality Companies USA – an oil and gas service organization consisting of three distinct companies: QCP, QPM, and TRACO. By continually investing in our greatest resource, PEOPLE, and keeping safety and service paramount, over the past decade Quality has transformed from a small maintenance contractor into a substantial turn-key contractor.
Website: www.qualitycompanies.com

our client base," Brady said. "Specifically, mechanical and structural engineers with Topside/FPSO experience, as well as project engineers and managers. Additional roles that are in demand include construction managers with offshore asset experience, as well as naval architects."

There is still intense competition to fill these roles, which is still bumping up salary and signing bonuses. Once talent is in the door, several LAGCOE Career Fair hiring companies shared that they are also focused on robust retention strategies.

2014 LAGCOE Career Fair participants. Photos from LAGCOE.

Attracting new talent

How are oil & gas companies bracing for the great "silver tsunami" of soon to retire baby boomers? First, savvy HR managers and recruiters are proactively reaching out to candidates from a variety of sources.

Chad Falgout, Human Resources Manager at Louisiana CAT, one company at the LAGCOE Career Fair, said: "In addition to traditional and online recruiting strategies, we also get out and visit technical and trade schools, and try to keep our name and brand active in the marketplace. We even reach out and recruit at high school level programs, and invite students in for field trips and job shadowing."

Many companies are shifting focus from recruiting from a limited talent pool to developing their own through entry-level training programs, succession planning and college partnerships.

A Mercer LLC report noted that companies need to shift away from poaching and toward talent development, advising that a more strategic approach is needed to build an adequate supply of required talent.

Looking forward

The oil & gas industry should be wary of tightening the talent belt too much, so it isn't caught off guard later. It will be a balancing act in adapting to the outflow of retiring workers, managing costs and retaining key employees from poaching activates.

Neil Duffin, President, ExxonMobil Development Co., said at SPE ATC in Amsterdam: "The important thing is we don't turn this in to a crisis. It is important we continue to recruit so we don't create the trough in the system like we felt from the 1980s that has lived with us forever. This is an opportunity to redefine ourselves."

Companies are doing just that while seeking positive solutions for managing the talent equation into the future. Take a look below to see open positions from the companies that participated in the career fair and check out their websites for additional opportunities. OE

Automation Manager/ Lafayette, Louisiana

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Proserv is an international energy services company specializing in the provision of life-of-field solutions. We have the ingenuity, expertise and proven track record to look at complex challenges and provide simple, yet outstanding, service-based solutions. We offer Drilling Control Systems, Production Equipment Systems, Subsea Production Systems and Marine Technology Services.
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Quality Engineer-Superior Completion Services/Houston, TX

Superior Energy Services

Superior Energy Services is a leading provider of specialized oilfield services and equipment, focused on serving the drilling and production related needs of industry companies as the decommissioning phase. The world's energy producers rely on us for the services, tools, equipment and exceptionally trained personnel needed to enhance and maintain the production of oil and gas wells.
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Multiple Opportunities

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Website: www.weatherford.com

Safety Specialists/ Lafayette, Louisiana

Safety Management Systems

As one of the largest providers of health, safety, environmental, medical and training services in the United States, we are committed to our mission of protecting lives and changing cultures worldwide. Our highly experienced personnel partner with clients to improve operational efficiency and achieve an injury-free work environment.
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Multiple Opportunities

United Vision Logistics

United Vision Logistics provides logistics services to customers across the United States. From hot shot to heavy haul services, United Vision has built a business over the past 50 years supporting the energy industry, with a commitment to operator safety and excellence, and a foundation based on integrity.
Website: www.uvlogistics.com

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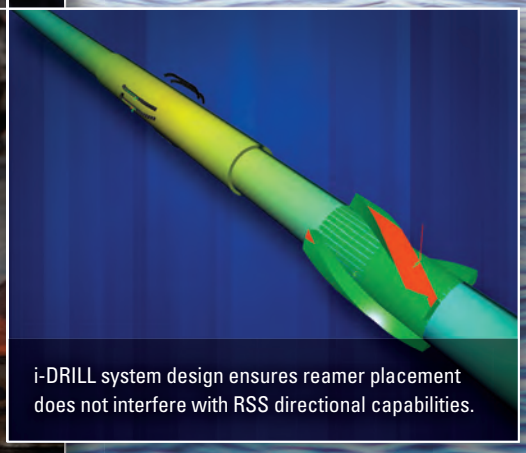
Rhino RHE

DUAL-REAMER RATHOLE ELIMINATION SYSTEM



i-DRILL system design ensures reamer placement does not interfere with RSS directional capabilities.

Dual-reamer system enlarges rathole, avoids a run, and saves 16 hours on a deepwater rig.

Rhino RHE rathole elimination system enlarged 178 ft of rathole while drilling a deepwater well in the Gulf of Mexico, saving 16 hours of rig time. The Rhino RHE system's dual-reamer process uses a hydraulically actuated reamer positioned above the MLWD tools to open the pilot hole and an on-demand reamer located near the bit to enlarge the rathole. The dual-reamer system eliminated a dedicated rathole cleanout run.

Read the case study at
slb.com/RhinoRHE

Schlumberger