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A fresh perspective

Welcome to a fresh look for *World Expro*, and to my first issue as editor. The oil and gas industry, too, is embracing the new, in particular the benefits offered by emerging technologies such as machine learning and artificial intelligence, cutting-edge tools for integrity management, and the possibilities stemming from a digitised oilfield. The potential offered by these next-generation technologies is huge. Previously unimaginable quantities of data open the door for unprecedented insight into operations, while robotics and automation promise increased safety and reduced costs.

As editor, I'm committed to covering the impact that these and other innovations will have on the industry, and providing in-depth insight at a time of great change. After all, no gains come without challenges. Data quality, especially of historical data, is a constant test. In our feature on subsea pipeline integrity on page 32, Dr Henry Tan discusses the development of computing models that are particularly suited to missing or uncertain data for predicting legacy pipeline behaviour. Elsewhere, in our profile interview on page 10, OMV Petrom's chief of innovation, Jaco Fok, points out the effort needed to make use of the records of a venerable company when decades' worth of valuable information was taken down with pencil and paper.

Crucially, Fok emphasises the central role played by people as a company changes to become more digitally agile. This is echoed in our discussion on page 52 with Torbjørn Folgerø, senior vice-president and chief digital officer at Equinor, where data is being made available to employees and the company is investing in teaching digital skills.

Here at *World Expro*, people are also crucial, and none more so than our readers. As I take on the role of editor, I'd welcome your feedback and any thoughts you have on topics we should explore in the future. I hope you enjoy this issue, and I look forward to meeting many of you in person to continue discussing the exciting developments covered here.

Grace Allen, editor

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In this issue



8 News & numbers

The headlines and vital statistics impacting the market.

Big interview

10 The people person

Grace Allen talks to Jaco Fok, chief of innovation at OMV Petrom, about data challenges, how to change patterns of working and why, in the end, it's all about people.



Safety & security

14 Those are the rules

Fire safety should be high on the agenda of any offshore operator. Jim Banks talks to John Pirie and Mark Royle at the UK's Health and Safety Executive about how regulations adapt to new technologies and how the industry approaches its engagement with regulatory bodies.

Events

19 In the long run

An overview of the 43rd Indonesian Petroleum Association Convention and Exhibition, taking place from the 4–6 September 2019 in Jakarta, Indonesia.

20 Golden opportunity

2019 marks 50 years of the Offshore Technology Conference.

Taking place on 6–9 May in Houston, Texas, representatives from over 100 countries will gather at the esteemed showcase to present and discuss the industry.

23 Innovation in HD platform technology

Probe

25 The heat of the moment

Heatec

27 Get ahead of the game

TrendMiner

29 Enhanced detection for improved protection

3M Gas & Flame Detection

30 A consistent evolution

Matjack

Pipeline technology

32 What lies beneath

The integrity of legacy subsea pipelines is a crucial issue for the industry. Grace Allen talks to Dr Henry Tan, senior lecturer in the University of Aberdeen's School of Engineering, and Neil Gordon, chief executive at Subsea UK, about the challenges in managing ageing assets, and the advances in data solutions and technologies that are improving this process.

35 Blow hot and cold

Energy and industrial processes have never been so high, deep, hot or cold. Mike Semens-Flanagan, and Brian Metz of IMI Critical Engineering, examine how valves can be designed for service in extreme environments.



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Exploration & production

38 Top of the rock

Predicting what lies beneath the surface of an oil field is a complex and data-intensive task. *World Expro* speaks to Bill Shea, CEO of Sharp Reflections, who explains how advances in data processing are making the guesswork more accurate – and how it's all taking place within the cloud.

41 Global strategy: the American way

North American assets are among the key elements in the exploration and production activities of some of the world's largest energy companies. *World Expro* looks at the recent projections from Chevron and ConocoPhillips to see how projects in Canada, the Gulf of Mexico, California and the rest of the Lower 48 figure in their ambitious plans for the future.

Digital oilfield

44 A silver lining

Large oil and gas companies are teaming up with major providers of cloud computing services to deploy artificial

intelligence (AI) to improve the interpretation of subsoil data. Jim Banks discusses how AI could facilitate a paradigm shift in the industry's approach to geoscience with Dr Eirik Larsen, an expert in AI, as well as data management.

48 Venture below the surface

Eddyfi

49 Strands that deliver

Battling with complex factors on the supply side that are driving down the price of oil, many energy players are focusing their efforts on becoming leaner and more efficient, with an aim to counteract the impact on margins. In this report, *World Expro* looks at how Total is combining technological

innovations to stay competitive and ahead of the curve.

52 The revolution will be digitalised

As the rate of digitalisation and data creation picks up, it is imperative for the biggest players in the industry to have a robust policy to exploit these developments. Torbjørn Folgerø, senior vice-president and chief digital officer at Equinor, updates Grace Allen on happenings at the forefront of the Norwegian company's digital strategy.

55 Quality cable solutions for the deep sea

DeRegt

56 Product showcase



"Effective use of data can be a game-changer."

Ariel Flores, BP's North Sea regional president

Discoveries up in 2019

Research firm Rystad Energy has reported that significant oil and gas discoveries took place in the first quarter of 2019, corresponding to 3.2 billion barrels of oil equivalent.

The average for the year so far has reached 1,042 million barrels of oil equivalent – the highest since 2015. "If the rest of 2019 continues at a similar pace, this year will be on track to exceed last year's discovered resources by 30%," commented Rystad Energy upstream analyst Taiyab Zain Shariff.

With 2.2 billion barrels of resources discovered, February was the most successful month for exploration since August 2015. The largest find is the offshore natural gas reservoir detected at the Glaucus-1 well, Cyprus, by ExxonMobil; this, plus two further discoveries, makes ExxonMobil the top major this quarter. The most significant onshore discovery is Kali Berau Dalam in Indonesia, operated by Repsol. Total and Eni also made offshore discoveries, in locations ranging from Glengorm, east of Aberdeen in the UK, to Angola, South Africa and Egypt.

3.2 billion

Amount of barrels discovered in the first quarter of 2019.

Rystad Energy

Shell invests in ecosystems

Shell has announced the investment of \$300 million over the next three years into nature as part of a strategy to reduce carbon emissions. This includes investments into low-carbon driving options, including the provision of electric vehicle charge points. Another area is carbon-neutral driving, which allows those with traditionally powered vehicles to make use of carbon credits, and the

Saudi Aramco leads oil producers in 2018

Ratings agency Fitch has named Saudi Arabia's national oil company Saudi Aramco as the largest oil producer in the world when assigning the company its first ever Issuer Default Rating: A+ with a stable outlook. The high rating is due to Saudi Aramco's "high production, vast reserves, low production costs and very conservative financial profile", Fitch outlined in a

\$224 billion

Saudi Aramco's 2018 EBITDA earnings. Fitch

statement. Saudi Aramco produced \$224 billion in earnings before interest, tax, depreciation and amortisation (EBITDA) in 2018; its liquids production for the year was an average of 11.6 million barrels of oil equivalent per day (MMBOEPD), and its total hydrocarbon production was an average of 13.6 million barrels of oil equivalent per day. The rating is capped due to the close ties between the company and the government. Fitch gives the company a stand alone credit profile at AA+.

UK oil and gas data made public

The UK Oil and Gas Authority (OGA) has launched an online platform that makes decades worth of data, ranging from seismic surveys to infrastructure information, available for free. The UK Oil and Gas National Data Repository (NDR) provides 130TB of infrastructure, well, field and geophysical data and is intended to facilitate innovation, exploration and investment.

"Effective use of data can be a game-changer in the oil and gas sector, delivering improved safety, reliability and efficiency, yet the value of existing datasets are never fully

130TB

The NDR's contribution to the industry. UK Oil and Gas Authority

realised," said Ariel Flores, BP's North Sea regional president. "The NDR should bring about a step change, bolstering the UK's digital infrastructure and liberating data flows to unlock a wealth of new opportunities that could ultimately boost recovery. Sharing data and information to build knowledge across the basin is key to maximising economic recovery from the UK. BP welcomes the launch of the NDR and, through active cooperation with the OGA and our industry colleagues, looks forward to fully realising the value that open data access can bring to the UKCS."

compensation of CO₂ emitted by fleet vehicles. Shell is also investing directly into the preservation of the natural environment: more than five million trees will be planted in the Netherlands and 300,000 in a reforestation project in Spain, while an endangered native forest regeneration project has been set up in Queensland, Australia.

"Shell's announcement signals that one of the world's biggest energy companies is pursuing a decarbonisation strategy with a broad set of solutions, including by investing in nature," said Mark Tercek, CEO of The

300 million

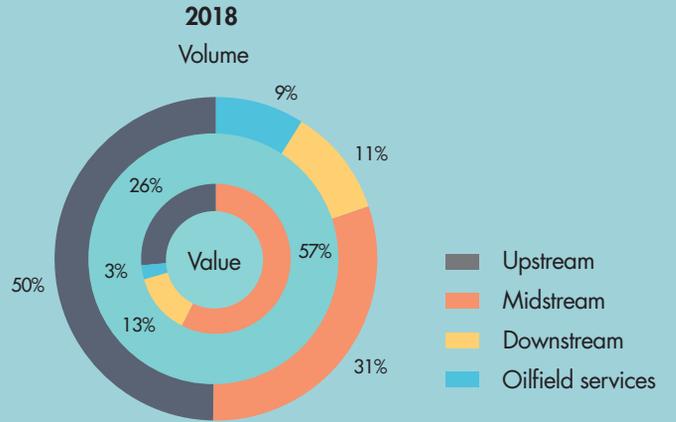
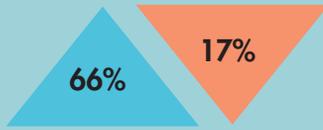
Shell investment in natural ecosystems. Shell

Nature Conservancy. "By doing so, it is helping to curb global deforestation, restore vital ecosystems, and help communities develop sustainably.

Shell is the first in the industry to set near-term targets for the emissions of both its operations and its products; this is clear progress, but it also illustrates how much work remains to achieve Paris Agreement climate targets."

Spotlight on the US

Increase in deal value and decrease in deal volume versus 2017.



A selection of upstream sales deals in 2018



Oil and gas deal volume and value



\$301.3 billion 2018 deal value.

186 2018 number of deals. **4** Upstream mega deals.

66% Increase in deal value on 2017. **33** Upstream shale deals in Permian basin.

\$35.96 billion Worth of 33 upstream shale deals in Permian basin.

Source: PwC US Oil & Gas Deals Insights year-end 2018 / IHS Markit

The people person

Jaco Fok is looking to the future. Even when discussing his past career – one that has taken him through five industries and as many continents – OMV Petrom’s chief of innovation can’t help examining how his experience with the first wave of internet-enabled technology might inform his understanding of the next.

“All of a sudden, the world was woken up by the internet,” he says, pointing out similarities between what he describes as the ‘hype cycle’ of the rise of the World Wide Web and today’s widespread digitalisation, as well as the vast underappreciation of what the internet would come to be – not just a marketplace, a way to conduct transactions more easily, but a game changer in how we communicate and collaborate.

“I’m pretty sure that whatever estimations we make of this digital revolution, we’re going to be underestimating something, and we’re missing something big,” he says. “And personally, I’m still looking for that big thing. What are we missing? What is the social media of this whole digital revolution?”

Roles of innocence and experience

Fok’s experience in innovation and change management puts him in a good position to anticipate what that next big thing might be. After an education in chemical engineering and biochemistry, he spent 12 years in varied roles at Dutch multinational Royal DSM, moving from management in food ingredients and super fibres into

Introducing a forward-looking digital culture across a large and historic company is no easy feat. Grace Allen talks to **Jaco Fok**, chief of innovation at OMV Petrom, about data challenges, how to change patterns of working and why, in the end, it’s all about people.

business development, strategy and innovation and weathering the 2008 crash along the way.

“At the time that we went through the financial crisis in 2008, that was where I really learned to be a good business manager,” he says, explaining that deep business experience prepared him for the post-crash turn to innovation. “From the business management job, I could have gone through more general types of management, but instead I chose to go to the business incubator of the company.”

Following roles that included the establishment of overseas innovation centres in China and India, and the directorship of the China centre for Royal DSM, Fok moved into oil and gas, spending four years at Shell working on the introduction and development of cutting-edge technologies, as well as a broader company-wide mindset change towards open innovation. In 2017, he was appointed chief of innovation at Romanian oil and gas producer – and South and Eastern Europe’s largest energy company – OMV Petrom. “My task is to make this company more innovative and more digitally dextrous,” he summarises. Enabling change across a company of 14,000 employees is no small task, but Fok emphasises that OMV Petrom is committed to the evolution. “The most important one of any piece of change management is senior leadership,” he explains. ▶



1988

Jaco Fok had degrees awarded in biochemistry and chemical engineering.

1997

He gains an MBA from Rotterdam School of Management, Erasmus University, the Netherlands.

2010

Fok becomes innovation director at Royal DSM.

2012

A move to Royal Dutch Shell sees a focus on open innovation.

2017

At OMV Petrom, he becomes chief of innovation.

“What you see is executive leadership being really supportive of this whole digital transformation.”

This change is already under way, including the development of a background architecture which can unite the company’s disparate data sources. Another project is the creation of a dashboard of refinery data, allowing a refinery manager to easily access undisputed key figures and areas for attention.

“We recently gave the big technology and innovation event here in [OMV Petrom headquarters] Petrom City, where we had 28 booths in a sort of internal exhibition that showcased innovations that have happened over the past two years, and people were actually amazed,” he says. As important as the introduction of new technology is the provision of the skills to use it. Fok describes how OMV Petrom is setting up a digital academy to provide training at a range of levels on key concepts such as the internet of things (IoT), video analytics and blockchain.

More in-depth training is also provided to allow people with a background in analytics to become data scientists: a vital skill set in a digital future. Fok points out the value of internally educating employees who already benefit from expert knowledge of the data sources and the challenges of the company, rather than bringing in data specialists who lack industry experience. “These people are hard to come by, and if you can find them, they typically have no idea about oil and gas,” he explains.

Turn and face the strange

The change in management Fok is implementing, however, goes deeper than the development of new technologies and the teaching of new skills. Fundamentally, his task is to change the way people think. Of particular importance here has been the introduction of design thinking: approaching problems in an iterative manner, creating versions that can be tested, adjusted and improved. It was Fok’s counterpoint to employees asking for increased ‘fail tolerance’ in their work, a system that sees each new version not in terms of failure but as a prototype to be refined.

While design thinking is most suited for front-end projects, Fok is also introducing other iterative methodologies in other areas of the company: Agile-SCRUM for project delivery and Lean Startup for commercialisation. “Now everybody in the company talks about it,” Fok says enthusiastically. “Design thinking is a word you can just mention in the canteen and people say, yeah, I know that. And two years ago nobody had heard of it. So we’re actually moving at lightning speed.” While Fok clearly views the adoption of design thinking at OMV Petrom as a success, he acknowledges that changing how people think is not without challenges. He muses that some of these may

have deep roots, in Romania’s communist history: the one-party Socialist Republic of Romania ended with revolution in 1989.

“Romanian culture still has a lot of remnants from the past where communism has left its scars, and that makes people somewhat afraid to speak up, makes people hesitant to share, makes people sometimes more focused on maintaining what they have rather than growing into something new,” he says.

This is amplified by OMV Petrom’s (and OMV, its parent’s) past as a state-owned company. “[This] makes them historically more hierarchical and more planned,” Fok says. “Having said that, there is already quite a large group of front runners that is eager to play a role, that is eagerly grabbing the wheel, initiating projects, but you see that there is different speeds in different departments, in different layers of the organisation. So I think as we move into this digital era with quite some speed at the moment, we need to be very careful to take the whole company along.”

Beyond people transformation, there are also the hurdles that every organisation must face when becoming more digitally adept: in particular, grappling with data quality. OMV Petrom’s 160-year history means a wealth of information has accumulated on the company’s wells, but this isn’t always easy to access.

“160 years ago we started drilling wells and we started our first oil well files, with a piece of paper and a pencil, and some of the data from the wells that we need is indeed a hundred years old,” Fok says, explaining that issues such as water damage or files being altered or lost can have ramifications today. “When you want to make predictions for reservoirs in oil and gas, you need decades and decades of data, and that is sometimes a challenge.”

New technologies, such as sensors in automated wells, need to be calibrated and checked to make sure that they give accurate readings. Predictive analytics depend on accurate data, and Fok believes that this is still something the industry needs to work on before the digital revolution can have full effect.

“I think the industry is coming to realise that there’s a lot of homework to be done before you finally get to the nice goodies like machine learning,” he says. “There’s a backlog of investments in data that need to be done before you have this crisp and clean data that your artificial intelligence can help you make clever decisions and predictions with.” Fok sees the potential arising from digital tools working with this data as world-shattering – but he’s insistent that it’s people, not technology, that will drive the digital revolution. “As important as AI is, if the people don’t use it, then it’s useless,” he says emphatically, referencing the necessity of democratising digitalisation. “Putting digital skills in the hands of the people, not just the experts – that is going to cause the breakthrough.” ●

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Those are the rules

Fire safety should be high on the agenda of any offshore operator. Jim Banks talks to **John Pirie** and **Mark Royle** at the UK's Health and Safety Executive (HSE) about how regulations adapt to new technologies and how the industry approaches its engagement with regulatory bodies.

As the number of offshore oil and gas platforms continues to grow, demand is set to rise for advanced safety systems, including fire and gas detection technology, as well as explosion and fireproof lighting. These are areas in which technology continues to develop incrementally, so regulators and operators alike need to be aware of how the capability of these systems is changing.

The advances in technology are driven partly by regulatory requirements, partly by innovative designs and uses of materials by equipment manufacturers, and partly by enhanced data analysis that changes how technology can be deployed to maximise performance and cost-efficiency. A key issue here is how the regulatory landscape adapts to the development of new technology or the refinement of existing systems.

Operators will no doubt put great emphasis on safety, but their eye must also be on cost management. For the regulators, performance against clear and specific safety criteria is the only benchmark that they examine, though they recognise the need to work closely with operators and with

technology manufacturers to help the industry incorporate advances in design and technology.

“From our point of view, we look at the functional safety piece of safety systems in the offshore industry,” says John Pirie, electrical and control systems principal specialist inspector at the UK's Health & Safety Executive (HSE). “There have been some changes in the standards, with additional reviews that operators must carry out.”

Pirie's job is to look after electrical, construction, and instrumentation (EC&I) issues in offshore installations, and is closely involved in planned inspections and investigations of incidents concerning all EC&I systems. The changing standards to which he refers include IEC Standard 61511 – a technical standard that sets out practices in the engineering of systems that ensure the safety of an industrial process through the use of instrumentation.

He also refers to the inspection of equipment that has been classified as safe for use in hazardous areas, known as EX equipment.

“Generally, the industry is good at compliance with regulations and guidance,” Pirie notes. “Some

are very advanced in their compliance procedures, most are in the middle of the road, and a small few need to be prompted. Safety has to be a top priority for this industry.”

A lightness of touch

Regulators will not necessarily mandate the use of a new technology such as LED lighting, though they will closely observe how it is used in the industry with a view to formulating new guidance. LED has potential benefits in terms of cost and performance compared with traditional lighting systems, but it is shown to be better suited to specific applications rather than being a direct replacement in every instance.

“When it comes to new lighting systems, it is all about meeting the right performance criteria,” says Pirie. “Offshore installations are reliant on gas and diesel-powered turbines, so the usage of fuel to power electrical systems is a very important consideration. At the HSE, however, we are just looking at the performance of the devices.”

Crucial to this evaluation is IEC 61892, which forms a series of international standards that are intended to enable safety in the design, selection, installation, maintenance and use of electrical equipment for the generation, storage, distribution and utilisation of electrical energy for all purposes in offshore facilities. The lux levels produced by LED lights have raised questions over their suitability for escape lighting, but there are other areas in which they are proving to be highly beneficial from a safety perspective.

“With floodlights, the move to LED has saved a lot of man-hours in maintenance,” says Pirie. “Before, the bulbs failed regularly and were hard to get to. Also, maintaining them at height brings risks. So, LED has certainly reduced the risk. In regular lighting, however, there is less adoption of LED technology compared with fluorescent lighting. The technology needs to develop a bit further in that application.”

“From an explosion protection perspective, you need to open these lighting systems up for inspection,” he adds. “LED lights that have a 10-year closed guarantee may be manufactured to EX standards, but the guarantee does not apply if they need to be opened up.”

Mark Royle, an offshore specialist inspector and leader of the fire and explosion team at the HSE,

agrees that the key advantage of LED lighting systems stems from how robust they are.

“LED lighting has reduced the maintenance burden, so there is less need for ropes and scaffolding to reach the lights,” he says. “That improves safety.”

Smart deployment is the future

Another area that is regularly reviewed by regulators, partly because of the potential impact of new technology, is fire safety. Systems for the detection of fire are, for obvious reasons, essential in offshore oil and gas production, as are the processes and procedures for responding to fires or gas leaks.

“Offshore installations are reliant on gas and diesel-powered turbines, so the usage of fuel to power electrical systems is a very important consideration. At the HSE, however, we are just looking at the performance of the devices.”

John Pirie

Royle looks at all passive and active fire protection and gas detection systems, assessing their fitness for purpose and the effectiveness of monitoring and response procedures.

He points out that, in general, the industry’s maintenance regime for safety-critical systems is very advanced. “The regulations are not proscriptive but every five years an operator must look at best practice within the industry and at new technology. Change in the detectors themselves is incremental and does not happen fast.”

“Gas detectors, for instance, have become more reliable in recent years and less likely to give false alarms,” Royle adds. “Now, the focus is on the optimal placement of sensors. Computational fluid dynamics is now easier to perform with the greater computing power that is available, so it is easier to calculate the probability of where gas leaks might occur.”

In the effort to optimise the placement of sensors, the focus has been on the analysis of vast quantities of data to work towards a more intelligent approach to the deployment of detectors. “The result is the operators can save money compared to the previous



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Key document IEC 61892

A series of international standards that are intended to enable safety in the design, selection, installation, maintenance and use of electrical equipment for the generation, storage, distribution and utilisation of electrical energy for all purposes in offshore facilities.

says Royle. “One area in which the approach to fire suppression is changing is the move away from putting sprinklers in accommodation areas, which means that a very advanced fire detection system must be in place.

“For instance, there is often a smoke alarm in each cabin that is linked to the control room,” he adds. “This initiates a manual response, not an automated deluge system response. For other areas of offshore installations, systems are mature, as they do use the traditional deluge system. We are also seeing the removal of halon systems, which are being replaced by systems that use other non-reactive gases or water mist. Halon systems were replaced by CO₂ systems, but then these were replaced by Inergen systems.”

The term halon covers a range of unreactive gaseous compounds of carbon with bromine and other halogens. Extensively used in fire extinguishers at one time, these gases are known to damage the ozone layer, so their use has abated. Inergen fire suppression uses naturally occurring gases – nitrogen, argon and a small amount of CO₂.

The cyber dimension

While the fundamentals of safety and security systems have not undergone dramatic change in recent years thanks to a focus on incremental performance improvement, a new issue has taken centre stage for Pirie and his team at the HSE.

“One of the main topics at the moment is cybersecurity, which is relatively new on the agenda,” he explains. “This is certainly pertinent to safety systems, as there is often a lot of connection to vendors’ control systems. Generally, the industry is in a good place in terms of security, as it is not easy to break into an offshore installation, but there is wide area network vulnerability. Operators want a connection for information about the installation to go onshore, but there is a cybersecurity risk.”

“The industry has always been advanced in its adoption of IT and business networks have been on the agenda. Nevertheless, in terms of the technology for control systems, operators must recognise the potential for risk,” he adds.

The HSE’s role in the cybersecurity debate is firstly to produce guidance for the protection of control systems. This was first released in 2017 and updated in 2018. Secondly, it is to perform the

role of a competent authority in the implementation of the Network & Information Systems (NIS) Regulations that are part of the UK government's national cybersecurity strategy. NIS, which came into force last year, places legal obligations on providers to protect UK critical services by improving cybersecurity.

The cybersecurity challenge highlights a key issue that the industry and regulators face in all areas, be it safety lighting, fire and gas detection or any other safety system – the need to keep pace with the development of new technology.

“Regulations move more slowly than technology,” says Pirie. “The uptake of technology may be slow or fast, and the pace at which the industry moves is what drives the response of regulators. We handle that through the guidance we produce in collaboration with the industry. Even if the regulations themselves have not caught up with new technology, our inspection guides show the inspection criteria that we will be using.”

Develop a dialogue

Regulatory bodies need to be as forward-looking as the industry and the vendors that supply it with new technology.

“When there is a new safety case, or a material change to one, it flags up that we need to speak to operators and maybe the manufacturer, too,” says Pirie. “The HSE also brings technology companies into our meetings to introduce new systems. We cannot sign off on new technology, but we do want to be aware of it. There is a very positive attitude from the industry. They engage with us well.”

The dialogue only brings benefits if it includes all relevant stakeholders – industry, regulators and technology developers. The role of the regulator here is not only to establish specific performance criteria for safety systems, but also to bring operators together around new ways of thinking.

“The HSE says that if there is an improvement in industry best practices, then other operators should consider implementing it,” says Royle. “They will always adopt practices and technologies that reduce their costs. We also issue guidance when technology is advancing, and they generally comply, though it can be expensive to put in an entirely new system.”

Operators may not cooperate directly in the area of safety, as they are naturally competitors, so regulators can perform a pivotal role in ensuring best practices, as they develop, are recommended or even mandated across the industry as a whole. ●

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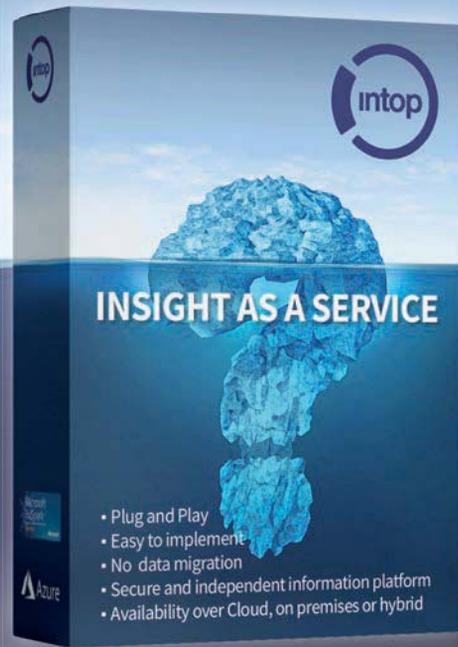
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In the long run

The 43rd **Indonesian Petroleum Association Convention and Exhibition**, taking place on 4–6 September 2019 in Jakarta, forms a valuable meeting place for the South East Asian upstream oil and gas industry. This year, the event focuses on the means of securing long-term energy security.

Indonesia has a long history in oil and gas, with exploration beginning as early as 1871 and commercial production in 1885. As the energy mix changes, though, it's vital to look to the future; while gas continues to develop, Indonesia's oil production has slowed from peaks of 1.6 million barrels per day to below a million barrels per day in 2007. The prudent management of resources is vital.

It's fitting, therefore, that the theme for the 2019 Indonesian Petroleum Association (IPA) Convention and Exhibition (Convex) is 'Driving Exploration and Optimizing Existing Production for Long Term Energy Security', a subject carefully chosen to reflect the currents in the industry.

The event, which usually takes place in May, is this year scheduled to be held on 4–6 September 2019 at the Jakarta Convention Center. "We are moving to September this year for strategic reasons which will allow the IPA Convex to be the industry's foremost event and will set the course for the region's upstream oil and gas sector," commented Hanny Denalda, the 2019 Convex chairwoman.

Bring it together

The convention, now in its 43rd year, is a significant marker in the upstream calendar. The 2018 event was attended by 23,329 people, including 1,657 convention delegates, who took part in 147 conference sessions. The 2019 event is expected to

be larger still, and promises to feature a technology session and the presentation of technical papers, as well as special and plenary sessions, which will see government officials and industry leaders provide insight on the cutting edge of the upstream industry.

"The event has been facilitating knowledge-sharing, networking and partnerships between industry and government over the years and shall to continue to be the leading platform and benchmark for the industry, not only in Indonesia but also in South East Asia," said Denalda.

Take the floor

The conference is accompanied by an exhibition, which in 2018 saw 116 companies showcase a range of work. "The IPA Convex always creates a welcoming and exciting show on the exhibition floor that is well participated by leading names in the business who represent the dynamic and exciting petroleum industry as well as members of the public and the student community," Denalda added.

Most of Indonesia's mature fields are in the west of the country, where 14 basins are producing oil and gas. The east is less developed, although there are 39 basins that may prove to hold resources. Over half of Indonesia's oil production comes from the island of Sumatra, while Java, where the capital Jakarta is located, is the country's biggest region for consumption. ●

Golden opportunity

2019 marks 50 years of the **Offshore Technology Conference**. Taking place on 6–9 May in Houston, Texas, representatives from over 100 countries will gather at a showcase of the offshore industry's innovation.



CELEBRATING
50 YEARS
1969–2019

The Offshore Technology Conference (OTC) has been a fixture on the Houston calendar since 1969, a year in which the city saw the Beach Boys and the Rolling Stones play, and the Mission Control Center guide *Apollo 11* to the moon. "For 50 years, OTC has encouraged scientists and engineers to develop innovative technologies that have unleashed the potential of offshore energy sources needed for global growth and progress," commented Patrick Pouyanné, Total's chairman and CEO, on the event's website.

This time around

The OTC's flagship event, however, is looking to the future, not the past. The first session, on 6 May, is titled 'OTC's Golden Anniversary Opening Session: The Next 50 Years of Offshore Developments', and will explore the impact of advances like machine learning and automation. The session will feature industry leaders such as Maria Claudia Borrás, BHGE's president and CEO of oilfield services; Arnaud Breuillac, president of exploration and production at Total; as well as Jannicke Nilsson, EVP and COO at Equinor.

In addition, a new series of sessions looks at offshore developments around the world, with panels made up of experts discussing advances in countries ranging from Norway to Israel, Mexico and Ghana. In total, the OTC will see over 350 technical presentations throughout the event.

Technical sessions over the length of the conference will cover forward-looking topics such as robotic technologies, artificial intelligence and machine learning, data modelling, digitalisation and smart materials. Others concentrate on the future for more familiar processes and technologies: drilling rigs, subsea processing, deepwater projects.

The more the merrier

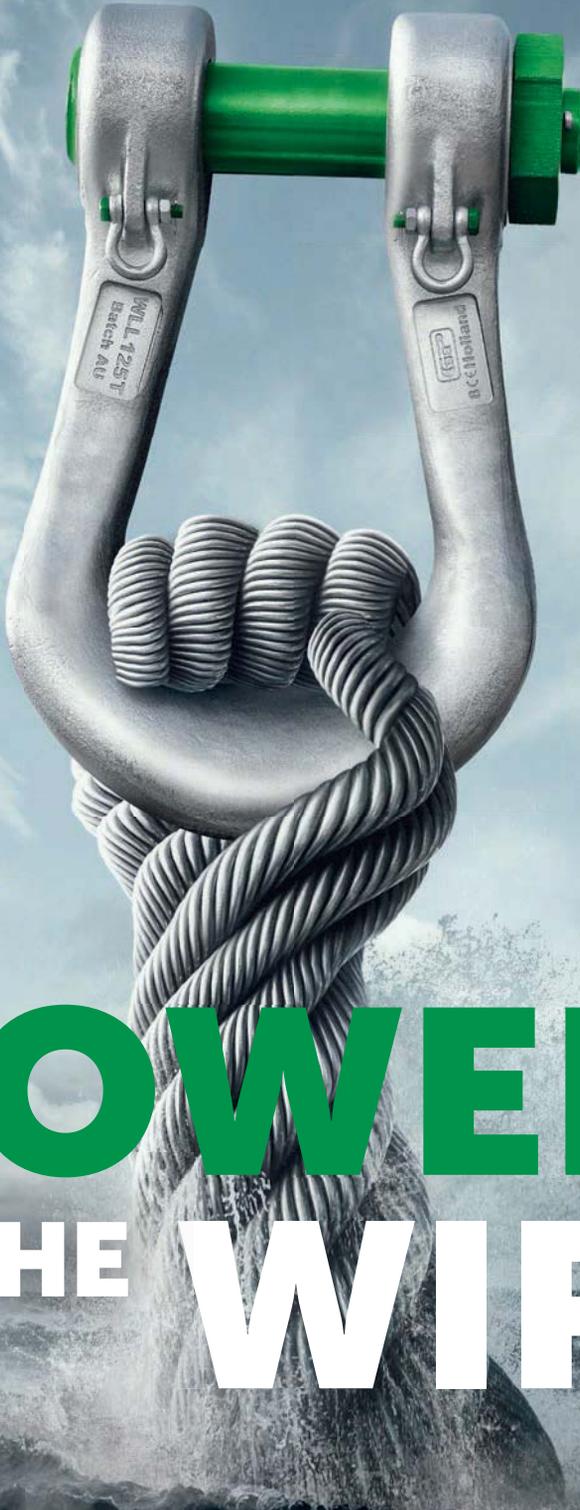
More than 2,500 exhibitors will present the latest innovations to thousands of global attendees, with the annual Spotlight on New Technology Award recognising the most ground-breaking advances, while peerless networking opportunities contribute to making the Offshore Technology Conference a must-attend event. Throughout the conference, university showcases provide an insight into cutting-edge research and development of interest and value to the industry.

The OTC is also acting proactively in committing to the future of the industry. The conference will feature the finale of the OTC Energy Challenge, a competition among high schools to find solutions to energy issues facing the world today; the programme seeks to enthuse and educate the next generation of STEM scientists and engineers, assigning them an industry mentor. The school teams will have the opportunity to present their work to attendees at the OTC and to win a scholarship award.

Thursday 9 May sees free workshops put on for teachers and high-school students by the Energy Education Institute. Participants can experience hands-on energy experiments and learn to interpret data in sessions taught by the National Energy Education Development Project (NEED).

Look no further afield

With the number of attendees expected to surpass 60,000, representing over 100 countries, the 2019 edition of the Offshore Technology Conference is an opportunity for scientists, engineers, executives and others working in the offshore industry to look to the future of the field. ●



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Innovation in HD platform technology

Probe has launched its high-speed digital (HD) telemetry platform with the aim to better its data-logging capacity, and increase productivity in its supply of technology to the oil, gas and geothermal industries.

Probe, a supplier of cased-hole logging and advanced monitoring technology to the global oil and gas and geothermal industries, continues to make headway to dramatically increase its data-logging capabilities through the adoption of its high-speed digital (HD) telemetry platform.

Known as the HD Platform, an increasingly wider range of high-speed, highly configurable digital sensors play critical and unique roles in helping operators to log data much more efficiently. In addition to its range of standard and array production logging tools, Probe has been focusing on cased-hole formation evaluation solutions:

- **RADii Segmented Bond Tool:** an implement that measures and maps the quality of cement behind casing in oil and gas wells.
- **Reservoir Analysis Sonde (RAS):** a three-detector pulsed-neutron logging tool for measuring reservoir saturation using sigma and carbon-oxygen techniques.
- **Spectral Gamma-Ray Tool:** an evaluation tool that offers insight into the radioactivity and mineral composition of cased-hole formations.

More data gathered per well intervention

“For years, the demand for logging tools that are highly configurable and capable of gathering high-quality data more efficiently has continued to rise unabated, so we believe that continuing to expand our truly intelligent, effective formation evaluation solutions is critical to our customers’ success,” says Martin Barratt, vice-president of global sales at Probe.

“The HD Platform is the result of a concerted initiative to enhance our



The RADii Segmented Bond Tool measures the quality of cement used in oil and gas wells.

field-proven tools with the highest quality measurements in the industry, and by enabling fully combinable configurations, Probe is confident that it delivers on every front.

By employing HD Platform-compatible logging tools, service providers can now acquire more data per run in every well intervention. This means that fewer entries into the well for logging purposes, which improves efficiency and reduces costs, helping operators to meet key objectives.”

What the technology is and how it better gathers data

The new HD platform consists of two parts: an inter-tool communications bus and mono-conductor telemetry. The inter-tool communications bus is a single wire bidirectional system that operates at 500kpbs, which is ample speed to accommodate many different combinations of logging tools. The controlling telemetry – or alternative memory tool – samples sensors at a rate of 50 times per second, allowing high-data-rate tools and, for example, multi-arm calipers to provide high vertical resolution. Commands and instructions are also sent to the sensors on the same single wire bus. All tools below

the telemetry or memory tools operate on DC voltage of between 18V and 55V. Power efficiency means the tools are extremely robust and reliable.

Mono-conductor telemetry makes up the second key component of the HD system. The telemetry control unit handles all communications to surface. This device controls the data collected by the tools below, and packages it for transmission to the surface system. It receives commands from the surface system via the fast downlink, and responds back to the surface, as necessary. As a result, the HD platform makes it possible to log data at variable speeds and is easy to transition between real-time and memory-logging capabilities. Operators will not only be pleased with its robust construction and field-tested performance, the HD platform is well suited to all operating environments, especially those offshore and in remote locations.

Looking ahead, as part of its continuing commitment to developing technologies that gather comprehensive data, Probe plans to integrate HD telemetry technology into all its cased-hole logging tools. ●

For further information

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The heat of the moment

Heatec has been supplying the offshore oil sector with specialist fluid and convection heaters since 1977. Adriano Santos, a sales manager at the company, discusses how its products stand up to the extreme conditions experienced on platforms.

Oil producers are picky for good reason, according to Adriano Santos. As a sales manager with Heatec, one of the world's leading suppliers of heaters for platforms and other offshore facilities, he knows full well that the extreme conditions experienced on board demand only equipment of the highest quality.

"Normally, it's required to be explosion-proof, or suitable for Class V areas," he says, referring to the designation of areas where combustible gases are present. "The threat of corrosion means that they require special painting, and all sorts of other redundancies and accessories to make the heater more reliable."

Production under extreme conditions

Heatec works hard to ensure its products can stand up to the dangerous conditions normally encountered on an offshore platform. A typical heating system – one or two heaters, a pump system and an expansion tank with an output of 10 million BTU per hour – is built with PLC controls housed inside NEMA 4X stainless steel panelling with Z-type purging, a CO₂ fire suppression system, heat sensors and special paint that resists water corrosion. Heatec is one of the sector's largest suppliers of package heaters, which emerge out of the factory fully assembled and readily tested. "As you know, real estate on offshore platforms is valuable," adds Santos. "A packaged unit, for them, is ideal."

Heatec's products are designed to work in the most extreme climactic conditions. The company's heaters can be found as far afield as the baking heat of the Sahara to the frozen wastes of northern Alaska. In the case of the latter, Heatec prepares its products by using either special materials, like low-temperature steel, or insulation equipment. "We can offer



Heatec's products are meticulously planned and produced to brave the inhospitable conditions of an offshore platform.

instrumentation and components that are designed and rates to -50°C," says Santos. "Alternatively, you have the option of enclosing everything in a packaging we call the 'dog house', which is heated to an appropriate level."

Ready for battle

That guarantee against equipment failure in extreme conditions is bolstered by Heatec's army of engineers. "Most of the other heater companies that have been playing in our market are much smaller, and do not possess an engineering group of the same size," says Santos. "At Heatec, we have a relatively large team of 30 engineers, who stand ready to tackle any challenge."

It's all part and parcel of the service customers sign up for at Heatec. "Our customers don't pay anything for that service," explains Santos. "Additionally, we have a fully equipped training facility with two rooms housing extensive simulation and heater repair equipment. Each room can house up to 48 people, and we make those facilities available to

our customers all year round." Since 1977, Heatec's reputation among offshore oil producers as a reliable partner in high-profile projects – some costing billions of dollars – is unrivalled in the sector.

Quality assured

The aforementioned qualities are underwritten by the company's core values: devotion to meeting the needs of the customer; honesty and integrity; respect for all individuals; and a commitment to the preservation of the entrepreneurial spirit, as well as to safety, quality and productivity as a means to guarantee success.

"Offshore oil producers need to rely on suppliers that not only have a sense of tradition, but the financial strength to support them when they need it," explains Santos. "We have the tradition, we have the brand recognition and we have that strength." ●

For further information

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Get ahead of the game

TrendMiner is a web-based analytics platform for the visualisation of time series-based process and asset data. The self-service software has proved to be an innovative addition to the maintenance and overall production of the oil and gas industry.

You've heard by now that data is the new oil. Digital transformation is everywhere. It can be seen emerging in marketing, sales, HR, supply chain and finance – but also in domains such as plant operations and manufacturing. Digital transformation is opening up new opportunities, challenging the traditional methods, and changing the way we think and act. The oil and gas industry in particular has historically been slower to adopt new technology, but is of course continuously under huge pressure to alleviate cost burdens and optimise production. One of the ways companies are successfully tackling digital transformation is by implementing self-service analytics.

Meet industry challenges

Today's oil and gas companies face many challenges. In order to be successful, it must be ensured that all areas are performing optimally. It is essential the right information is available across various levels of the organisation to make the best decisions:

- At the production unit level, operators need to know how equipment is performing in real time. This is where

analytics can be used to improve uptime, efficiency and throughput.

- At the facility level, managers must be able to make educated decisions about procurement, production scheduling, and shipping without having to spend a lot of time and money on modelling by data scientists.
- At the enterprise level, executives need real-time, accurate data to relate production to the larger business context and understand the impact of fluctuating costs, changing market conditions, as well as asset performance.

Simplify asset performance management

Data analytics can improve a company's bottom line by prolonging equipment life, increasing asset availability and extending maintenance windows. For example, data mining and analytics can make a big difference in pressure testing blow-out preventers (BOPs). Deepwater Subsea is the industry's first and only independent third-party inspection company capable of providing 24/7 real-time monitoring and BOP compliance inspection. Its platform, Janus24,

the brainchild of Mike Fry, the CEO and founder of Deepwater Subsea, is a BOP real-time monitoring system that allows for the collection, monitoring, trending of faults and alarms, reporting of subsea control system data, and regulatory compliance inspection points. It is used on rigs across the Gulf for customers such as Chevron, Pacific Drilling and TransOcean. The specialists at Deepwater Subsea have been running BOPs through pressure tests for years, and previous methods would generally be time consuming and labour intensive. With the implementation of TrendMiner, however, they are able to simplify this work and establish practices related to BOP testing.

“TrendMiner's given us better visibility than what we've ever had before because it allows us to speed up our troubleshooting in our analytics with their predictive models,” says Fry. “Utilising a software like TrendMiner gives us greater access to the data and a better understanding without having to be a data scientist.”

It's easier than you think

Now oil and gas companies have a quick, easy and affordable solution for optimising performance through pattern-recognition software that can quickly sift through billions of time series data points to find instances where events have occurred. By using this new approach to data analytics, oil and gas companies gain valuable insight into operations and systems behaviour – often in just a few hours after installation – to discover new areas for improvement.

Unlike big-data-modelling projects, which address a single issue, self-service solutions are used by engineers day to day, helping uncover thousands of small to mid-size opportunities for optimisation, all of which contribute to increasing overall profitability. ●

For further information

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TrendMiner's interface has proved to be an inimitable development for the oil and gas industry.



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Enhanced detection for improved protection

3M Gas & Flame Detection is gearing up to showcase the CXT with WirelessHART gas detectors at the Offshore Technology Conference in Houston, Texas, on 6–9 May 2019.

High-quality global manufacturer 3M Gas & Flame Detection will be exhibiting the new CXT gas detector with WirelessHART communications at the Offshore Technology Conference in Houston, Texas, this year.

The CXT gas detector with WirelessHART will be an easy addition to any existing HART wireless network. Owners of the device can simply mount it to a wall or pole, set the network key and the unit will automatically join any existing HART wireless network. These gas detectors are designed for use in heavy industrial environments and include electro-polished 316 stainless steel housing with fully encapsulated electronics and dual layer surge protection. These details in design virtually eliminate the threat of outside damage to internal components due to water ingress, corrosion, vibration and transient spikes.

Infrared right hand

Power for the CXT with WirelessHART gas detector is supplied by disposable or rechargeable battery options that provide

up to 34 months of continuous operation on a single charge. Available in two basic sensor versions, the IR is equipped with an infrared sensor for monitoring combustible hydrocarbons and the DM is fitted with one of a variety of electrochemical sensors for monitoring toxic gases and oxygen.

The products will carry CSA, ATEX/IECEX and HART Foundation approvals at launch, and will quickly gain INMETRO certifications a few months thereafter its debut. The devices operate at a frequency of 2.4GHz, have a greater than 0.4m line-of-site communication capability, and uses the industry standard WirelessHART network topology that allows each device to operate as a repeater within the network, ensuring redundant and reliable communication at all times.

Company-wide expertise

3M Gas & Flame Detection, a new product portfolio under 3M's Personal Safety Division, has debuted its gas and flame solutions, product breadth and innovative technologies as a unified front. The new group is formed from 3M's 2017

acquisition of Scott Safety and its Detcon, Oldham, Simtronics and GMI brands. "By unifying our expanded portfolio of brands into 3M Gas & Flame Detection, we're providing the POG, industrial, hazmat and commercial communities with a single source for a broad line of safety equipment, including an enhanced offering of gas and flame detection system solutions," says Mel Gerst of 3M Gas & Flame Detection.

"From the safety managers who are responsible for choosing their team's equipment to the workers who need confidence in that equipment so they can stay focused on the task at hand, our customers can be assured that under the umbrella of 3M Gas & Flame Detection we have products, technology and service that can help them be safe and successful," Gerst adds.

The products from 3M Gas & Flame Detection are well recognised for being designed for harsh environments and tough applications and appreciated for their user-friendly portables and large fixed selection. They help keep personnel and plants safe from hazards thanks to a wide range of sensing technology, including electro chemical, catalytic bead, metal oxide sensor, infrared and other optic solutions for gas and flame detection.

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When customers require a customised approach, 3M Gas & Flame Detection's application engineering groups help clients build the right plan for their unique hazards. A complete product line and industry-leading solutions offer excellent perspective and quality products trusted for the most critical situations. ●

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The full range of products is designed for harsh environments and poor conditions.

A consistent evolution

Founded in 1981, **Matjack** has grown to become an industry leader, manufacturing a range of cutting-edge airbags and cushions for lifting and moving heavy objects. John Sweezy Jr, CEO of Matjack, details adapting to new construction technologies and staying true to its founding values.

Matjack was founded in Indiana, in the US, back in 1981. How has the company stayed true to its founding values?

John Sweezy Jr: This business was founded to provide the best available products and to take care of customers and service their needs. Originally, we only built the high-pressure Matjack airbags and learned through our endeavours in heavy industry such as structural and machinery moving, along with deep underground mining how to build the best, long-lasting airbags in the world.

How has the advent of new construction technologies changed the way that Matjack works and develops its products?

As time has gone by, we have adapted and developed new equipment to help with the challenges faced by our customers who are adapting to new construction techniques and requirements. As the company grew throughout the 80s and 90s we added products and advanced our technology. Many of our products developed over the past decade are industry specific and job specific, so that makes installation of equipment or erection of beams and panels much easier.

Matjack has consistently evolved through its endeavours in heavy industry. How has this improved overall product quality?

As with any work or endeavour you come away with new knowledge on how products can be modified or improved to work more efficiently. As we worked to lift buildings, machinery or even bridge sections we found certain reinforcing materials worked better than others and, in some cases, different sizes were required, which led to the extensive line



Matjack's high-pressure airbags.

of Matjack products we build today. Today's Matjack airbags are designed to lift heavy weights with very little insertion height, and are available in 120psi/8 bar and 175psi/12 bar working air pressure.

The high-pressure bags are neoprene rubber reinforced with either steel or Kevlar cord and we offer a five-year unconditional warranty on these products. Matjack gives you the ability to get in tight spaces and lift loads to insert machinery skates, strapping or even larger hydraulic jacks if necessary.

“Many of our products developed over the past decade are industry specific and job specific, so that makes installation of equipment or erection of beams and panels much easier.”

You said that one of the strengths of Matjacks is its willingness to build custom requirements. Could you give specific examples?

Over the years we have customised our product to meet the customer's specific requirements, whether that was an 'off the shelf' product or something specific. We have built bags for the oil and gas industry capable of working in extreme environments, from Antarctica to the tropics, from cleanroom environments

to combat theatres and the ocean floor, all without failure. Matjack's low and medium-pressure cushions are used in just as many environments as the high-pressure bags. These cushions are a different style of product because they are made with neoprene rubber and Hypalon in the case of the low- pressure cushions, but Kevlar cord-reinforced neoprene with the medium-pressure cushions.

While they don't have the weight-lifting capacity the high-pressure option affords, they allow for greater lift height. Medium-pressure cushions lift at 15psi/1 bar and low-pressure lift at 9psi/6 bar working air pressure. The two options equally provide a wide range of heights and weights depending on the customer's needs.

Matjack's underwater lift bags are used to support offshore work with recovery of sunken equipment, allowing for the maintenance of vessels without dry docking. The products are used extensively, as well as exclusively, by the US Navy for recovery support.

What does the future hold for Matjack as a company?

We will continue to stay true to the foundation we have built, endeavouring to satisfy the desires of our customers and help them meet their challenges with utmost success. ●

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What lies beneath

The integrity of legacy subsea pipelines is a crucial issue for the industry. Grace Allen talks to **Dr Henry Tan**, senior lecturer in the University of Aberdeen's School of Engineering, and **Neil Gordon**, chief executive at Subsea UK, on the challenges in managing aging assets and the advances in data solutions and technologies that are improving this process.

Despite exploration that has taken our understanding beyond the Earth's atmosphere and into the darkness of space, the deep sea of our own planet remains largely unfathomable. The ocean floor can seem as remote as Neptune or Jupiter.

For the oil and gas industry, this inaccessible environment is what makes subsea pipeline failure so potentially catastrophic – it takes time and vast effort to locate and fix a leak, resulting in huge financial, environmental and reputational losses.

In Cook Inlet, Alaska, a natural gas leak from an 8in subsea pipeline was spotted in February 2017. The pipeline was losing an estimated 210,000 to 310,000ft³ of natural gas into the water per day and possibly threatening the habitat of wildlife, which included the critically endangered Cook Inlet beluga whale. The Pipeline and Hazardous Materials Safety Administration suggested that the leak might have gone on undetected since December 2016; it was not fixed by the pipeline's owner, Hilcorp, until April 2017.

The pipeline in question was over 50 years old, constructed in 1965. The continuing use of legacy infrastructure – which may be in service long after the end of its intended design life – is a challenge faced by many in the business, as life extension is so much more financially viable than replacement. It's familiar to Neil Gordon, chief executive of industry body Subsea UK.

"If you look at not necessarily just the pipelines, but the whole offshore infrastructure in the North Sea, many years ago, we said, yeah, a 20-year lifespan, and most of these things will be gone," he says. "We now have Brent, Beryl and a number of other fields which are pushing over 40 years old."

At long last: pipes that age gracefully

While the concept of 'ageing' as it relates to these pipelines refers not to the passage of time but their material degradation, older pipelines have been exposed to potential risk factors for longer and managing their integrity is a significant priority. "They're designed to last, these pipelines, for many, many years," Gordon says. "But as we've seen over the years, those pipelines have had their life extended, and we just want to make sure that they are fully integrity safe for operation."

Corrosion is one of the most significant causes of material ageing in pipelines; high hydrocarbon volumes as well as water, carbon dioxide and hydrogen sulphide can cause thinning of the steel from inside the pipeline, while variables such as salinity and temperature have an impact on the outer surface.

Furthermore, corrosion rates can vary. "If it's a highly corrosive product that they're putting through [a pipeline], then they might have a more intense inspection regime to have a look at that, because that might have a shorter lifespan than something that was fairly benign," Gordon explains.

Integrity management also needs to consider the many other potential hazards that can affect the integrity of pipelines. Hilcorp's pipeline in Cook Inlet was damaged where it lay on a boulder on the sea floor, while a crack in a pipeline off the coast of Balikpapan, Indonesia, in 2018 was reportedly caused by an anchor.

Shifting sea beds, instability of the sea floor and currents are further issues with which pipeline experts are familiar. "It could perhaps have things like free span, where a pipeline may be not supported underneath, because the tide or the current has actually moved a lot of the seabed away from it so it might be unsupported," Gordon says.

Furthermore, for older assets, data on the original construction specifications and historical

assessments may be missing as years pass and pipelines change hands between owners. This makes it even harder to judge how a pipeline may be affected by corrosion, erosion and other similar hazards.

This year's modelling: systems to inspect integrity

Dr Henry Tan works on the development of mathematical modelling systems to predict pipeline condition and deterioration at the University of Aberdeen, and the lack of this data is an issue he has encountered. "When we do the life extension, we want to predict the life of the subsea pipeline: we need the historical data," he says. "Sometimes for this kind of historical data, we don't have a complete set of the data from the designing stage to the current stage."

"Machine learning and artificial intelligence is coming so fast, once the technology can be applied to one area it will soon be applied to many other related areas."

Dr Henry Tan

To assess their integrity, the pipelines need to be inspected, but their challenging environment makes this an operation that requires significant investment, skilled technicians and specialist equipment. The employment of risk or condition-based monitoring, which targets inspections on areas deemed more likely to experience problems, streamlines the process. Regularly scheduled inspections may not pay enough attention to high-risk assets and waste resources on those less in need of inspection.

Risk-based monitoring requires a predictive element, judging the likelihood of an asset's failure, and allocating resources appropriately. At the University of Aberdeen, Tan and his colleagues are developing a data modelling methodology that makes better use of the data available to model pipeline corrosion and predict residual life. "It's more on the softer technology," Tan explains. "Not the hard technology like how to get the data, but how to use the data you have so far."

Tan, with his colleagues Reza Aulia and Srinivas Sriramula, outlines the proposal in an article due to be published in the proceedings of the 26th CIRP Life Cycle Engineering Conference. They employ dynamic Bayesian networks, a soft computing technique that uses a directed acyclic graph to lay out the relationships between causes

and effects. It is particularly suited for situations where information is uncertain or incomplete, and allows for the input of both past and present data as well as qualitative data such as expert opinions. In the model, variables such as carbon dioxide, oxygen and hydrogen sulphide levels, pH, temperature and pipeline diameter and material, as well as past records of these variables, combine to produce an assessment of the probability of pipeline failure.

The use of this modelling to better understand risk and direct assessment resources has great potential for the industry. “We have the theory, the model, and then we develop the software that can be used by industry,” Tan explains. “So we are involved from the modelling to the software developing.”

company Swire Seabed conducted what it called the first autonomous inspection of a pipeline for Equinor, collecting bathymetrical, synthetic aperture sonar and visual data.

The incorporation of scanning technologies is also revolutionising inspection. “Some of the technologies that we’ve received more recently are how we can actually look from the outside of the pipeline, inside,” Gordon says. “The intrusive sort of inspection is done through loading in pigs and having a look from the inside, and we’re starting to get a bit cleverer now with the unobtrusive, so looking in from the outside.” A CT scanner for subsea inspection was launched by Tracerco in 2013, able to inspect the pipeline wall and the contents of coated pipelines.

The more data that is collected, the more it can be used in applications with artificial intelligence and machine learning capabilities, speeding up the process of flaw detection and improving its accuracy. “When you introduce technology at that level, you can accelerate the pace of the data acquisition and the actual interpretation of some of the flaws in there,” Gordon says.

The pace of innovation means that integrity management is set to revolutionise further in the years to come, as Henry Tan makes clear. “Machine learning and artificial intelligence are coming so fast, once the technology can be applied to one area it will soon be applied to many other related areas,” he says. As the world’s energy supply continues to rely on legacy pipelines, technologies that allow us to catch a clearer glimpse of the ocean floor become ever more vital. ●

“As we’ve seen over the years, [older] pipelines have had their life extended, and we just want to make sure that they are fully integrity safe for operation.”

Neil Gordon

A scanner sharply: a revolution in pipeline inspection

When it comes to actually undertaking assessments to monitor pipeline integrity, advances in hard technology, too, are improving accuracy and driving down costs, as well as allowing increased visibility on challenging pipelines that could not be inspected using methods such as pigging. Remotely operated vessels, operated from a shore-based control centre, or autonomous vessels can be used to obtain high-quality images of a pipeline as well as other information. In December 2018, survey



New technology is constantly monitoring the projected lifespan of subsea pipelines.

Blow hot and cold

Energy and industrial processes have never been so high, deep, hot or cold. The commercialisation of more remote resources has led to an increase in demand for valves that can withstand extreme environments. **Mike Semens-Flanagan**, chief technology officer, and **Brian Metz**, senior design engineering manager at IMI Critical Engineering, examine how valves can be designed to have a long service life in extreme temperatures.

Valves intended for service in cold ambient environments below -40°C or even -50°C present a unique set of challenges. Material selection, control accessory selection and meticulous testing are critical factors in ensuring valves and actuators can operate at extremely low temperatures.

Materials used for the valve body and bonnet must be selected carefully to compensate for the effects of very low temperatures on the ductility of metal. If the metal chosen isn't designed for performance in low temperatures, there is a high risk of brittle failure. This risk can be mitigated by choosing special carbon or stainless steels, which are specifically designed to remain ductile in low-temperature environments. In some cases, special mechanical tests can be carried out to verify the metal used will maintain the specified ductility at low temperatures.

The valve actuator and control accessories also require special attention, mostly due to the extensive use of elastomers. Normal elastomer

seal materials, typically used in an actuator, become hard and brittle at low temperatures. When a seal becomes hard, it loses the ability to conform to the mating surfaces, potentially causing the seal to break. On top of this, the hardening of dynamic seals (like the piston seal in an actuator) can cause erratic operation or complete failure to operate due to increased friction between the seal and the actuator cylinder. Selecting special low-temperature elastomers will ensure the seals remain flexible and maintain their functionality as designed.

Any accessories used to control the flow of air to and from the actuator, such as trip valves, air pressure regulators or boosters, must also be rated for low-temperature service for the same reasons. Control accessories must also be completely watertight, and any air exhausts must be aimed downward, and protected from water, snow and ice ingress. The air that feeds the actuator and control accessories must also be free of moisture when it leaves the plant air compressor, as excess moisture in the air lines can collect and freeze inside control accessories.

Lubricants used for actuator seals must be also suitable for low temperature service. Some lubricants become too viscous at low-temperatures, which can prevent the actuator from operating smoothly. Any lubricants carried over from the air compressor must also be filtered out, as this hydrocarbon oil can cause erratic operation or failure of the control accessories and actuator when exposed to low temperatures.

Other mitigation measures such as heat tracing or a heated enclosure may also be used in low-temperature environments. Heat tracing involves wrapping the valve components and actuator in a special resistance heating element connected to a power source and a temperature controller. The resistance heating element warms the valve components, making sure the temperature never

drops below a specified point. Alternatively, a heated enclosure can be provided. This is typically a small, insulated aluminium housing that completely surrounds the valve and uses a built-in resistance heater to maintain a local ambient temperature within a specified range. The heated enclosure provides a uniform temperature for the entire valve and actuator assembly, as well as providing shelter from snow, ice and wind.

Arctic conditions in western Siberia

The ZapSib-2 facility at the Tobolsk Petrochemical Complex in western Siberia illustrates the challenges of valve and actuator design in extremely low ambient temperatures. The new facility will be the biggest integrated complex for the production of polymers in Russia when it comes online.

As well as meeting the challenges of the extreme processing environment for polymers, which includes a highly corrosive atmosphere, suppliers have the additional challenge of ensuring their equipment can withstand the stress of extreme climate conditions, in this case, the potential for temperatures to fall as low as -52°C .

IMI Critical designs bespoke valves and actuators that will allow processors to operate safely, efficiently and reliably in some of the harshest environments on the planet. For this project, two IMI Critical companies worked together to produce anti-surge valves and actuators. The anti-surge valves required actuators ranging in size and stroke from ND200 with a stroke of 70mm, to an ND500 with a stroke of 300mm.

Another challenge was to tailor the actuators to the highly corrosive atmosphere and very low temperatures at Tobolsk. To withstand the corrosive environment, most components for the actuators were made in grade 316 stainless steel, as was the FasTrak positioner, which is TR CU-certified for -55°C . Grade 316 stainless steel includes molybdenum, which gives it higher resistance to corrosion.

Ensuring the actuators could work in very low temperatures was a bigger challenge. Actuators are typically required to work in temperatures of between -20°C to 70°C although our specialist actuation division, IMI STI, has previously supplied actuators to operate in -60°C .

The solution developed by IMI STI was to design a bespoke cabinet, also constructed in grade 316 stainless steel, to house the actuators. The cabinet contains heater cables to maintain a higher temperature inside. In addition, the design of the actuators incorporated a number of other common features to cope with the combination of a corrosive atmosphere and very low temperatures. The vent port faces inwards to avoid water entry or ice build-up or formation.

Low temperatures present challenges in valve design.



In addition, the stroking times specified were that all actuators must open in less than two seconds and close in less than three seconds, without overshoots, and while also guaranteeing the high dynamic performances required by anti-surge applications. IMI STI designed a purpose-built test sequence to simulate the actuators' performance in the harsh conditions they were designed for. With correct use and periodic maintenance, the actuators are expected to have a lifespan of some 20 years.

Some like it hot

Valves in high-temperature service face a different set of challenges. Combined cycle power plants are operating at higher and higher steam temperatures in order to increase overall plant efficiency. Temperatures of 56°C are now commonplace and would have been impossible to design if materials technology had not advanced accordingly.

When selecting materials for the valve body and bonnet in high-temperature service, special alloy steels are preferred for their ability to maintain sufficient mechanical strength at high temperatures. This ensures that the valve will maintain its pressure boundary integrity and functionality when confronted with high steam temperatures.

High ambient temperatures can also spell disaster for actuation and control accessories. The elastomers that become hard and brittle at low temperatures can become soft and gummy at high ones. As elastomers are heated, they become soft and can extrude through gaps between sealing surfaces, leading to a failure of the seal. Additionally, elastomers in dynamic service (like the actuator piston seal) can soften, causing erratic operation, or even failure, of the actuator. Special, high-temperature elastomers must be used for any actuator installed in a high-temperature environment.

Valves in high-temperature service also need to be insulated for the safety of plant workers, as well as for plant efficiency and to protect surrounding equipment from heat radiating from the valve itself. This insulation typically extends to the top of the valve bonnet and provides some degree of protection for the actuator and accessories. Additionally, the valve yoke locates the actuator up and away from the hot valve body and bonnet, further protecting the elastomers in the actuator and control accessories.

The internal components for high temperature service valves are also analysed for the effects of thermal expansion to ensure there is no binding or interference of components once the valve operating temperature is reached.

Couple high ambient temperatures of deserts with valves for LNG trains (-162°C), and it is clear why engineering knowledge and experience is critical.

The heat is on in Ohio

The Lordstown Energy Center combined cycle power plant in Ohio, Pennsylvania, exemplifies the challenges presented by high-temperature severe service applications. A high-pressure steam to cold reheat bypass control valve was needed that could withstand temperatures of 574°C and pressures of 36 MPa. Experts at IMI CCI employed special materials to withstand the high steam temperatures, as well as a high-performance actuation and controls system that would meet the system response demands caused by a special, reduced-size high-pressure steam drum located on the Heat Recovery Steam Generator.

The challenge of high-temperature steam operation was met with a combination of materials specifically designed for performance at extremely high temperatures. The body and bonnet pressure boundaries were made of F91 alloy steel, while the superalloy Inconel 718 was chosen for the body-to-bonnet bolting, valve stem and DRAG disk stack trim. The alloy steel valve plug and seat ring were overlaid with Stellite 6 to ensure smooth, reliable operation and tight shut-off under these demanding conditions.

“When selecting materials for the valve body and bonnet in high-temperature service, special alloy steels are preferred for their ability to maintain sufficient mechanical strength at high temperatures.”

Due to the reduced-size high-pressure steam drum, especially strict control requirements were imposed for the valve and actuator. A smaller steam drum requires faster and more accurate temperature and pressure regulation response time in order to keep the system stable. The total inaccuracy between valve demand signal and actual valve position had to be less than 0.5%; several times higher than typical. The actuator had to have zero overshoot and a full stroke time of less than four seconds. Typically, these specifications would require a hydraulic actuator, but the IMI STI QuickTrak actuation and control system was able to meet these specifications, while easily achieving the stroke and trip speed requirement of less than four seconds, open or closed. The actuation and controls can perform to these strict requirements and still withstand the 66°C environmental temperature caused by the nearby piping and equipment.

Today, thanks to innovation in materials, bespoke accessory design and painstaking testing, valves can be designed to operate at extremes of temperature that would have been unachievable a generation ago. This allows processors to operate their plants safely, cleanly, reliably and efficiently. ●

Seismic inversion is the process of transforming seismic reflection data into a quantitative rock/fluid model of the subsurface. Using the raw seismic data (collected by sending a sound pulse through the ground), geoscientists create a reconstruction of what is happening beneath the surface of the earth.

While this reconstruction is inexact – digging a well would obviously prove more accurate – it does enable them to gather information about the entirety of an oil field, estimating where the boundaries lie between different kinds of rocks.

“In the biggest and most mature fields, you might have a couple hundred wells, and that’s still a tiny sampling of the area,” explains Bill Shea, CEO of Sharp Reflections. “Because geology is not so homogeneous, the inversion is used to understand the rock properties away from the well.”

He adds that, despite its mathematical sophistication, inversion is an inexact science. “You would stick a logging tool down the hole at one place in the seismic survey and directly measure the density or velocity of the rock in the well,” he says.

Top of the rock

Predicting what lies beneath the surface of an oil field is a complex and data-intensive task. *World Expro* speaks to **Bill Shea**, CEO of Sharp Reflections, who explains advances in data processing are making the guesswork more accurate – and how it’s all taking place within the cloud.

“The measure of how good your inversion result is, is how good is your match between the inversion model and the real measurement at some specific locations.”

At Sharp Reflections, a Norway-based data analysis company, inversion is just one piece of the puzzle. The company works with clients to extract information from their seismic data, both in its raw (pre-stack) and processed (stacked) form. Its software, Pre-Stack Pro, includes an inversion module to convert data into geological modelling.

There is an inherent limitation with seismic data, in that it doesn't measure the rock properties an engineer actually needs. If you're looking to drill an oil well, you'll be most concerned with permeability and porosity, since that's what determines how the reservoir will flow. Seismic inversion, however, can only tell you about the 'elastic' properties of the rock.

“It's now routine to be able to invert an entire seismic volume to estimates of velocity and density, but that's not what people care about,” says Shea. “They have some correlation to the engineering properties of porosity and permeability, but those things can't be modelled directly. So mathematicians keep coming up with cleverer ways to do it.”

Sharp Reflections' new inversion module, PCube+, is one such example. It is able to predict the rock type (and hence the engineering properties) from the seismic information, along with a probability estimate that a given guess is correct.

“Normally simulating the reservoir requires two steps – first you estimate the elastic properties and then you try to figure out if you can make any sense of the rock distribution from the result,” says Shea. “What PCube+ does, is it tries to go directly from the seismic data to a colour-coded breakdown of the rock units, simulating this in one step instead of two.”

Ordinarily this would be an extremely computer-intensive process. However, PCube+ features an improved algorithm that makes the idea easier to implement. Shea provides a good analogy. If you give a basket of Lego blocks to a group of children, some of them will interweave all the colours quite regularly, while others will put all the reds together and all the greens together. There are billions of possible combinations they could make.

“You could imagine doing that with geology units as well, stacking up 1km of rocks in a huge range of different ways,” he says. “But if you know something about geology, you know not all combinations are possible. If you rule out what we call ‘illegal transitions’, which violate geologic principles, then rather than testing several billion combinations you can get it down into the hundreds and it becomes a practical technique.”

The power of five

The technique, which was developed by Statoil (now Equinor) and the Norwegian Computing Center (NR), has now found a long-term home at NR. “Statoil said, let's open it up, and get the guys who write the code to start a ‘Geophysical Inversion to Geology’ (GIG) Consortium,” explains Shea. Five different oil companies are now engaged in improving the technique, while Sharp Reflections has a licensing agreement to access those improvements and make them commercially available. “So now



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5

Number of oil companies working on improving the PCube+ technique.

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it's on healthy footing and it's creating a very dynamic innovation space around something that was once off the shelf at Statoil." For those who have been in the field a while, it's nothing short of amazing to see such data-intensive processes become everyday practice. And it's no less astonishing to see how it's happening – not via on-site servers, but in the cloud.

"There's a lot of buzz about oil companies moving to cloud computing and part of it's a cost issue, but it's also being able to use large banks of computers for computer-intensive tasks," says Shea. "The challenge for us wasn't just to be able to get our software running in the cloud, it was to get a high performance version running in the cloud. So we're creating connected banks of servers that operate as one virtual machine."

Effectively, this means that if you want to use Sharp Reflections' software, you don't have to worry about owning hardware – you can simply access the tools as and when you need them. And while cloud computing has been around for a while, this kind of ultra-high-performance architecture is new.

"With this capability we're able to do seismic inversions on huge data sets that could span tens of thousands of square kilometres, and do them more or less effortlessly," says Shea. "We can do

that computing anywhere and give you access to it anywhere."

Lead by example

To take just one example, during the first week of January 2019, Sharp Reflections received freshly processed seismic data in Houston, which it stored in an Amazon cloud. The processing was completed on surveys in Sydney, Australia. Then it began detailed interpretation with OMV (the client) and Western Geco (the supplier) in New Zealand, all before the end of the month. "This would have been unthinkable without this cloud capability," says Shea. "If you have software that's written to perform very well in cloud data centres with lots of servers, it brings the data quality assurance to a faster, more collaborative place."

He says that to some extent, Sharp Reflections has played the role of evangelist, convincing the early adopters to give high-performance cloud computing a go. Now we are approaching the tipping point where it will become mainstream practice.

"There's still some resistance to ceding control of your data to these public cloud vendors, but it's amazing how rapidly attitudes are evolving," he says. "The model for how you pay is changing fast." ●



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Global strategy: the American way

North American assets are among the key elements in the exploration and production activities of some of the world's largest energy companies. *World Expro* looks at the recent projections from Chevron and ConocoPhillips to see how projects in Canada, the Gulf of Mexico, California and the rest of the Lower 48 figure in their ambitious plans for the future.

Exploration and production are truly global activities for oil and gas majors. They must scour the world looking for promising new assets to develop, while trying to maximise the production life and efficiency of mature assets. As Steven Green takes over as president of Chevron North America Exploration and Production, having guided the company's upstream operations across the Asia Pacific region for many years, we look at how the region contributes to the future growth plans of both Chevron and ConocoPhillips.

Both companies have extensive portfolios of assets in the US, and across the globe, and balancing their development will be a key part of their strategy going forward. Last year, Mike Wirth, chairman and CEO of Chevron Corporation, laid out the company's strategy 'to win in any environment', outlining three key strengths – an advantaged

portfolio, sustainability at lower prices, and a strong balance sheet.

"We reached significant milestones with upstream major capital projects in 2018, including the start-up of Wheatstone Train Two, our fifth operated LNG train in Australia," he remarked in a recent earnings call. "We also continued the ramp-up of the Permian Basin in Texas and New Mexico, started production from the Big Foot Project in the Gulf of Mexico and continued to progress our Future Growth Project at the company's 50%-owned affiliate, Tengizchevroil, in Kazakhstan."

"In 2018, we delivered," he added. "We grew oil and gas production by more than 7%, achieving our highest-ever annual production. We grew cash margins in our operated upstream assets, contributing to an improvement in cash returns. We lowered our unit costs, and we sold \$2 billion

of assets. 2018 was a very successful year and we intend to build on this momentum in 2019.”

Part of this ongoing strategy is the allocation of capital across a diverse portfolio, including the funding of the company’s highest-return projects, which Wirth sees as essential to supporting sustainable growth in the future.

Asset sales show strategic intent

For Chevron, 2018 saw upstream earnings increase by more than \$9 billion between periods, largely due to higher realisations and increased liftings, though these were slightly offset by higher operating expenses associated with continued ramp-up in production.

“We actually dropped a rig at the beginning of the year in Eagle Ford to optimise the ratio of our rigs to completion crews.”

Matt Fox, ConocoPhillips

“2018 production was 2.93 million barrels a day, an increase of 202,000 barrels a day or more than 7% from 2017,” remarked Pat Yarrington, Chevron’s vice-president and CFO. “This is the highest level of production in the company’s history. Excluding the impact of 2018 asset sales, production grew approximately 8%, or 1% above the top of the guidance range we provided last January.”

In Australia, the LNG plants at Gorgon and Wheatstone performed well in the fourth quarter, averaging almost 400,000 barrels of oil equivalent per day. “Major capital projects increased production by 227,000 barrels a day as we continue to ramp up production at multiple projects, most significantly Wheatstone and Gorgon. Shale and tight production increased 132,000 barrels a day, primarily in the Permian, where production grew by more than 70% from 2017,”

The Permian Basin oilfield, situated in West Texas and New Mexico boasts a sizeable quantity of pump jacks.



Yarrington added. The Permian Basin, which spans West Texas and south-eastern New Mexico, is one of the most prolific oil and natural gas geologic basins in the United States, and a key element in the company’s North American asset base. Chevron is among the largest producers of oil and natural gas in the basin, and with more than 8,900km² it is one of the largest net acreage holders.

The basin holds some of the largest oil fields in the US, including 20 of the country’s 100 biggest fields, and is an area in which enhanced oil recovery techniques have been used to good effect.

“Turning to the Permian, production in the fourth quarter was 377,000 barrels per day, up 172,000 barrels per day or 84% relative to the same quarter last year,” remarked Wirth. “Annual production was up more than 70%. In the Permian, we remain focused on returns. We are not chasing a production target nor are we altering our plans based on the price of the day.

“We are pleased with our position and leading performance in the Permian,” he added. “In just two years we have doubled our rig count, increased our resource base, decreased unit development and operating costs, and more than doubled our production.”

The sale of assets has been a key part of the company’s portfolio management strategy, both in the US and the rest of the world. Its sale of assets in the US mid-continent, the Gulf of Mexico shelf, and the Elk Hills field in California reduced production by 50,000 barrels per day.

“As with all divestments, we are focused on generating good value from any transaction,” noted Wirth. “Divestments are driven by a view on strategic alignments. With our broader portfolio and our view of the future, the resource potential that remains in a particular asset, will it compete for capital within our portfolio.”

Against this backdrop of asset sales, the company has performed well in terms of reserve replacement. In 2018, its reserve replacement ratio was 136%, meaning that it added almost 400 million more barrels than it produced and divested.

This was achieved while production grew by more than 7%. “Our reserves to production ratio stands at a healthy 11.3 years, showing the strength and sustainability of our portfolio,” remarked Wirth. “Our five-year reserve replacement ratio of 117% further illustrates that strength through the price downturn. Our largest adds came through our Permian shale and tight activity, other shale and tight, Gorgon and Wheatstone. So, primarily in the unconventional, but with contributions from Australia, Canada, Asia, Gulf of Mexico, Eurasia.”

Bring investors back into E&P

Looking back over the same time period, ConocoPhillips has managed its E&P activities in a way that it feels will attract investors back into the sector, and its activities in the US are central to this plan.

Located in south Texas, along a 200-mile corridor, the Eagle Ford shale trend represents one of the company's most promising developments, and the Permian Basin in West Texas and New Mexico is a strong growth area. In North Dakota and Montana, the company is focused on further exploring and developing areas in the Bakken play in the Williston Basin.

"We're on a path to manage this company for the business we're in, one that's mature, capital intensive and cyclical," remarked chairman and CEO Ryan Lance in his company's February earnings calls. "We've embraced this view of the business with a value proposition that we believe should be the new order for E&P companies. Now what do we mean by the new order? We mean a value proposition that competes on returns and doesn't change cycles up or down.

"Our value proposition, now more than two years old, is fundamentally structured to offer this," he added. "Over this period, we've driven our sustaining price lower and made our balance sheet stronger. We completed high-value asset acquisitions and achieved significant exploration success in Alaska. We progressed our Montney appraisal programme in Canada and began exploring in our new Louisiana Austin Chalk play."

The company's 2019 planned capital expenditure for 2019 is, at \$6.1 billion, similar to the figure for the previous year, and it includes funding for ongoing conventional and unconventional development drilling programmes, major projects, exploration and appraisal activities, and base maintenance activities. Much of this spend will go to projects in the US. Just over \$3 billion is slated for the Lower 48. This anticipates running 10–11 rigs across the Eagle Ford, Bakken and Delaware – the Big 3 unconventional plays – with some built-in flexibility to shift activity between these plays as necessary to maximise value. The budget allocation for Lower 48 Eagle Ford and Delaware also contains provisions to conduct multiwell pilots of new completion designs that the company believes may drive future resource upside and be applicable to other unconventional plays.

Outside of the Big 3, capital spending will also target ongoing exploration and appraisal activity in areas such as the Louisiana Austin

Chalk play, and \$1.2 billion is slated for projects in Alaska. The increase in budget for Alaska over 2018 reflects the cost of ongoing construction at Greater Mooses Tooth-1 (GMT-1), as well as the further appraisal of discoveries in the Willow area.

Risk-assess the balance

Projects in Canada are expected to see \$0.5 billion in capital expenditure – an increase that reflects the company's ongoing appraisal and development activity in the Montney unconventional programme. Last year, ConocoPhillips significantly expanded its 100% owned and operated position in Montney, and operations are currently under way to drill a multiwell pad and to install the requisite processing capacity.

"Our Montney 14-well pad programme is in full swing in Canada," remarked Lance. "In the Lower 48 Big 3, we expect to grow production by about 19%. We're focusing our activities in the early part of the year on testing potential resource-enhancing programmes such as multiwell pilots of our Vintage 5 completion technique. In the Louisiana Austin Chalk, we've already started our four-well exploration programme and expect to have results later this year."

"We are pleased with our position and leading performance in the Permian. In just two years we have doubled our rig count, increased our resource base and more than doubled our production."

Mike Wirth, Chevron

"We're running six rigs in the Eagle Ford just now," added Matt Fox, CEO at ConocoPhillips. "We actually dropped a rig at the beginning of the year in Eagle Ford to optimise the ratio of our rigs to completion crews. And we're running three in the Bakken and two in the Permian. At those sort of rig levels, we would be continuing to grow in the Eagle Ford."

It is clear that ongoing investment in E&P activities in the Lower 48, Canada and Alaska is high on the agenda for the big players, and that the balance of their global portfolios is constantly under review. Finding the line between low-risk opportunities in the US and potentially higher-risk plays around the world will no doubt define the strategy of the oil majors going forward into the future of the industry. ●

2.93 million

Rate of production of oil barrels for Chevron in 2018.

Chevron

A silver lining

Large oil and gas companies are teaming up with major providers of cloud computing services to deploy artificial intelligence (AI) to improve the interpretation of subsoil data. Jim Banks discusses how AI could facilitate a paradigm shift in the industry's approach to geoscience with **Dr Eirik Larsen**, an expert in AI and data management.

Industries of all kinds are investing heavily in artificial intelligence (AI). There is widespread anticipation that its ability to not only crunch data, but also learn to interpret that data effectively and at high speed to give accurate models of current conditions and future trends, will deliver big dividends. The automotive industry is already well down the road of using AI to develop self-driving cars, the retail industry is putting it to good effect in generating appropriate recommendations for customers, and the oil and gas industry is now turning AI towards the subsoil environment.

Last year, Total announced a partnership with Google Cloud with the aim of using AI to analyse subsoil data. The endeavour makes it possible to interpret subsurface images, including seismic studies, using Computer Vision technology and to

automate the analysis of technical documents using natural language processing capability. As the project develops, its goal is to enable Total's geologists, geophysicists, and reservoir and geoinformation engineers to explore and assess oil and gas fields faster and more effectively.

"The world is changing," said Jean-Michel Lavergne, senior vice-president of strategy, business development and R&D at Total Exploration & Production when the partnership was announced. "Looking ahead, one driver of change will be artificial intelligence. We're starting to apply it to geosciences, the field that differentiates oil companies from each other.

"Geosciences allow us to find new sources of oil and gas faster and better than our competitors," he added. "The purpose of the agreement with Google

is to develop systems that make us more efficient. Today, geoscience interpreters spend more than half their time gathering the data they need to be able to perform the value-added work. The aim of this AI project is to shorten the time our teams spend on prep work so they can focus on value-added tasks.”

In the UK, the Oil & Gas Technology Centre, that focuses on innovation to maximise recovery from the UK Continental Shelf, has put out a call for ideas that might enable machine learning (ML) to unlock the full potential of the North Sea; the move comes as operators face difficult decisions about end of field life and the decommissioning of key infrastructure. Its aim is to help develop tools that will open up a better understanding of the remaining hydrocarbon potential in the area, and it has a huge volume of data from decades of successful exploration and field development that innovators can use to build and refine sophisticated analytics algorithms.

With these initiatives, and others backed by small and large energy companies, it is clear that AI and ML have a huge role to play in the future of the industry.

A close eye on AI

As co-founder and CEO of Earth Science Analytics, that focuses on the commercial application of AI in petroleum geoscience, Dr Eirik Larsen is well placed to answer the questions surrounding AI. His company’s goal is to integrate data management, data analytics and ML with the petroleum geoscience workflow. He has 19 years’ experience from the E&P industry, having held technical and managerial roles in oil companies and consultancy firms including Statoil, Rocksource and Geokonsulentene, which has seen him involved in research, exploration, field development and production on the Norwegian Continental Shelf (NCS) and internationally.

“The industry is very excited about the opportunities it sees with this technology, though its use is not yet mainstream in exploration and production,” he remarks. “Currently, companies are planning, making roadmaps and running a lot of proof of concept projects. They are rushing to embrace the open-source AI tools and neural network tools that are available and then working out how to apply them.”

The key reason for adopting the new technology is, for now, the potential increase in efficiency that it offers. Larsen sees AI delivering a 100-fold increase in the speed at which subsoil data can be analysed, but also believes that this is just scratching the surface of what AI can do.

“As we progress, we will see it used for predicting rock and fluid properties in wells,” he says. “This is now done using equations that need to be tuned by experts, but there are not enough of them. AI algorithms can train on well logs and measures from

ground cores, and they can learn. The efficiency improvement means that you can obtain fluid property curves for all of the wells in which you are interested, not just a sample.”

“This can fuel creativity in exploration on a data-driven basis,” he adds. “When a new licensing round is announced, there is a huge acreage to explore, which is difficult given that there are always resource constraints. Now, with AI, you can look at everything. You can examine more leads and prospects and select the best high-grade opportunities from a large set rather than from a small set.”

Not only does this have major implications for the exploration of new discoveries, but it also helps the industry with the growing need to make existing assets last for longer.

“There are many mature facilities that owners and authorities want to keep going, and in which they want to open up new volumes. With AI, they can identify exploration opportunities in a data-driven way. Many decisions have been made in the past because people were digging into historical data and found that wells that were believed to be dry could come into production again. The list is long. We can now automate that analysis using well data,” says Larsen.

A perfect storm

The trend among energy companies to partner with providers of cloud computing services is growing stronger. Total and Google began sounding out the use of AI last year. Equinor, formerly Statoil, is working with Microsoft Cloud in Norway to push forward its digital transformation initiative and drive cloud-enabled innovation. Shell is deploying C3 IoT with Microsoft Azure as its AI platform, and intends to rapidly scale and replicate AI and ML applications across its upstream and downstream businesses.

“Companies are rushing to embrace the open-source AI tools and neural network tools that are available and then working out how to apply them.”

At the start of 2019, Pandion Energy in Oslo kick-started the process of digitalisation in its subsurface capabilities to drive innovation and enhance efficiency in the exploration of the NCS. It has partnered with Computas and Google, and has mobilised a dedicated team of ML, data science and geoscience experts in an initiative driven by its financial backer, Kerogen Capital.

“Pandion has always had a holistic approach to our exploration activities,” remarked Jan Christian Ellefsen, CEO of Pandion. “Having Kerogen to select



Dr Eirik Larsen



Across the industry, oil companies are using AI to better hone the reading of subsoil data.

us as their first pilot case for developing an advanced digital subsurface platform also reflects on the potential in digitalisation on the NCS.”

For Larsen, these initiatives show how a combination of technologies – AI, ML and cloud services – have come together to enable a step change in the industry’s capability.

“Cloud platforms are a big enabler for this,” he says. “You are working with really large data sets, so you could choose to buy hardware that could be out of date in three or four years, or you can rent that hardware in the cloud, which is what most people choose to do because of the cloud’s data storage and computing power. That is why they are partnering with internet giants like Amazon and Google.”

“Many decisions have been made in the past because people were digging into historical data and found that wells that were believed to be dry could come into production again.”

“We have seen it work well in other domains like retail,” he adds. “It is why Amazon grew so big. It built that capability for itself as a retailer and that allows it to now be the biggest provider of cloud services. The oil and gas industry has been digital for 20 years or more, having used computers to interpret well logs, but now it can do much more through automation.”

The potential for collaboration

Larsen’s company is set to continue developing its AI solution beyond its current capabilities. It chose to focus on predicting rock and fluid properties in wells, then to go through the same process with seismic data and marry the two together.

“Computers consume measured data, and generate rock and fluid curves back to the platform,” he explains. “Then you create a

loop because you have built a repository of predicted data that can be checked for accuracy against the measured data that comes back from the well. In the next level of analytics, queries can be made on that data to develop better models. That is the field we are moving into now.”

“What the industry wants out of it is better decisions,” he adds. “It wants to make more discoveries, drill fewer dry wells, increase production from existing wells and increase the return on investment. Those are the end goals. Human scientists could not consume all of the data, partly because of time constraints and partly because the traditional tools cannot handle the full volume of data. Now, we can use the biggest supercomputers in the world.”

Next steps to take

From here, the next step is to allow AI to learn, as it has in other industries. In image analysis in the automotive industry, for example, AI is learning to move from photographs to real-world models through image segmentation. Autonomous cars need to learn how to recognise other vehicles, pedestrians, cyclists and all of the other features they will encounter on the road. They do this by working on a large image library that has been labelled with the necessary parameters.

“In geoscience, you need a lot of labour to mark up different images with properties on which the algorithms can train,” Larsen explains. “There are some national data repositories in the UK, Norway, the Netherlands and elsewhere that we can use.

At the moment, however, companies are doing this on their own. Companies are guarding their projects closely because knowledge and technology give a competitive advantage, so they are reluctant to open up. There is a lot of talk about sharing, however, so perhaps the industry will open up in the future.”

Whether or not the industry is able to find a way to collaborate to deliver the potential that AI promises remains to be seen. Regardless, AI and ML are set to have a momentous impact. The key issue will be how fast the industry can progress without the sharing of innovation, as well as insight.

“As far as I am concerned, this is a game-changer,” Larsen says. “It is beyond anything the industry has seen in 20 years. It is bigger than 3D interpretation software because of the scale and the 100-fold increase in speed. When we build analytics on top of what we already have, we will open up a new domain.” ●



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Venture below the surface

Testing and inspection are the keys to preventative maintenance, which saves time and money in an industry that thrives on efficiency. Here, Dr Mike Smith of **Eddyfi**, which specialises in non-destructive testing equipment, explains how the company is helping to ensure the oil and gas sector avoids equipment failure without costly shutdowns.

Historical data shows around 60% of pipe leaks are caused by corrosion, which is just one of the causes of potential failure in critical equipment. Knowledge of corrosion and vulnerabilities in pipes and tanks can help to ensure that any threat to smooth operations – and to the safety of workers – is solved before it happens, and that is what Eddyfi helps operators to achieve.

The company specialises in non-destructive testing (NDT) equipment, specifically high-performance eddy current and electromagnetic solutions for the inspection of critical components and assets. Established in 2009 in Quebec, Canada, the company is developing eddy current array (ECA) technology for a range of markets, including oil and gas, transport and nuclear power, and for the past 30 years, one of its key subsidiaries, TSC, has been developing revolutionary alternating current field measurement (ACFM) systems.

“The original founders of Eddyfi have backgrounds in the inspection industry, particularly in electromagnetic inspection, and they saw a gap in the market for advanced electromagnetics.”

“The original founders of Eddyfi have backgrounds in the inspection industry, particularly in electromagnetic inspection, and they saw a gap in the market for advanced electromagnetics. They focused on one aspect of magnetic inspection, which is eddy current arrays, and basically developed that to its full potential,” says Dr Mike Smith, Eddyfi’s director of technology and innovation.

Eddyfi now has four subsidiaries, including Swansea-based Silverwing, which focuses on the inspection of storage tanks and vessels using magnetic flux leakage (MFL) techniques. In 2017, Eddyfi bought TSC, based in Milton Keynes, UK, to bring



An example of Eddyfi’s non-destructive equipment.

into its portfolio a technology that has been in development since the 1990s, in order to replace difficult-to-use methods of finding and characterising surface cracks in subsea environments.

Deep dive NDT

ACFM senses disturbance in the electromagnetic field created by cracks. The return signal is converted into alerts, immediately warning operators of any defects.

Independent testing has shown ACFM misses fewer defects than magnetic particle inspection (MPI), as well as the more conventional eddy current testing.

“These electromagnetic technologies are particularly good at the surface inspection of metals, looking for cracking – particularly stress corrosion cracking – and other damage mechanisms, but with some conventional techniques, you need to remove the paint or coating from a structure. So, if you are inspecting a well you may need to strip it right back to bare metal. Our technology enables you to do this inspection without removing the coating. So, there’s a huge potential

for cost and time saving, and you are not interrupting the reason the coating is on there in the first place, which is usually as a barrier against environmental weathering,” remarks Smith.

Distinguish and extinguish

ACFM can support in-land-based safety and testing applications, but its key advantages come in when displayed within deepwater environments.

“We can distinguish between the wide variety of defects failure mechanisms. The advantage of this is not only that we can avoid unplanned, shutdowns and outages, but also that only tubes that are actually damaged are replaced. These technologies are typically able to characterise defects more thoroughly, so you have information about the depth of defects, beyond what you may see on the surface. And it’s typically the depth of a defect that is key when determining its severity and the remaining life of the structure, which informs the type of repair that is going to be done,” says Smith.

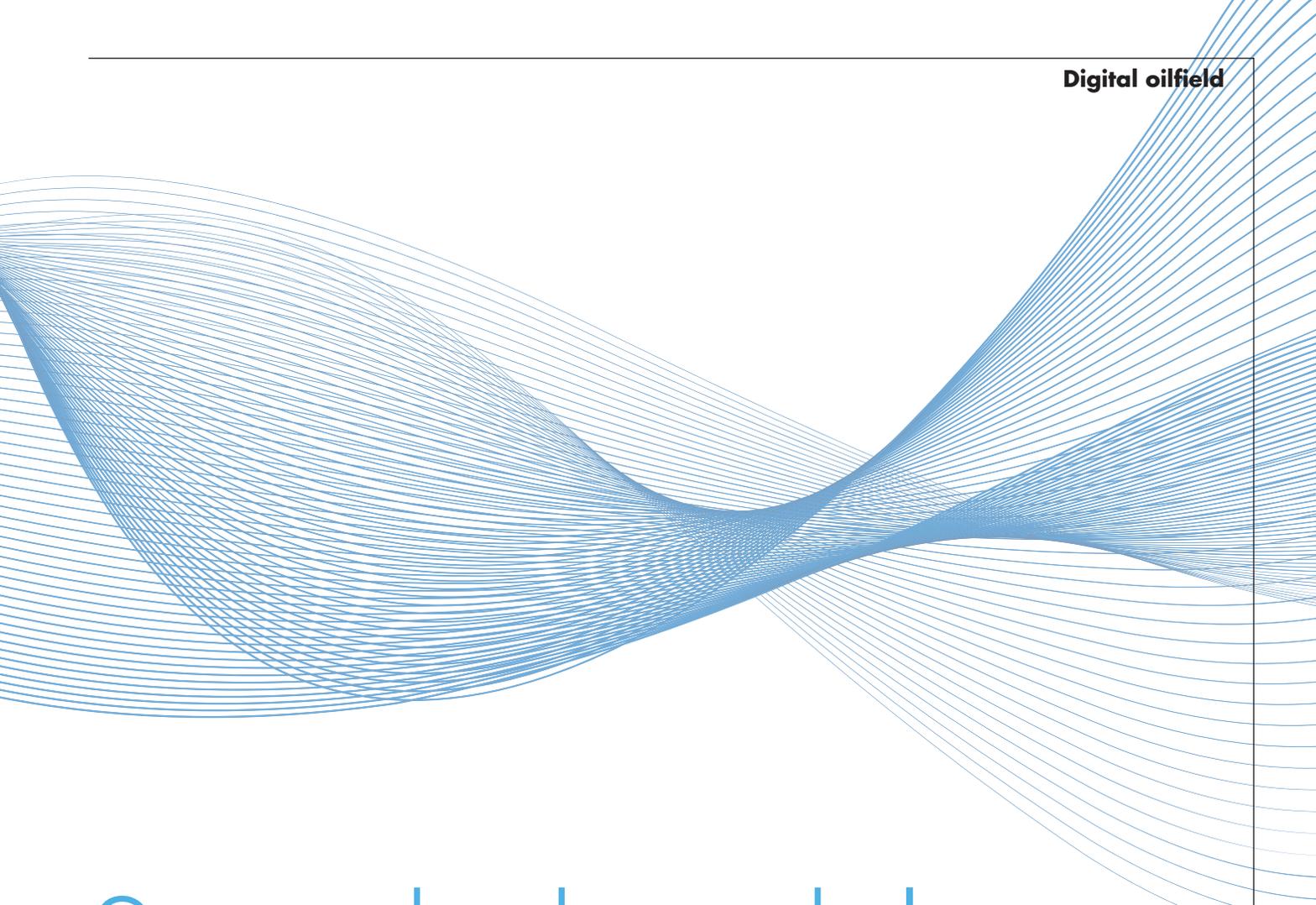
Improve, cut and save

“The two main technologies are ACFM, which is excellent at detecting surface breaking cracks through the subsea paints and coatings, and the pulsed eddy current (PEC) system, which can detect corrosion under insulation and thermal jackets subsea. And TCS has developed a range of tooling for ROVs that has been used on a lot of different geometries subsea. The advantage here is primarily in safety,” he adds.

In the harsh subsea environment, improving safety, cutting costs and saving time are high priorities. The output of Eddyfi uses technology to achieve all three goals. ●

For further information

www.eddyfi.com

An abstract graphic consisting of numerous thin, blue, wavy lines that flow across the top half of the page, creating a sense of movement and depth. The lines are more densely packed in some areas and more sparse in others, creating a textured, wave-like effect.

Strands that deliver

Battling with complex factors on the supply side that are driving down the price of oil, many energy players are focusing their efforts on becoming leaner and more efficient in order to counteract the impact on margins. In this report, *World Expro* looks at how Total is combining technological innovations to stay competitive.

A combination of factors on the supply side is influencing fluctuation in the price of oil. From October 2018, the price of crude dropped more than 25%. The US economy has experienced strong growth, which usually pushes up demand for oil and, therefore, prices, but there may be clouds on the horizon as trade tariffs start to bite. Trade tensions, as well as falling rates of global growth – notably in key economies such as China, Germany and Japan – are combining with a glut of production from Iran and Russia to put downward pressure on prices.

Faced with this, cost-cutting is the way to protect margins. In order to cut back on operating costs, however, many companies are doing more than simply applying pressure within their organisations to do more with less. Instead, they are looking to invest in new technologies to increase efficiency. Some of

these technologies – big data, cloud services and robotics – are familiar to many industries, but their potential is still not fully exploited. While companies find new ways to derive value from them, the technologies themselves continue to advance. As a result, the industry could well be undergoing a paradigm shift in terms of how it operates.

Combine to drive value

No single new technology is capable of revolutionising the industry on its own, yet we are in an era when many different strands of development are coming to maturity. A combination creates unprecedented opportunities for companies to run leaner and more efficient operations based on real-time data and decision-making.

Big data and artificial intelligence (AI), for example, bring together a wealth of detailed

77%

Percentage of their maximum potential that offshore platforms work at on average.

McKinsey

information on every aspect of the energy business – from subsurface imagery to well production data – with the ability to deploy sophisticated algorithms to query that information and model future trends.

According to a 2017 report from McKinsey, offshore platforms, on average, run at only 77% of their maximum production potential. The report further suggests that the rigorous use of analytics could substantially improve that figure. The kind of predictive analytics that AI can perform is, therefore, high on the list of priorities for software developers and energy companies alike.

GE Digital is one company working to help oil and gas businesses to build automated analytics models and to use machine learning to put in place predictive maintenance processes for industrial equipment. Their solution, Predix, uses AI to process data from a network of sensors and combines the use of big data with other factors, such as weather conditions, to see whether a facility is running at optimum levels and, if not, to recommend maintenance.

“Total’s aim is to deliver improvements to industrial safety, enhance operational performance, cut costs, create a better experience for employees and customers, and develop new services and new areas of activity.”

HortonWorks is another solution provider working in predictive analytics. Its open-source application – Hybrid Data Platform (HDP) – also collects large data sets of structured and unstructured information, including seismic and drilling data, to monitor performance and view potential problems before they arise. Another of its solutions, Well Log Analytics, works with HDP to create predictive models to increase the speed of E&P activities through the analysis of well logs and sensor data.

Maersk Oil has long been working on its Predictive Drilling Analytics (PDA) project, which started in 2015, and it has been able to combine real-time and static drilling data to reduce the amount of non-productive time in its assets. The advanced pattern recognition capabilities of AI are able to pick up anomalies in real-time data and compare these inputs with historical data to predict events that might shut down production.

The internet of things (IoT) is another technological advance that has been applied across many industries and has a lot to offer the oil and gas sector. IoT relies on smart devices or components that can, for instance, monitor all aspects of an asset and its performance, and is

currently driving rapid transformation of exploration, drilling and production activities. Part of its value comes from its ability to connect the activity of people and equipment in disparate and remote locations with real-time analytics and predictive maintenance algorithms to improve safety and productivity.

The crux of IoT is that it enables end-to-end connectivity and the real-time monitoring of assets. The speed with which an accurate picture of production capability can be generated, and the accuracy of the outputs from sophisticated analytics, mean that the companies can make better decisions faster, whether it is in exploration, production, maintenance or any other aspect of their operations.

This depends largely on the capability of cloud services. Rather than owning huge amounts of additional computing hardware to store and process data, the cloud enables companies to host applications and store data off-site. The data and the applications can then be accessed remotely from anywhere, giving global and real-time connectivity to business-critical information.

It is in the confluence of technologies such as the cloud, big data, AI and IoT that the potential for a great leap forward lies.

Total commitment

Total is a prime example of a company that has embraced digital transformation as a key driver of its strategy. Its aim is to deliver improvements to industrial safety, enhance operational performance, cut costs, create a better experience for employees and customers, and develop new services and new areas of activity. Its annual investment in digital technology currently stands at around \$400 million.

Its track record of developing a digital culture within the business goes back five years, and it includes training and skills development, as well as investment in new technologies. In 2014, for instance, the company introduced a reverse digital mentoring programme in which executives received coaching from young digital natives. In 2016, more than 30,000 of its employees obtained a digital passport showing they had mastered the basics of digital culture. Since then, it has created a digital bootcamp, which consists of a three-month development programme dedicated to digital issues.

For the past four years, the company’s executive committee has taken a Digital & Innovation Week annually to learn from different innovation ecosystems in the world, including Silicon Valley, India and China. This year, that took in the CES 2019 consumer electronics show in Las Vegas. The company has created a bespoke course on artificial

intelligence for its senior executives. It will also set up structures similar to The Booster – a digital learning laboratory in Paris that acts as an incubator for internal ideas and helps to push forward digital projects.

Furthermore, the company has invested in a Data Squad, which consists of a team of data specialists and IT experts that works hand in hand with Total's data officers to design new data-related projects and enable the company to deploy those projects more rapidly across the group.

As well as developing this broader culture, Total is also investing in partnerships to boost its production and marketing operations. Its partnership with Tata Consulting Services in India is a prime example and it has led to the creation of an innovation centre dedicated to the development of refinery 4.0 technologies. It is currently working with Google to develop AI techniques that can be applied to seismic imagery and can enable the semantic analysis of geoscience documents, in order to facilitate the work of its geoscience experts in identifying and developing new reserves.

Digital technology is also helping the company to improve the performance of its workers on oil rigs and refineries. It has implemented the Total Industrial Mobility (TIM) programme, under which all of these workers will be equipped with smartphones or tablets featuring applications to facilitate and simplify their jobs, improve safety and reduce the risk of errors. In 2018, this was rolled out across 40 sites.

Another important strand of its digital strategy has been the implementation of the Data Driven Asset Performance (DDAP) programme, which aims to accelerate the deployment of AI in its industrial operations.

It is not only the oil majors that are exploring the advantages of AI, big data and advanced analytics. Leading oilfield services company Baker Hughes, for example, is also making swift progress down the road towards digitalisation. It is working on next-generation cloud-native software products that will digitally transform the industry.

The company's industrial IoT software is at work in the area of field development and planning, where it helps to maximise recovery and optimise access to hydrocarbons by integrating subsurface, well, drilling and completion data, and AI-powered software helps to further maximise primary and secondary recovery through the proactive management of upstream operations. Alongside this is a powerful suite of tools that provide an enterprise-wide view of the company's assets to reduce downtime and monitor asset performance, corrosion and process management.

A fast-growth future

It is a huge task for the industry to leverage existing digital technologies to deliver quick gains in efficiency and productivity, but while taking on that mammoth task, companies must also keep an eye on the disruptive technologies that may soon emerge.

Investing in internal R&D efforts is one option, though potentially an expensive one, so many are looking at how emerging technologies are being applied in other industry sectors and at how nimble start-up companies are able to generate innovative ideas that are ripe for development.

Working with start-ups to accelerate innovation is a key part of Total's strategy. In 2018, the company engaged in collaboration efforts with more than 100 start-up companies.

“The internet of things (IoT) has been applied across many industries and has a lot to offer the oil and gas sector. IoT relies on smart devices or components that can, for instance, monitor all aspects of an asset.”

These relationships frequently centre on co-development projects to create and refine new technologies. The plant 4.0 incubator – which is led by Total but includes other companies such as Solvay, Air Liquide, Eiffage, Vinci Energies or Orano – exists to enable start-ups to test their products and solutions under real-world conditions. It has already borne fruit. Start-up company Fieldbox.ai, which was identified through this incubator, is now Total's partner in its DDAP programme.

As Total has shown, digital transformation is not just about new hardware and software, but also about business culture, skills development and investment in new ideas that will shape the future. The industry is on the verge of a technological revolution and it is the forward-looking companies that take the lead on digital transformation that will reap the benefits, rather than those who follow in their wake. ●

The revolution will be digitalised

As the rate of digitalisation and data creation picks up, it is imperative for the biggest players in the industry to have a robust policy to exploit these developments. **Torbjørn Folgerø**, senior vice-president and chief digital officer at Equinor, updates Grace Allen on happenings at the forefront of the Norwegian company's digital strategy.

Located in the cold expanse of the North Sea, 160km west from where the Norwegian Petroleum Museum in Stavanger maps out an industry that has shaped the course of Norway's recent past, lies a field set to shape its future. Named after the country's first parliamentary prime minister Johan Svedrup, the Equinor-operated field is slated to begin production in November 2019 and run for half a century.

The size of Johan Svedrup provokes superlatives. Equinor's website describes it as 'elephantine'. Stretching over 200km², the field will provide revenue of Nkr1,350 billion (£156 billion) over 50 years, and at peak deliver 660,000 barrels per day – 25% of all Norway's petroleum production.

The sheer enormity of Johan Svedrup is not the only way in which it is significant. The development of a new field offers an unparalleled opportunity to



implement a new generation of technological tools, including permanent reservoir monitoring, fibre optics and virtual rate monitoring. “Johan Sverdrup will be best in class on digitalisation and new technology,” stated Margareth Øvrum, Equinor’s executive vice-president for technology, projects and drilling, on the submission of the development plan for the project’s second phase.

Room for improvement

The product of improved and increased digitalisation is data, and huge quantities of it. “I think that in three months of operation Johan Sverdrup will have created as much data as we have in Equinor’s history,” says Torbjørn Folgerø, senior vice-president and chief digital officer at Equinor. “So this is also saying something about the ability we need now to manage that data in new ways.”

All this data, managed and analysed appropriately, will provide previously unthought-of insight into the workings of the field, but Equinor is aware that this will require serious investment, and is putting Nkr1–2 billion into digitalisation by 2020. “We believe that ability to utilise data is going to be one of our competitive advantages,” Folgerø says.

This included the establishment of a Digital Centre of Excellence in 2017, which Folgerø heads. “We are setting the digital roadmap, where we want to go in years to come, what are the targets you want to achieve,” he explains. “And then we work with the rest of the business to initiate and process new digital initiatives.”

In the Digital Centre of Excellence, units work on data science, enterprise data management – such as data strategy and policies – and emerging technologies, which looks at long-term solutions such as quantum computing. There are also the programme managers for the six programmes that make up Equinor’s digital roadmap: safety, security and sustainability; subsurface analytics; next-generation drilling and wells; field of the future; data-driven operations; and commercial insight. “These six programme managers are doing that overall orchestration strategy setting in their areas, so that we cover the totality of Equinor’s value chain,” says Folgerø.

Investing in the company’s personnel and developing knowledge is another way of preparing for the influx of data already changing the realities of the industry. Digital training programmes have resulted in more than 20,000 learning sessions already taught. Refining working methods is also leading to a more agile approach to digital solutions. “They work in iterative cycles instead of the traditional waterfall approach, so we get a much more rapid development of the solution, to get the

quick user feedback and also create value earlier,” Folgerø says. “We are following the process of creating a minimum viable product first, and we continue to develop the product. It’s also a new way of working for Equinor. It is very interesting and it’s also already providing value.”

A connection is made

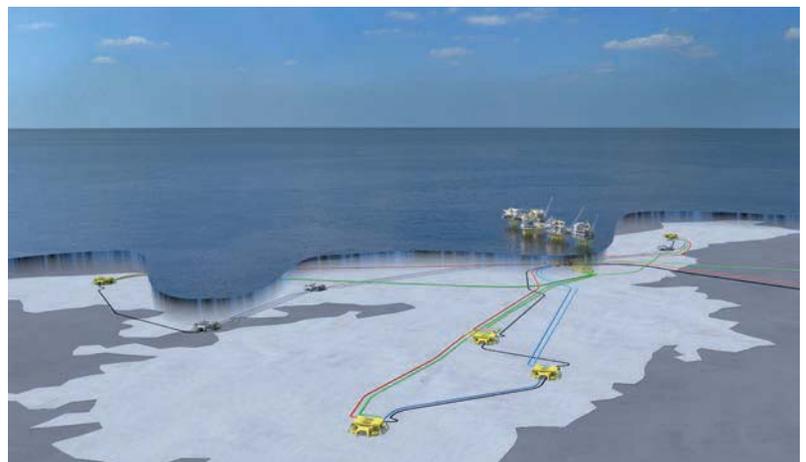
As the company moves into a more connected future, the development at the Johan Sverdrup field offers an opportunity to explore the new capabilities this can offer the oil field. “We have set up Johan Sverdrup to be a digital front-runner in the company,” Folgerø says. “So many of the digital initiatives my group is working on, we are using Johan Sverdrup as the pilot asset.”

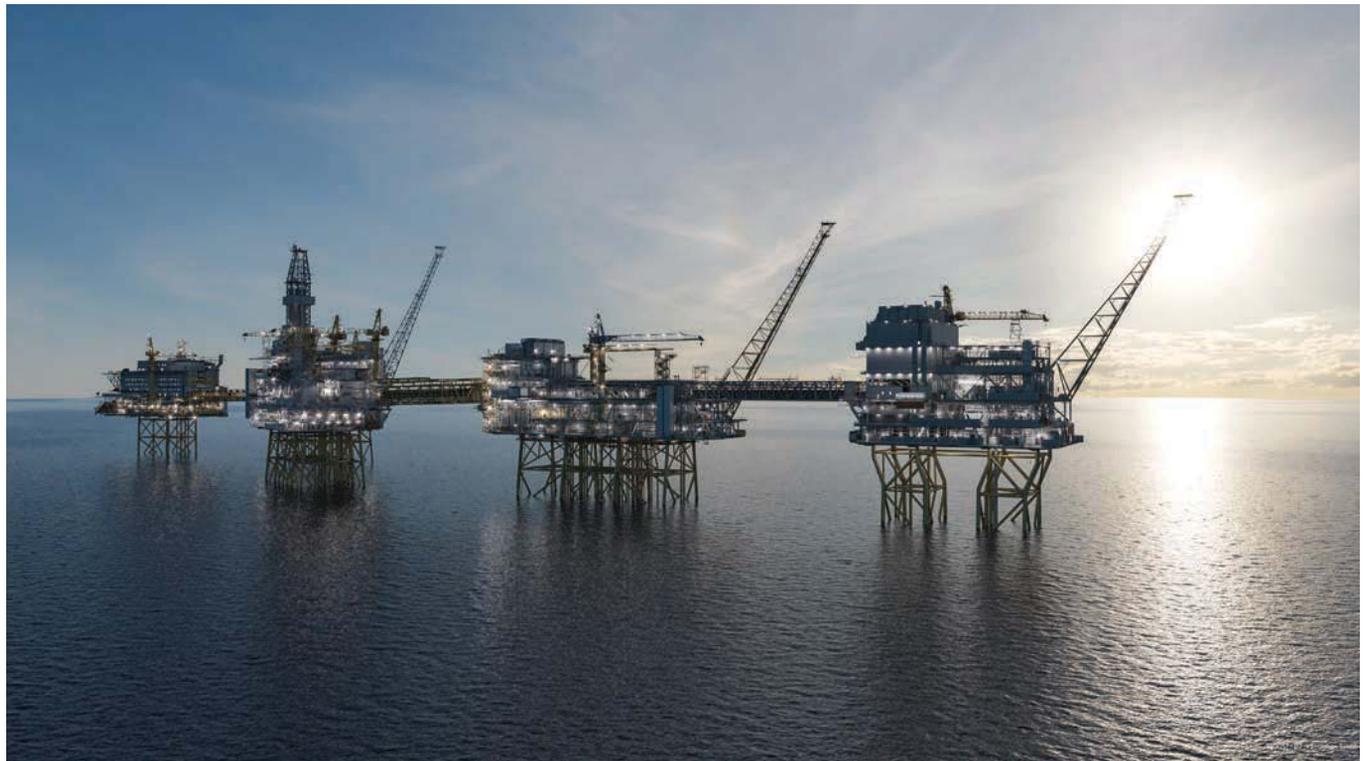
“We are creating a digital twin of the whole Johan Sverdrup that is already live, so the operators at Johan Sverdrup can now see the asset and find the relevant equipment information.”

One of the most significant examples is the use of sensor technology to create a virtual, real-time version of the whole installation. “We are creating a digital twin of the whole Johan Sverdrup which is already live, so the operators at Johan Sverdrup can now see the asset on their iPad, on their iPhones, and find the relevant equipment information,” Folgerø explains. “We can rethink how we are working with the offshore team, with the team on shore. We can also rethink how we work with our suppliers by using the digital twin in new ways.”

New techniques such as those employed on Johan Sverdrup are central to Equinor’s field of the future strategy, which intends to reduce capex by 30% and opex by 50% through digitalisation, automation and the use of robots. Another key milestone in Equinor’s strategy is the establishment

A visual presentation of the subsea section of Johan Sverdrup.





© Equinor

**Johan Svedrup,
an oilfield managed
by Norway's Equinor.**

of a cloud-based data platform, named OMNIA, that allows access to the data being created in ever-greater quantities. “That’s the architecture side, to make the data available, so that is one foundational step we are making,” Folgerø says. An up-to-date single platform that ends the siloisation of data is vital, especially as fields like Johan Svedrup are set to vastly increase the amount of data the company has to deal with.

Developed in partnership with Microsoft, OMNIA is based on the Azure platform; Equinor is moving data into Microsoft data centres, two of which are due to be built in Norway in 2019. A data platform like this allows not only data visibility, but innovative ways of working with and analysing information to extract insights of value. “Through OMNIA we are creating something we call sandboxes, so that means you can expose the data in a safe environment,” Folgerø says. Applications making use of the data can be built rapidly on top of the platform.

The development of OMNIA is part of a broader relationship linking Equinor with Microsoft. “Extending our long-standing collaboration with Microsoft enables continued IT innovation, business growth and furthers our digital ambitions,” commented Equinor’s CIO, Åshild Hanne Larsen when the partnership was announced in June 2018. “The strategic partnership will, through cloud services, involve development of the next generation IT workplace, extended business application platforms and mixed-reality solutions.”

40,000

The amount of Volve field data files available to students and R&D.

Equinor

Open to anything

A less insular, more cooperative way of working characterises Equinor’s approach to digitalisation. The company is making information available to not only its employees but also other partners.

By using OMNIA sandboxes, “internal employees but also suppliers and startups can work on those data, build machine learning algorithms and so forth and test it out”, Folgerø explains. External companies can also use Equinor data to improve processes. “We are also now currently piloting sharing equipment data with more traditional oil and gas suppliers, so they can also use their expertise.”

An example of this open approach is the disclosing of data from the Volve field in the North Sea, which was in production for eight years from 2008. In 2018, Equinor and the field licence partners made the subsurface and production data available – around 40,000 files for use by students, as well as in continued research and development.

Within the company, the new strategies around data and digitalisation are already reaping rewards. “We are seeing our operators or engineers testing out all our solutions, they’re generating many new ideas,” says Folgerø, indicating that colleagues are telling him which data they would like in the digital twin in order to do their jobs differently. After all, digitalisation best succeeds when people buy in and use their expertise to keep innovation constant. ●

Quality cable solutions for the deep sea

Subsea cable expert **DeRegt** provides inimitable quality in its broad range of deep-sea solutions. The company's cables can withstand any global climate with ease.

Clients of DeRegt are always looking for innovations that will allow ROVs to dive deeper. As a cable expert, the company has an unrivalled understanding of the challenges ROV manufacturers face as they go deeper undersea than even before. As the underwater pressure builds and currents become more powerful they'll need stronger, more buoyant and more flexible umbilical and tether cables to stay connected to their ROV.

That is why DeRegt participated in the development of a sonic wireline-operated remote drill. It designed, manufactured and tested a unique cable that combined electrical and optical components with a

high-tensile lightweight strength member. The aim was to deliver a lightweight electro/optical umbilical, with a minimum break strength of 2,000kN. The company has successfully tested the launch and recovery umbilical for this deepwater system, up to a terminated break-strength of over 360t.

DeRegt delivers the best possible cable solution for any given situation, from the immersive depths of the Arctic seas to the blue skies of the Middle East. From its Dutch HQ, it provides future-proof cable solutions based on the specific needs of its clients. The company is there to provide bright ideas, great products and excellent service. The company can

provide the best possible solution for your specific situation. Quality, craftsmanship and innovation are the three pillars that have helped it become a leader in the development and manufacture of high-quality cable solutions for the past 90 years.

The company has built quite a reputation in the fields of design studies, trial product development and qualification tests for client applications. DeRegt's depth of knowledge is sure to unlock the next level in cable solutions. ●

For further information

www.deregtcables.com



Discover our cable solutions for the deep sea

Working off shore often means going deeper than even before. As the pressure builds and currents become more powerful you'll need buoyant, stronger and more flexible umbilical and tether cables to stay connected to your remotely operated vehicle. That's why we participated in the development of a sonic wireline-operated remote drill. We designed, manufactured and tested a unique cable that combines electrical and optical components with a high tensile light-weight strength member. So you can work in great depths.

Curious to see how we developed a whole new range of deep sea cables? Deep dive into our free case study at <https://blog.deregtcables.com/cables-that-work-under-pressure>

Please feel free - no pressure - to visit us at the Houston OTC, stand 3139.

DeRegt. Your cables. Our strength.

Meet us

Zaag 2-4 | 2931 LD Krimpen aan de Lek | The Netherlands | +31 180 66 88 52 | deregtcables.com

Blowing all competition out of the water

Amazon Filters has excellent experience in developing, supplying and supporting a variety of process filter requirements for the international oil and gas market. Its expertise, combined with a comprehensive own-manufactured product range, has always been put to good use when undertaking major oil and gas contracts.

When offering any filtration solution, fully understanding an application is vital. Many applications rely on excellent water quality for injection. The importance of effective water treatment is often underestimated. Water intake quality can vary tremendously due to algae and plankton blooms, silts and other sediments – leading to significant impact upon the performance of downstream water treatment facilities. If not addressed correctly, injection water (produced water and sulphate removal process water), can be of poor quality – resulting in oil production loss and a drop of reservoir pressure. Amazon Filters specialises in water for injection and its filter cartridges excel at protecting critical downstream membranes used in these processes. Amazon Filters SupaPleat XP filter cartridges are specifically designed for water



The SupaPleat XP filter provides high-quality service at a multitude of flow rates.

injection. Using these filters can maximise membrane life by avoiding cartridge blinding, membrane fouling and interruption to the process. Reduced operational expenditure replacement costs are an additional benefit. The high surface area filter cartridges utilise multiple-layer, pleated depth media technology to provide low pressure losses and high dirt capacity at multiple flow rates. This allows the SupaPleat XP filter to provide a unique combination of long life and reliable performance under varying fresh, sea and produced water conditions.

Value-added service is supplied by expert filtration engineers – as well as laboratory facilities – from project initiation through to delivery and aftercare support.

Further information
Amazon Filters
www.amazonfilters.com

Quality LED floodlight

Designed for hazardous environments, the HDL106 modular floodlight combines all of the game-changing features of its Hadar predecessor with the Chalmit stamp of high quality.

Hailed as the ‘future of hazardous area lighting’ when it launched in 2009, the HDL106 range was a revelation. Using the latest in LED technology, the floodlight could generate the illumination as a SON, MBI or other typical HID floodlight with a 40% reduction in weight.

However, shortly after Chalmit acquired Hadar in November 2016, HSE released a bulletin regarding Hadar products. During a routine assessment, CSA-Sira found issues with the production process and control measures.

Chalmit has responded to the bulletin by applying its core mantra for safety, quality and reliability. The HDL106 has



undergone the same rigorous in-house and third-party testing as all Chalmit products, to ensure that every single fitting exceeds market and site expectations. The luminaires have all been updated with a new polycarbonate with a diffuser that ensures that the HDL106N satisfies the impact requirements and IP ratings for its complete rated ambient range.

“Our aim with the HDL106N has been to bring back the ‘future of hazardous area lighting’ and we believe we’ve achieved just that,” says Ken Eddleston, lighting product manager for Chalmit. “We’re reintroducing a much-loved product with the assurance of safety and reliability that our customers have come to expect from all [our] products.”

The HDL106N range provides:

- instant-on crisp white light output
- marine-grade construction
- multiple beam options
- extensive ambient range
- full ATEX and IECEx certification
- zone 1, zone 2 and industrial variants
- multiple mounting options for different applications.
- a lightweight lighting solution
- modular design allowing up to four interlinked luminaires
- high energy efficiency
- 80,000 maintenance-free hours at 25°C
- lower power consumption than HID lamps.

Further information
Chalmit
www.hubbell.com/chalmit/en

Expert value for your money

NGD-One is the first wearable device developed by ENGIDI to materialise the concept of the internet of things (IoT) for workers' safety. NGD-One, located inside the protective helmet for industrial workers, has been designed to be universal and monitors them in terms of safety. Because safety is first, the company is now able to have an accurate control and update for good. ENGIDI knows that tracking for tracking does not generate any value. The device is made of a series of perfectly calibrated sensors to obtain the necessary data to avoid an accident or to report it in real time informing of what happened. With NGD-One it is now possible to monitor:

- check-in/out of the workers to know how many workers are active within a work site
- helmet use, to be sure the workers are committed with the PPE policy
- altitude where they are operating
- impacts and falls, sending real-time notification with the location of the workers in case of strong impact
- thermal stress, sending notification in real time in case the workers are reaching critical values.

Finally, the device has a rescue button to be pressed by the operator or a colleague in case of an emergency, accident or incident. This alarm sends real-time notification to the platform



NGD-One formally materialises IoT.

with the exact location of the worker. The firmware can be programmed to inform the OHS Manager every time an operator enters a previously defined dangerous area or to inform those without accreditation for certain areas or machines. It is very useful for those who work alone. All the data collected by the device is sent to an IoT platform through NBIoT/LTE-M connectivity to ensure a complete update and digitalisation of OHS.

Further information
ENGIDI
<https://engidi.com>

Unsung heroes

GAI-TRONICS' service engineers are reliable, adaptable, work in some of the most extreme conditions imaginable, and are on call every day of the year.

The company believes its products speak for themselves, but there is a whole other world working behind the scenes that contributes to its success.

Whether it's the assembly line staff, office-based teams, product developers or design engineers, every cog, regardless of its size, contributes to the overall running of the machine.

Service engineers are unsung heroes. These are the people that visit sites that are experiencing problems to provide the expertise in order to find an effective solution, or provide advice when planning a new project.

They may look like ordinary members of the public, but there is more than meets the eye to these extremely versatile and skilled professionals.

A typical scenario might find a GAI-TRONICS service engineer flying from the UK to the Middle East at a moment's notice. After a seven-hour flight, they will arrive in the destination country. They will then travel to another location where they may be

required to take a helicopter to an offshore oil rig. There, they will be expected to deal with extremely difficult conditions, often working 12-hour days, seven days a week for up to three weeks, in all kinds of weather, until a satisfactory solution to the specific problem has been found.

Until recently, accommodation saw them 'hot-bunking', which meant taking it in turns to sleep in a single bed shared among multiple other workers. Food is basic at best, and access to the outside world is virtually impossible. Then there are the qualifications and certifications that service engineers are required to have, some of which include passing a full medical, achieving their offshore training certification and their safety certified training qualification.

Further information
GAI-TRONICS
www.gai-tronics.com

Learn the tricks of the trade

The UK's leading manufacturer and supplier of hydraulic tools, Hi-Force, has experienced an increase in demand for training since establishing its state-of-the-art training schools and tailored training packages.

Hi-Force is approved by the Engineering Construction Industry Training Board (ECITB) for the provision of mechanical joint integrity (MJI) training courses in line with industry standards and practices. With many years of 'hands on'



Smit Lamnalco provides impeccable marine services.

experience in the oil, gas and petrochemical industries, as well as power generation and construction, Hi-Force's ECITB-approved trainers have the technical and practical knowledge to deliver -accredited training courses. Courses are held at the ECITB- approved training schools in the UK, Middle East, Malaysia, South Africa and the Netherlands.

The extensive Hi-Force range of bolting products is used to deliver the MJI training courses. The TWM and HTW range of manual torque wrenches offer output torque capacities up to 2000nm, with a choice of square drive sizes from 3/8in to 1in. In cases where high output torque is required, the TWS-N square drive and TWH-N low-profile hydraulic torque wrenches are available in capacities up to 48,181nm. Operating at 700 bar maximum pressure, all hydraulic torque wrenches are designed for accurate and consistent tightening and loosening of bolts

Hi-Force hydraulic bolt tensioners are manufactured using only the highest-quality materials, to ensure the tolerances needed for operating at pressures of 1,500 bar are accurately maintained. Available in capacities up to 2,649kn, the STS topside, SBT spring return and STU subsea range of bolt tensioners, suitable for imperial bolt sizes up to 4in and metric bolt sizes up to M100, are specially designed for single and multi-tensioning applications.

Through investment in the best technology and world-class manufacturing facilities, quality control is assured in the Hi-Force brand; it is certainly a company that can be trusted with current and future hydraulic demands.

Further information
Hi-Force
www.hi-force.com

The search is over

Analysts, employees and management may navigate, collaborate, discover and filter data in IntOp Fetch using the filters based on the defined contexts and appropriate facets such as file type, extension type, source, author and date. This selection may be saved, shared and reused while keeping the access rights intact. Contexts are patterns for grouping data into intuitive selections. The main differentiator in the solution is the IntOp Context Layer. The IntOp Context Layer is a patent-pending technology that automatically links files to contexts, regardless of how the files are structured or tagged in the sources. It also provides an easy interface to design, curate and improve contexts.

Standard contexts are available out of the box or fit for purpose contexts may be added quickly. It requires no IT experience or developer skills to design and manage the contexts. The instructions about the contexts are introduced in language-based thanks to the Context Layer Management Tool.

IntOp solution is set up with flexible connectors that easily harvest non-structured data from any source. The solution will harvest content and metadata from files or records from the sources. The connection to active directory ensures that identity and access rights are also harvested.

During and after data harvesting, statistics regarding the harvested data will be available. For non-editable files, depending on the source quality (OCR), content may be presented directly or run additional automated ingestion to improve the result.

Through powerful APIs, data from the IntOp Solution may be navigated or displayed in IntOp

Product showcase

Fetch, IntOp Fetch for 3D and IntOp Fetch for GIS, statistics may be made available in BI dashboards or other solutions. The solution is very flexible and can be easily implemented on premises, in cloud or as a hybrid.

Further information
Intelligent Operations
<https://intop.no>

Increasing asset lifespan

Maintenance in the energy industry is a costly challenge for asset owners; damage from corrosion and contamination can deliver a costly blow as assets degrade before their time. Abrasion and corrosion-resistant coatings for metal components are the ideal solution.

Offshore platforms are exposed to constant salt water and mist causing corrosion of moving and serviceable metal parts, thus reducing the operational efficiency and longevity of the installation. The ultimate solution is a thermoplastic coating that encapsulates without adherence allowing moving parts to continue moving and access for maintenance able to take place. Thermoplastic coatings make maintenance in the field more affordable for asset owners. Oxifree TM198 is an organic, patent-protected thermoplastic coating that lasts several years and is proved to extend the life cycle of components and reduce maintenance costs by at least 40%. It protects metal components from corrosion and contamination, acting as a barrier for sand abrasion, dust ingress, galvanic pitting and atmospheric corrosion. TM198 has had extensive use for protection of metallic equipment in a variety of industries protecting equipment from corrosion.

Take for instance an offshore oil offloading tower (OLT); the



Oxifree maintains unmanned OLTs.

flanges on the riser turret had suffered extensive corrosion due to its offshore location. Salt, water and changing temperatures were allowing corrosion to develop on the flanges making maintenance an issue. TM198 was applied to nine flanges in total. All work is applied with the new Oxifree Polymelt 50 application machine with a 15m hose.

Oxifree active anti-corrosion and contamination solutions will prolong the lifespan of asset components, reducing expenditure and the cost of both shutdowns and maintenance caused by corrosion and damage.

Further information:
Oxifree
www.oxifree.com

A safe pair of hands

Smit Lamnalco provides first-class, reliable and customised marine support in challenging environments, ensuring safe and efficient operations in any part of the world. The quality is in its people. With dedication, the company goes to extremes to deliver the best towage and related marine services possible. No matter how demanding the operation, remote the location or complex the local conditions, Smit Lamnalco is dedicated to meet and exceed expectations. The company lives by its purpose. It challenges its people, partners and stakeholders to always maintain the highest safety standards, adhere to industry best practices and strive to continuously improve the quality of operations. At Smit Lamnalco, the esteemed staff

understand the behaviour of LNG. It has one of the world's most sophisticated support fleets at its disposal and is recognised for the capability to deliver customised

solutions that meet the specific requirements of LNG/FSRU terminal operations. With experience, skill and knowledge, the company is committed to expanding its presence in this growing business. While working around gas, you have to work with care. To make things work, you have to know the drill. And more importantly, you have to be alert all the time. Safety always comes first. That is why the crew not only provide excellent marine support, but also bring expert safety training to the job.

Smit Lamnalco's concern for safety is a good example of its profound involvement. The company remains actively engaged in creating procedures for LNG emergency response and sharing its expertise with clients, providing personnel training to enhance awareness, skill and knowledge. Smit Lamnalco recently developed an in-house LNG emergency response training program based on the SIGTTO guidelines. A theoretical and interactive elearning tool for crewmembers, complete with certificates, designed for mobile use.

Further information
Smit Lamnalco
<https://smitlamnalco.com>

Noise-free suction pile foundations

SPT Offshore is a specialised contractor and market leader in the design, fabrication and installation of suction pile foundations and anchors. The company applied the suction pile technology for:

- oil and gas platforms
- wellhead protectors and blow-

out preventers

- anchors for FPSOs and buoys
- offshore wind turbine foundations
- substations.

Worldwide, it has installed over 450 suction piles and anchors since 1997. The technique is feasible in almost all sedimented type of soils. SPT Offshore installed and relocated 14 pieces off its patented Self-Installing Platforms for small to medium-sized platforms up to 10,000t, such as the Centrica F3FA platforms. It has provide T&I services for its Self-Installing Platforms and lifted installations using sheerlegs for topsides up to 25,000t using its innovative technology. Furthermore, the company supplies and installs complete moorings including hook-up to the FPSO, buoy or floating wind turbine.

The staff at SPT offshore is specialised in project management, as well as geotechnical, structural, project and marine engineering. SPT Offshore operates its own suction pump spreads for the installation of suction piles and anchors from shallow (5m) to deep water (3,000m), which are operated by its offshore installation crews. Besides the pumps, the company rents out suction piles for temporary start-ups or moorings.

Unlike the massive sound generated by the blows of underwater hammers, the installation operation of suction piles is virtually noise-free. Suction pile installation does not cause vibrations in the seabed that may disturb marine species or damage adjacent structures. At the end of its lifetime the suction piles and attached structures can be fully removed by simply reversing the operation.

Further information
SPT Offshore
www.sptoffshore.com

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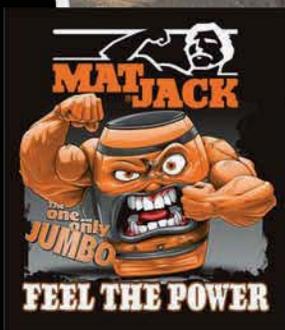


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