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The oil industry needs people "comfortable being uncomfortable" - BP's head of upstream technology

Ahmed Hashmi, global head of upstream technology with BP, talked about how the industry is becoming a 'margin business', how it needs people who feel 'comfortable being uncomfortable', and the need for more time to think

Ahmed Hashmi, global head of upstream technology with BP, shared his thoughts at the Aberdeen ENGenious event on September 4-6 about how the industry is becoming a 'margin business', how it needs people who feel 'comfortable being uncomfortable'.

As the industry comes out of the downturn, "this is time for us to find the next production gear, and digital has a lot to offer in that space," he said.

The industry is trying from focussing on increasing resources to improving productivity. "Upstream is a margin business, we just don't see it that way," he said. If oil and gas had improved its costs on the same trajectory as the automotive sector, it could have reduced its costs by 50 per cent by today, he said.

On the day of the conference, BP issued a press release about its "Plant Operations Advisor" being active on its Gulf of Mexico operations, analysing 150m equations every day, and providing data to help staff make decisions. The project was deployed just 3 years after the initial idea.

Staff can use it to develop their own applications for monitoring equipment health, including adding in their own code.

"This is about doing something with the data," he said. Nothing like this in the industry has existed before. "We want to know the status of our plant at any time, and not just for greenfield, we are going to deploy on all assets."

It is part of BP's efforts to develop a 'connected upstream', including thousands of kilometres of subsea fibre optic cables, high performance computing, and digital twins.

To illustrate BP's idea of what a digital twin is, Mr Hashmi presented a 3min video, which you can see at https://www.youtube.com/watch?v=q_gcioB0ao8 (or Google APEX – BP's digital twin).

The video explains digital twin by showing a digital twin of a human, and explaining how the model or data could be used to help it perform a task better, with the example of hitting a ball.

One illustration of the benefits of data analytics are that BP discovered that its H_2S "Scavanger" processes, which add chemicals to produced hydrocarbons which react with H_2S and help remove it, resulted in higher costs in the refinery, so it was just moving the costs downstream.

One big challenge is finding ways to make IT development a continuous development process, not setting requirements and seeing a finished product 5 years later, as the company has worked in the past.

BP's current projects build on its "Field of the Future" project, which ran from around 2000 to 2017, achieving its target of improving production by 100,000 bopd.

It took a long time to get there, and leaves behind some 'legacy' systems which still need to be supported, he said.

Human transformation

Mr Hashmi stressed that "digital transformation is not about technology. It is a human transformation."

For people to change how they work will involve feeling uncomfortable at times. "We need to get comfortable feeling uncomfortable," he said. "If you are uncomfortable you

Ahmed Hashmi, global head of upstream technology with BP

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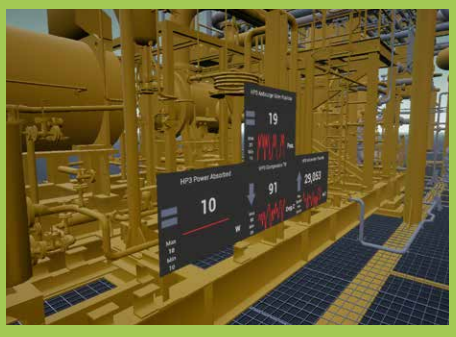

Cover image: Combining virtual reality with integrated operations. With an VR integrated operations centre, you can put together a 'virtual team' of experts, all looking at the same data, but working from any location, even their homes. See page 18

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change and adjust. If you are comfortable you reject."

One important personal characteristic required is humility. "Being in a state of transformation requires us to acknowledge we don't know what we are doing, and we have to learn."

Many people attracted to work at BP are people who like the stability of a large organisation, and who like clear performance evaluation targets. But a culture which is ruthless in evaluating people can also inhibit innovation, if people are worried about being poorly evaluated for a new idea they are not yet confident in.

BP likes to partner with companies with a different way of doing things. In one example, BP was talking about discussing a point with a workshop in 4-6 weeks' time, and the partner company said, "why don't you Skype on it right now."

"We realise – our practises and ways of working are unacceptable to partners," he said.

BP tries to head off people's fears about automating their jobs by rewarding people who manage to do it. "When people come to me with tools they have created – 'I have automated my job on the back of tools you gave me,' I say, 'good on you, what are you doing next.'"

One of the biggest missing elements, "for most of us, me included", is having time to think, he said.

Learning from shale

The Aberdeen oil and gas industry might have something to learn from the USA which has transformed efficiency in its onshore / shale operations, including with companies being forced to share large amounts of data with others, including their frac designs, and learning from each other.

The US onshore industry also has an "every day has to be better than yesterday" mindset, he said. This could also be described as a growth mindset. In Mr Hashmi's definition, a fixed mindset person says, "I'm going to draw on my experience". A growth mindset person says, "I will draw on experience but look to the future with a wider aperture." When recruiting, BP looks for a learning mindset, he said.

Domain expertise

There may have been a notion at some point in the past that data science was the future and would be able to run the business, but now "we have killed the notion," he said.

"It is leadership, particularly first line leadership, who have to embrace the change," he said.

BP is looking to help its domain experts – engineers and geologists – develop new digital skills, including providing data science "boot camps", and investing in leadership training for how to be a leader in this new era, which involves "being uncomfortable with the status quo."

When it comes to analysing data, "some petroleum engineers are the best data scientists," he said. "Give them the tools and they will surprise you."

BP is putting its top 2000 leaders through a data science re-training, covering topics like Power BI and Python.

In 2017 BP held a "digital energy" day in London, which was attended by the CEO, and where staff worked on some business problems together. "Several people said they were shocked at seeing this side of BP," he said. "They did not think we were a modern company or technology centric company.

We have to change that view, or we will not be able to hire the kind of people [we want]"

Questions

Mr Hashmi was asked why oil companies don't release more data publicly, so other people can have a try at analysing it. "We do this all the time," he replied. "People think we don't do it, we've been doing it for eons. For example, giving cores to research institutions."

When asked whether digital technologies threaten jobs, Mr Hashmi said that the ups and downs with the oil price have been "much more disruptive." He is now hoping for more stability. "If we get on a rhythm of improvement these shocks can be minimised."

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Perspectives from the TLB's co-chair

Bill Dunnett, Co-Chair, The Technology Leadership Board and head of the executive management team for Repsol Sinopec Resources UK Limited, shared his perspectives on how to develop technology for the North Sea

Bill Dunnett, co-chair of The Technology Leadership Board (TLB), an industry-government group to help the UK North Sea oil and gas industry adopt, adapt or develop technology, shared his perspectives on how to develop technology for the North Sea.

Mr Dunnett is also head of the executive management team for Repsol Sinopec Resources UK Limited, and on the board of the UK's Maximising Economic Recovery (MER) Forum.

Bill Dunnett, Co-Chair, The Technology Leadership Board and head of the executive management team for Repsol Sinopec Resources UK Limited

Developing and deploying new technology can be very hard, when everybody believes their technology needs are unlike anyone else's, and so technology can only be developed just for them, he said.

To help get new technology implemented, the TLB is encouraging each North Sea operator to "sponsor" a technology development, he said.

Mr Dunnett believes that a common problem with new technology is that the initial roll-out is not good enough to add value, and gets over promoted, and so with one failure people reject it. In order to be successful, technology needs to be continually refined, putting it to use, testing it and improving it. People need to accept it might not work well the first time.

On the other hand, perhaps the success of the first iPhone could be attributed to how refined the technology was at the point launched to the public, following years of secret technology development.

One priority of TLB is finding ways to extend the life of assets running in the North Sea – which means better ways to assess their condition. Most of the North Sea assets in operation today were designed in the 1970s.

Mr Dunnett would like to see a transformation in inspection technology. Some methods have been tried in one of Repsol's North Sea platforms, carrying 45,000 bopd, where it managed

to achieve 97 per cent uptime by avoiding equipment failures. Most of this downtime occurred due to closures in the export pipeline, which is managed by another company.

Mr Dunnett likes the idea of streaming data from an asset to an onshore control room, where it can be displayed on a "massive screen", showing all operations – including process engineering, maintenance and support. People work facing the screen. There is also a continuous video link from the platform. It has installed such a system on a new platform Repsol commissioned.
The data can also be streamed to vendors.

"It's been phenomenally successful," he said. Bringing in smart analytical solution is a "simple goal", but it is extremely hard work to get there, he said.

In the exploration sector, there is interest in trying to find better ways to directly "see" oil in seismic, known as Direct Hydrocarbon Indicators. There is an interest in reducing seismic processing time "from months to days". Also driving down the cost of full azimuth seismic surveys, perhaps using better ocean bottom seismic technology.

There is interest in finding ways to improve and clean well data, perhaps using artificial intelligence.

The oil and gas industry also has challenges being more environmentally friendly, since that is "a massive factor in how other people see us," he said. "We need to make this a long term sustainability business."

Mr Dunnett is not a fan of too much functionality. His daughter observes that his car has 60 functions on its hi-fi, and Mr Dunnett only knows two of them.

Saudi Aramco and Cognizant - ENGenious opening session

The opening session of the ENGenious event in Aberdeen (Sept 4-6) included talks from SPE's president Darcy Spady, Saudi Saudi Aramco's VP Southern Area Operations Khaled A Al-Buraik, and Cognizant's head of strategy and marketing, Malcolm Frank

Darcy Spady, president of the Society of Petroleum Engineers, said that there had been extensive debate about whether petroleum engineers or data scientists are more important in the new digital world. The better answer, Mr Spady said, could be to say that both are important – and "the two are inter-related from here out."

Saudi Aramco

Khaled A Al-Buraik, VP Southern area operations with Saudi Aramco, (and responsible for a sizeable chunk of the world's hydrocarbons, as well as a seawater treatment plant), said he believes "the petroleum industry is on the threshold of technological revolution."

Saudi Aramco is continuing to invest in people, increasing its research and development budget, taking on more people with PhDs, and doubling the number of patents it is filing for, he said.

In terms of digital technology, Saudi Aramco is looking to manage its operation "on a real time basis", use predictive algorithms in drilling, instrument its well and use the data for diagnostics and planning intervention.

For subsurface, it is using underwater vehicles for deploying seismic equipment, looking for ways to increase seismic acquisition speed and reduce costs by 30 per cent. It is using "machine learning" on subsurface data. Another aim is predicting geochemical parameters, improving seismic interpretation, and early detection of water and gas breakthrough,

Like other companies, Saudi Aramco is challenged by a common apprehension accompanying digital transformation technology. A commonly heard complaint is that these "systems are not suitable for the oilfield".

Cybersecurity also brings in new risks, with the energy industry one of the top 3 targets of cybercrime, and the costs of cybersecurity having doubled or tripled in 5 years.

The biggest threats are "uninformed or undisciplined users," he said, because "that is a hard risk to mitigate against."

"The oil and gas industry has always risen to challenges," he concluded. "We may be slow to change but are quick to move when the time is right."

Malcolm Frank, Cognizant

Malcolm Frank, head of strategy with technology company Cognizant, said the oil and gas industry could do well to follow some of the work done by aviation or automotive manufacturers, installing enormous numbers of sensors and working with the data.

However there are some jobs which require skills which computers could probably never develop, particularly ones requiring emotional intelligence. Mr Frank suggests executives, coaches, policemen, nurses, salesmen, maintenance people, and teachers. We should be looking for ways for machines to help them do their jobs better, not replace them, he said. For example a machine which can answer the question, "What is the next best action we should take right now."

Darcy Spady, president of the Society of Petroleum Engineers

Mr Frank also imagines software bots which could run in company boardrooms, providing quick answers to the sort of questions which come up in internal company discussions – pros and cons of entering a certain market, activities of competitors, regulatory changes, and costs.

If you are involved in technology development, rather than trying to come up with something clever, you should just look for ways to solve problems which people complain about, he said. For example the rapid growth of Uber in New York could be attributed to the fact that people preferred clean Uber cars to smelly taxis.

Mr Frank is an enthusiast of the use of virtual reality or augmented reality in training, saying that people's information retention rate can be 79 per cent when they use virtual reality or augmented reality tools. They have already been used to help sports professionals train, enabling them to virtually play far more games than they could in real life.

How BP and Aramco Ventures invest in technology

Technology investors from BP and Saudi Aramco Energy Ventures explained their approach to investing in technology, in a panel discussion at the Aberdeen ENGenious forum in September

Technology investors from BP and Saudi Aramco Energy Ventures explained their approach to investing in technology, in a panel discussion at the Aberdeen ENGenious forum in September

Stephen Cook, chief commercial officer, Group Technology at BP, said that his job could be described as fixing BP's pain points, picking up on a comment by a previous speaker that the best best approach to developing technology can be to identify things which don't work or "suck" and try to fix them.

Getting into 'ventures', for BP, was a strategy to "manage uncertainty - having a portfolio of options not tied to your current group think, rather than looking for a new unicorn," he said.

Mr Cook has a Phd in bio-organic chemistry, and has been with BP for 20 years, now working in its "central technology" organisation, in a role defined as "business development", looking for ways to combine new technology and business models, together with "strategic insights". He looks after alliances BP forms with other organisations, and new company spin-outs, or new "commercial structures".

His team works closely with BP's "corporate ventures team", which are looking for more "disruptive technology" likely to have an impact over the longer term.

Technology he is particularly excited by includes fibre optics in the well for acoustic recording to understand what is happening, and improved seismic technology to see subsalt and sub basalt.

One company it invested in is XACT Downhole Telemetry Inc of Houston and Calgary. Another is a NASA spin-out AI company called Beyond Limits, he said.

The relationship between small start-ups and a big oil company is fraught with challenges, he said. To a start-up company, BP appears like a telephone box on a street looks to a bystander, a confusing mass of wires. Perhaps the solution is for BP to better mould its 'interface' around the needs of small start-ups, he said.

BP does not see owning IP as the only way or necessarily the best way to achieve competitive advantage with new technology. It could also be achieved through the relationships the company has, or the speed at which it can do things. "As we look at some digital opportunities, IP becomes less and less important," he said.

Saudi Aramco Energy Ventures

Hans Middlethon, managing director of Saudi Aramco Energy Ventures Europe (SAEV) venture capital, said that it is getting hard predicting where the next technology will come from.

In former years, new oil and gas technology generally came from Scotland or the West Coast of Norway. but now it is developed in many more places, such as Berlin, Helsinki, Capetown and California, he said.

SAEV is headquartered in Dhahran, with offices in Aberdeen, Oslo, Houston, Tokyo, Seoul, Beijing and Singapore. It has invested in 30 companies so far, mainly in the US and Europe, typically investing $5m to $10m. Mr Middelthon is a former director of private equity company 3i.

The company sees its role as helping "young digitech companies" to break in, and in particular giving companies the sort of long term support they need to break into the oil and gas industry. You need a long time to understand the ins and outs of the industry, he said. And many other investors lost interest in the industry after the oil price crash or the financial crisis.

The biggest hurdle is separating the "quick wins" and the "not quick wins" – and quick wins means a technology which Aramco is ready for. "Trying to force technology into a system that is not ready, is not going to work."

By contrast, managing intellectual property is not the biggest hurdle, and generally something you can sort out, he said.

How oil and gas compares to mining

Rachael Bartels, Chemicals and Natural Resources Industry managing director with Accenture, explained how the mining industry is doing its digital transformation and what lessons there may be for oil and gas

Rachael Bartels, Chemicals and Natural Resources Industry managing director with Accenture, explained how the mining industry is doing its digital transformation, such as with its "connected mine" offerings, and what lessons there may be for oil and gas.

The mining sector has been through big challenges over the past few years, including with commodity prices tumbling, she said.

It has been forced to re-evaluate where exactly the value is created, and this has sometimes led to a change in focus.

For example, the company saw that it could be better to invest in self organising conveyor belts, which sort ore from dirt within a mine, rather than large trucks, which allow more ore (mixed with dirt) to be transported from a mine. Or it might see that it may be better off choosing a site where a lower volume of product is mined, but it has a smaller concentration of a certain impurity in it, which is expensive to remove, such as arsenic.

The mining sector is aware that just because it is important in society does not mean it is a valuable business, seeing the example of the rail sector, which had the biggest companies in the world 100 years ago.

The mining sector has done many digital projects, including automated vehicles, enormous amounts of data, cloud storage, analytics centres, tracking people in underground mines, fatigue monitoring helmets, weather monitoring and video analytics. But they are mainly "proof of concepts" – used once in a limited project, not across an entire company. "For every mine site that has it, there's 10 in the same business unit that doesn't," she said.

When it comes to scaling up the technology, important factors include getting a consensus in the company on where to invest, and finding ways to work with legacy systems. And "unless you've thought through how to build it into your business you are creating more 'legacy' that needs to be cleaned up," she said.

Companies tend to be "quite risk averse about stuff they haven't done," she said.

Mining companies also recognise that they need to be more co-ordinated and decentralised about their technology implementations, although have different ways to do it. Some of the smaller companies are able to implement technology via command and control, with a direction from the top that everybody will use a certain technology.

But larger companies with many different types of mines cannot do this, so they need alternative approaches such as setting 'standards' for how technology will be implemented in certain sorts of mines, or trying to co-ordinate the technology development between similar sites.

A critical element proves to be having a CEO who believes in the technology, and is willing to put staff in charge of driving the company's development of technology, perhaps as a "transformation office".

Rachael Bartels, Chemicals and Natural Resources Industry managing director with Accenture

Ms Bartels says that a "North Star" – or an idea of the destination – is very important in motivating people. It should be "big and bold". "Big goals make people more uncomfortable, so you have better ideas."

You also need a structure around the program, with process and discipline, not let it get "loosy goosy".

You may want to do things which conflicts with other targets people have. For example, if your data analysis shows you might be better off processing product in a different place, there will be people whose department budgets will be adversely affected (i.e. spending more than they would otherwise), and people might be more motivated / rewarded by whether they meet their budgets than anything else.

The companies which were most successful were ones who did a revamp of their performance management system, so people would be rewarded for different things. "When they move, the whole company moves so much faster," she said.

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Case studies with oil data analytics from Shell and Total

At the ENGenious forum in Aberdeen on Sept 4 data analytics session, we heard about how Shell is deploying a data science "centre of excellence", developments with Total's program to develop robotics for offshore use, and a case study using analytics on data about screwing casing pipe together

Daniel Jeavons, general manager of data science with Shell, talked about his work to develop or 'scale' Shell's data science capability,

A fundamental principle for data science in Shell is that the digital systems should be 'owned' by the business units it serves, but supported by the data Centre of Excellence (COE).

"The customer is in control. I learned that the hard way. It is extremely easy to think, "I'm a good data scientist and all these guys don't understand." You have to harness people who understand the business problem to where they are able to leverage technology."

As an example, Mr Jeavons mentioned a project where the data team worked together with a central corporate team, rather than the people who would ultimately use it. "I got really excited about the engineering, Natural Language Processing (NLP), data lakes, core engineering delivery."

At the end, "we showed it to the user and said, isn't it brilliant, and they said 'no, it's rubbish, we can't use it.' Ultimately it delivered zero for the business." "I've seen several like this."

So it is important for data scientists to work

"highly proximately" with engineers, he said.

Mr Jeavons sees his job as a "servant leader", with staff in his department working together with the project teams.

However it is important for a company like Shell to develop its own data science technology, rather than buy it in, because that's the only way that the company can get to understand it properly, and you need to understand it to get value out of it, he said.

Also, you don't necessarily know where you are going to end up when you start, which means it would be very hard to select or instruct a third party supplier, he said.

The main drivers of the potential for data science are the big cost reductions in sensors, data storage, data processing, and communications. All of these things come together in making it possible to build a tool like Waze, giving drivers real time information about traffic and road conditions, he said.

Oil companies are asking themselves, what could they do if all of their data was available all the time, and what could they do if they made more data analysis automatically, rather than sending it to analysts, he said.

Also, if more decision making can be made "at the edge", or on site, then all the systems to put data in databases, send it to analysts and decision makers, can all become redundant.

Shell sees other companies developing business models for services in spaces which Shell could be working, partly with the help of analytics. For example Schlumberger doing field development, BHGE providing equipment management, big engineering companies assessing suppliers, BHP making automated mining trucks, and Starbucks doing personal marketing.

It helps roll out data science capability if there are obvious benefits to the core business you are serving. For example, you can have an 'incubator' to try to develop something new, and then try to develop a "minimum viable product", or "a proof of concept", and then do a series of releases. Only involve the IT department when you are ready to scale it out to the wider company, he recommended.

For example, Mr Jeavons was involved in building an "exploration basin screening" tool, involving taking Shell's full corporate knowledge base of basins, indexing it by geographical location and by stratigraphy, and creating a "Google for subsurface".

It talks about the benefits of tools like autonomous drilling, "digital rock", automated mud log interpretation, drone video analysis, fouling prediction systems, getting early indicators of safety issues. The technology needs to continually prove itself, so no-one argues about its value.

Once people agree a project should be developed on a broader scale, you need enough time to get something working, and frequent engagement with your 'stakeholders". Individual products can be developed in "sprints" of say 2 or 3 weeks.

You also need to select good "foundational technologies" to run your systems on. "You can't run this at scale if you don't have a platform," he said.

Mr Jeavons sees three separate core skills – data science, data engineering and data visualisation.

Data science is the ability to work with data to get results, so can include machine vision, computational insight, statistics, applied maths, optimisation, machine learning.

Data engineering is the ability to work with data technically, including writing instructions in Python, doing Extract/Transform/Load operations on data, and business analysis. "A data scientist is nothing without an engineer," he said. In particular, data engineers can build tools to clean up data, before the data scientist can start working on it.

The "data visualisation" is about showing data, such as on dashboards, visualisation tools like Spotfire, or doing database enquiries. "The ability to tell a story is fundamental," he said.

It is possible for individuals in Shell to get access to software tools Shell has subscriptions for, such as Maana and Spotfire, and try out analytics on their own data, with the support from the Centre of Excellence when required.

Shell's data science Centre of Excellence itself takes on a marketing role within the company, showing people what is possible, where they're missing out, what the quick wins are, helping people understand the value of it. Altogether the effort could be described as "trying to show excellence and catalyse a movement in the company."

The data science COE runs over 40 events a year, with outside vendors invited to some of them. It has set up an internal network for people interested in "analytics", which has 1800 members.

The team has also run "hackathons", where people can come to with their data set, a laptop, and data analytics tools, and then spend 3 days trying to find something useful from it, or build a 'minimum viable product".

Total – image analysis for robotics

Total has been developing systems for analysing visual images, which could be used on images gathered by robots on offshore oil platforms, for example to better understand the condition of structures and equipment. It is working together with UK data analytics company Merkle Aquila.

Over the past few years, Total has run a competition called "Argos," asking teams to develop robots capable of doing a variety of tasks which they might come across on an offshore platform. The winning team will deploy their robots at some Total sites from summer 2019.

The images from sensors on the cameras will be combined with data from drones and sensors, and manually entered data.

It would be helpful if more data analysis can be done onboard the robots themselves, thus reducing the amount of data which needs to be stored and communicated, and perhaps meaning that data handling draws less power from the robot's battery, said Mike Atkins, data engineer with Merkle Aquila.

For example, the image analysis onboard a robot could flag up that a certain item is in a different place from where it is expected to be. Or the images could be classified, working out where all the gauges are, and just sending data back from those.

Total decided to use Microsoft Azure for data storage, since it has ready made tools for working with sensor data, said Nick Hayward, data scientist with Total

The system could also work with different types of cameras, for example infrared cameras for detecting gas leaks.

The system has 30,000 photos of offshore objects which are used for training, so the system can look for the same objects in new image files. Training models takes a great deal of time, and so careful consideration of exactly what you want to train the system to do is helpful before you begin.

When a system has been trained to spot one kind of object, perhaps it can be adjusted in a small way to track a different object, Mr Hayward said.

Analytics on screwing casing

Marcus Savini, R&D Manager, Strategic Technology Group, a company in Dulles, Virginia, specialising in motors and motor drives, presented a case study of how the company used analytics on torque data from screwing together of casing, large diameter pipe which is placed inside recently drilled wells to prevent the well from collapsing and well fluids from leaking.

The torque (the amount of force used to screw the pipe together) is different in different stages, as it is if you are screwing a nut onto a bolt with your hand. The torque needed is low until right at the end, the 'shoulder point', when more torque is needed for the final tightening.

The purpose of the study was to find ways to detect problem joints (which might have a different pattern of torque vs number of turns). It could also improve the automation systems, with more control of the torque at different stages of the turning process. The data analysis could also compare one piece of equipment or site with another.

The data analysis showed the average, minimum, maximum turns per connection, and the variation of any specific connection from the average. It could also present the average turning speed in revolutions per minute at the shoulder point.

The client company had 1.26m data records of screwing together casing, showing how torque varied with the number of turns.

The biggest part of the project is cleaning the data, making sure only data which looks valid is subjected to the analysis. For example if a graph shows that the system did not have the torque applied which would have been needed to tighten the joint, the graph can be rejected, Mr Savini said.

ENGenious – data analytics session

A conference session on data analytics at Aberdeen's ENGenious forum on Sept 5 looked at better ways to work with data, with speakers from Maana, Energistics, Brainnwave, OGTC and Accenture

A conference session on data analytics at Aberdeen's ENGenious forum on Sept 5 looked at better ways to work with data in the oil and gas industry with speakers from Maana, Energistics, Brainnwave, OGTC and Accenture.

Jeff Dalgliesh, director, oil field digital transformation, with Maana explained how his company helps oil companies fit all of their data together, in what it calls a 'computational knowledge graph' or a model. It means oil companies can start thinking like intelligence agencies, in the way they draw together a web or map of the available information, showing how it links together.

Mr Dalgliesh is formerly global drilling and completions information services team lead at Chevron, where he worked with drilling automation systems and working with data exchange and data model standards (WITSML and PPDM).

Connecting data in different ways provides a different perspective on what is happening. For example, you can see the job history of a person, brought together from seeing their names on multiple drilling report. You can see a drilling project by timeline, including activities related to equipment, people or regulators. You can see different wells listed by production potential, he said.

The system can find out about different 'entities' and extract them out of multiple documents, for example find about different wells where a certain chemical was used, or there was an H_2S problem.

For example, in an analysis of drilling jobs for one oil major done between Jan 2010 and May 2015 on multiple rigs, accounting for 169 years of drilling data in total, you could see there is a huge link between consistency, safety and excellent performance.

One challenge is putting together lots of old unstructured data to get a picture of what is going on, with some drilling departments having data for wells going back 80 years.

As an example of how it can be done, Mr Dalgliesh showed a YouTube video of The Venice Time Machine Project (online here https://youtu.be/uQQGgYPRWfs or at this web page https://vtm.epfl.ch).

The project team is aiming to build a picture of how Venice changed using documents covering 1000 years. The project started with scanning documents, then looked for common elements between them, and patterns, so it was able to build a digital twin or "virtual time machine" of what Venice actually looked like in any year.

The oil industry has a similar challenge, with many manually written comments and notes. One oil major counted 20m "well site comments" in its databases.

The oil industry's text is not as hard to read as general English, because it has commonly repeated terms, and specific information such as well name, date, mud weight, depth, common oil and gas terms, which a computer can pick out. The Maana software can be trained to understand common drilling terms, such as POOH means "Pull Out of Hole".

Once the terminology is understood, the notes can be much simpler than normal English for a computer to understand, because they can all be written in a common way

The computer can be trained to automatically recognise documents, such as a directional drilling reports, Mr Dalgliesh said. The algorithms can be trained to recognise different "events" in the documents. It is better if it is trained on the customer's own data.

Ross Philo, Energistics

Ross Philo, CEO of data standards organisation Energistics, emphasised that data standards can make a big contribution to data quality, which is very important if you want to get benefits from data analytics.

Energistics sees itself as an organisation which supports people from industry to develop standards, rather than an organisation which develops standards itself, he said. Its most widely used standard is WITSML, currently used on 85 per cent of offshore drilling projects around the world.

The company recently launched a system to support much faster data streaming, "like Netflix", called Energistics Transfer Protocol (ETP). As a result of this, some oil companies are seeing less need to send staff offshore, because they can get the data so fast onshore, it can be monitored just as well from their offices.

Having data in standard formats also makes it easier and faster to put together and assess. Engineers and geoscientists can still spend 60 per cent of their time compiling and assessing data, he said.

Data quality would be easier to assess if there were detailed records with it, such as its source, what sensors generated it and if they were working properly, and then what happened to the data next, what software it was manipulated

with, and who did it, he said.

One area it would like to improve is to have a standard way to record time together with drilling data. Too often, drilling data is developed by multiple contractors all with a different time reference, which makes it much harder to put together. The problem could be solved if an oil company specifies that al contractors must use the same time reference, such as from a GPS.

Brainnwave

Brainnwave, a company based in Edinburgh, offers services to help companies identify commercial opportunities, by compiling data from different sources together, with the motto "uncovering hidden opportunities within your data".

The company's CTO and co-founder, Graham Jones, formerly led development teams building data management systems for big companies and worked as a consultant to the US FBI and DARPA (Defense Advanced Research Projects Agency).

Steve Coates, CEO, Brainnwave presented a case study of how Brainnwave works with Aggreko plc, a supplier of temporary generators, to develop automated tools to help it identify good customer targets.

For example data can be analysed to look for prospective clients in the mining industry, taking into consideration the size of the company (smaller ones may be better), the commodity being mined, whether the customer has a debt, and the distance to a cabled power supply.

The system has algorithms to reduce duplicates, for example if it identifies that some opportunities have very close co-ordinates geographically, indicating that they are probably in the same place.

Mr Coates emphasised that marketing successes can be very important in data science. One example is the US National Geospatial Agency, which got very little attention until it played a key role in helping find Osama Bin Laden.

Stephen Ashley, OGTC

Stephen Ashley, Digital Transformation Solution Centre Manager with the Oil and Gas Technology Centre (OGTC) in Aberdeen, divides OGTC's digital projects into "fixing today" and "transforming tomorrow".

Under "fixing today" it includes methods to use digital technology to improve recovery, such as getting a better understanding of small pools, doing more remote (unmanned operations), working better with AI and big data, using robotic systems and composite materials. Also more advanced inspection technology (such as drones) and virtual reality for learning.

Under "transforming tomorrow" it puts a move towards a service orientated business culture, with perhaps more focus on hydrogen power, more focus on carbon, and more unmanned activity.

OGTC spent 18 months trying to decide which projects to target, distilling the different projects to six themes, with broad agreement that some technologies would be necessary. For example, all participants agreed that carrying a tablet computer offshore is not very convenient, so the means of delivering data to offshore workers is likely to be "some kind of voice activated type thing". There was also a recognition that local wireless communications networks on offshore platforms would be necessary.

It has one project to look for overlooked pay, analysing well log data to try to find opportunities which may have been missed. It took proposals from 77 different companies for the project, and picked four.

Another analytics project looked at marine logistics, working through a year of North Sea shipping data supplied by operators, to see how many times vessels are shared between operators. The analysis showed that nearly all the time, vessels are just going from land to one platform and back again. "There are perceptions we do vessel sharing but data shows we're not doing much."

A third project looked at setting up a shared supplier information repository, working with technology company ShareCat, and operators / contractors Shell, BP, Petrofac, KBR and Wood Group. It could potentially reduce procurement costs by 90 per cent, he said.

There is a big focus at OGTC on how to train existing domain experts (such as geoscientists) to do more with data science, he said.

One challenge is persuading people to spend more time thinking about how they will use the data to improve their business and make better decisions, rather than spending time on making nice visualisations, he said.

The data science discipline

The panel had a discussion about the best way to develop data science in oil and gas as a discipline – and what skills the industry particularly needs.

Jurgen Weichenberger, senior principal, data science, with Accenture

Jurgen Weichenberger, senior principal data science with Accenture, chairing the session, said that there is a role emerging of "industry data scientist", who knows how the industry works, and can talk to clients about it.

Companies like Accenture aim to have data staff with both business understanding and a depth of experience, Mr Weichenberger said.

There is also some crazy talk about salaries, Mr Weichenberger said. People with no experience and a PhD in the US are asking for $100,000 salaries, and are still not able to provide any useful contribution to the business. Europeans are copying the US example, except now asking for £100k salaries instead of $100k.

So it is not surprising companies are looking much harder at teaching data skills to people who already understand oil and gas and have some problem solving capability. Such a person can typically learn Python in 6 weeks, he said. With machine learning, the necessarily knowledge is typically around the specific software package which is used. It can be complex putting different software packages together.

Brainnwave's Mr Coates said that there are Phd data scientists with fairly narrow specialist expertise, such as in deep learning, neurolinguistics programming or computer vision. But businesses don't tend to have narrow and deep problems. And data analysis requires that people are "engaged with the business" or a lot of time gets wasted.

Mr Coates noted that while many data specialists prefer to work in academia than industry, academics are increasingly being asked about their 'impact scores' in their quests for funding – and having a better score largely means working with industry.

Geologix's Julian Pickering said that while we definitely need data scientists, "if you use data analytics the way I showed, you need domain experts," he said. "If you just have pure data with no context it is very dangerous."

However companies should not believe that domain expertise is everything. Maana's Mr Dal-

gliesh recalls asking a driller what he thought were the main factors influencing cost of the well, and the driller could only answer "depth".

Breaking up monolithic software

Companies are increasingly looking to move away from the big 'monolithic' software applications, and instead use a range of smaller software applications, perhaps running in the cloud, said Ross Philo from Energistics.

Oil companies may decide they want to use a mix of different algorithms from different software – a bit of Schlumberger and a bit of Landmark. So the big software packages will need to split into microservices.

Accenture's Jurgen Weichenberger said he had been involved in one project where finding a result would need data from many different data sources and software. Some of the software companies resisted it, saying that they would only allow their software's data to be viewed in their own software.

A solution was developed which would work 80 per cent of the time, but with the critical data set unavailable. The oil company eventually negotiated a fee of "several millions of NOK" with the provider of the software which was locking up this critical data set, on the basis that the potential savings from having the data unlocked were even greater.

Oil companies may bear this experience in mind, when making purchasing decisions about software applications in the future.

Mr Weichenberger noted that many oil companies are increasingly working in an integrated way with academia, and using open source software, rather than in the past where only supermajors had the budgets to buy the software products available and customise them. "The industry has reached a point to go away for narrow closed loop products to open platforms," he said.

Getting a job

A delegate asked if the panel had any recommendations for how to get a job in data science. The person had a background as a reservoir evaluation engineer at Schlumberger.

Jeff from Maana suggested to "learn some basic AI" – find some public data sets from a domain you understand, and try out analytics / machine learning tools on it.

"I'll take a domain expert with a little bit of data science any day over a data scientist," he said. "If you already understand it, you're very unique. That's what employers like to see."

OGTC's Stephan Ashley noted that there are not enough data scientists with energy expertise to meet the demand. "If you have experience and some data science skill, you'll find a job," he said.

Accenture's Mr Weichenberger suggested making sure you have the right words on your CV. If you say you know how to program in languages like C and FORTRAN, an employer will believe you can learn whatever else you need to know.

The oil and gas industry needs people who can work out how to create business value, and interpret results and know if they make sense, not do "deep Bazean algorithms", he said. Someone who can interpret output of machine learning in the right way can warn people of a problem earlier.

As an example, one operator of an LNG compressor train had an incident which cost $100m, although it was collecting large amounts of data. "The CEO said, 'I will lose $100m once – now you find me the people who can interpret the data,'" Mr Weichenberger said.

Beyond Limits

AJ Abdallat, founder and CEO of California AI company Beyond Limits, sees AI as being in a pyramid with data analytics at the base, with data science, then deep learning, then cognitive reasoning above it.

By cognitive reasoning he means "actionable intelligence", which tells you what to do, not just what is going on. "We believe AI should be in everyone's office to magnify human talent," he said.

The company's technology grew out of work done by the NASA Space Program, trying to develop 'human like reasoning' for the "Curiosity" car sized rover, which landed on Mars in 2012.

In 2017, the company received $20m investment from BP, which was looking for tools to support BP decision makers, including with monitoring the health and maintenance of wells, and autonomous pipeline inspection. It also wanted ways to make expertise from a few individuals available to the whole organisation, by embodying it in digital tools.

Together with BP, the company is looking to develop what it calls 'physics based AI', or AI based on physics.

To illustrate what this means, Mr Abdallat told the story of the May 2016 collision between a Tesla in autonomous mode and a truck.

It was a "black swan event", with the sun hitting the sensors on the Tesla in such a way that it made the background impossible to see, and a truck painted white, so the system could no longer see a truck. So the autonomous driving system gave the vehicle instructions to change the lane.

However the system could see the truck a few moments before.

A physics based AI model could have informed the system that it makes no sense in physics for a truck to go to 'no truck', Mr Abdallat said.

Saudi Aramco's Saeed Mubarak – reality different to PowerPoint

You can make great PowerPoint slides about how you are doing big data and analytics – but it ends up very different when you try it on real data, said Saeed Mubarak, intelligent fields Champion at Saudi Aramco, speaking at the ENGenious forum in Aberdeen

Saeed Mubarak, intelligent fields Champion at Saudi Aramco, emphasised that the world of PowerPoint can be very different to reality, when it comes to analytics on real data.

Mr Mubarak says he has never seen a technology that "fails by itself". When technology implementations fail, it is always due to other elements – people and process – rather

than technology.

Rather than talk about 'intelligent fields' it might be better to say that people are 'managing fields intelligently', he said.

There is no "one size fits all" in digital technology, Mr Mubarak said. And just like with cooking, using the same ingredients doesn't always produce the same results. You have to make sure you pick the right technology, and make sure it is aligned with the strategic goals of the company, such as to maximise oil recovery, enable sustainability or minimise cost.

To consider how 'intelligent field' digital tools work in reality, consider a well which goes to 2km depth then branches into three laterals, with valves and gauges in each lateral, enabling flow to be opened or choked to varying levels. The valve is a "sliding sleeve" type, powered by hydraulics from the surface.

There are multiphase flowmeters and pressure sensors on each lateral, sending data via a control system to company headquarters, finally to an engineer's desktop. You discover that if all valves are open, the entire well only produces water. The question is how the valves should best be set to maximise production.

You can't solve this problem just with a data scientist, because only a domain expert would understand what the data is actually saying, and have a sense of the confidence level at any point.

A domain expert can work with the data to understand that lateral A produces only water whatever the choke setting, Lateral B produces oil when partially open, and lateral C produces both oil and water, but at a more closed choke setting, will only produce oil.

Coming up with the right setting took a team a whole week, with people in the field and people at headquarters, taking into account an understanding of the completion, the rock, and the water injection and its sweep efficiency, Mr Mubarak said. It was not the data or the well which was "intelligent" in this example.

The intelligent fields technologies are not particularly cheap – it can cost $100k to install a downhole gauge, and $1m to change it.

Saeed Mubarak, intelligent fields Champion at Saudi Aramco

The technology itself is often the least value adding component. There is more value in the ability to optimise a system, and helping the people working on it to adapt to working in a new way.

Yet when people working in the field are asked where their expertise lies, they are far more likely to say they are expert in technology than say they are expert in change management.

Meanwhile the lack of tolerance to change, and other organisational challenges, are the reasons why the industry is not getting maximum value from digital oilfield.

Digital transformation with the Aberdeen Chamber of Commerce

The Aberdeen and Grampian Chamber of Commerce held a 'business breakfast' on digital transformation in Aberdeen on Sept 4, with speakers from EY, Servelec Controls and Return 2 Scene

Companies should be wary of putting all their emphasis on output, judging people just on what they have achieved, because that can push people into protectionist behaviour, said Gemma Noble, insurance partner with consultancy firm EY, speaking at a Aberdeen and Grampian Chamber of Commerce business breakfast on 'digital transformation' on Sept 4.

It may be useful for the industry to explore "robotic process automation", where a software tool is developed to do simple administration steps, which would otherwise be done by a person. The insurance industry has "had cost reductions of 25 to 40 per cent with RPA," she said.

Running "sprints" have proved very valuable, to see what people can do in a limited time, such as a week. One sprint developed a robot software tool which could do 35 hours of someone's work in 15 minutes, at a cost of £50k. "More than anything, make a start," she said.

Servelec

Ronald Holden, divisional director with Servelec Controls, said that a common problem is oil and gas companies trying to do too much with the data, before they have the basics right.

Their data is still chaotic, with systems configured or tagged in different ways around the company, unreliable data collection, inconsistent measurements and units.

The "second base" could be the ability to assess the quality of data, or separate good quality from bad. Only then can you get to the "third base", the ability to do statistical analysis on it, make recommendations and notifications, he said.

One client wanted to install a vessel monitoring system, but after getting some way with the project, realised that a lack of consistency in their data meant that serious fixes needed to be made, delaying the project for a month.

In hindsight, Servelec, as the supplier, could have pushed more strongly with the client to get this sorted out at the beginning, Mr Holden said..

Return to Scene

Bob Donnelly, managing director of Return to Scene, emphasised that "digital transformation" means using "digital technology to solve their traditional problems, and they prefer the digital solution to the old solution". It does not mean the industry has fundamentally changed in what it does.

Return to Scene develops 360 degree digital imagery, onto which maintenance data can be superimposed, enabling someone to get a view of an offshore platform or other location without having to be there.

The technology was originally developed for police work. It did its first offshore project on the Foinaven platform in 2007. Now the photography covers 136 oil and gas facilities, and has 11.5m photos.

Digital "needs to be led by people who understand it" – Accenture's Andrew Smart

Digital technology has far more of an impact than just relocating roles, says Andrew Smart, a managing director who leads Accenture's Energy business it is about operating faster and better. But it must be led by people who understand it.

The changes digital technology implementations make to the oil and gas industry are far deeper than simply moving. some roles from offshore to onshore, as happened in the first round of 'integrated operations' projects, says Andrew Smart, a managing director who leads Accenture's Energy business.

We are talking about different ways of operating, with better use of data and a wider range of computing capability.

We "are at a point where we can imagine doing things differently," he said. For example, changing where in an organisation certain decisions get made.

The fundamental way the industry works – exploration, drilling, production, operations – will not change, of course.

But there can be a "different set of operational characteristics," he said. For example, companies could change the way they do engineering, so it is much more standardised and simplified, with more modular implementations, leading to more predictability in how projects are executed.

The industry could also become much more integrated, rather than operate in disconnected silos.

A big challenge with digital technology in the oil and gas industry remains getting systems deployed at scale (throughout the company), after they have been proven to work in a single project. For example, companies develop a new way to do maintenance inspection but then don't use it everywhere. Projects can compete with other projects for attention.

"I would say the industry is still not at the point where it knows which ones it wants to scale and has a ready mechanism for scaling them," he said.

Andrew Smart, a managing director who leads Accenture's Energy business

The industry has formed a consensus that digital is important and "we need to build real understanding and capability," he said.

As an organisation, Accenture is focussed in helping organisations get clarity on how they can fundamentally transform to boost efficiency and agility, he says, as well as helping them understand what the key concepts are, what new organisational constructs are needed, including process and standards, and how to take advantage of proven concepts. Getting there "requires leadership engagement and determination," he said.

Working better

There can be efforts to "increase the clock speed of operations," doing everything faster.

Here, there are lessons to be learned from the unconventional oil and gas industry, which has a different culture and attitude, one that is more cost-conscious and operationally-orientated, he says.

One difference between the unconventionals and conventionals industries is that the pressure to change can be higher, with investors expecting better returns on shorter-term time horizons, and continuous improvement in performance.

There is also higher competitive intensity in the unconventionals sector, with investors looking to support those companies who can make the most money out of their capital and deployments, he says.

As a result we have seen "a sharper and more dramatic overall performance trajectory in unconventionals than we've seen elsewhere."

The US unconventionals sector has used technology to its advantage. Although it isn't necessarily true to say that the unconventionals sector is more "digital" than conventionals, he said.

The unconventionals sector can work on shorter cycle times than in conventional environments, which means that companies are under pressure to show performance within a timeframe of perhaps a year. This pressure means that people cannot lock themselves away easily in silos, he said.

Across the upstream sector, the pressure to improve productivity and efficiency is mainly applicable to drilling and operations domains, rather than exploration.

But explorers should not be left out. Digital technologies "offer cost and performance improvement to all forms of analytical activity, of which exploration is clearly one," he said.

Digital improvement managers

Mr Smart's idea is that companies could employ "digital improvement managers", with a brief to look for ways that companies can improve their processes and standards, backed up by technology.

They would understand what technologies are available. They would keep up to speed with changing technologies and what is possible, including knowing what is happening beyond the industry.

A common mistake is that people believe that all they need to do to get the benefits of technology, is to deploy it.

"It is not simply a matter of adding additional technical resources, AI capability, or design thinking based skills," he said. "It is about engaging the whole workforce and even more importantly the leadership in new ways of working. And it will certainly require some new skills.

Some oil companies are already trying to set up this sort of capability in a centralised way, making different technologies available to their managers and leaders.

Understanding all the digital technologies can be like "horizontal rain", with so much more to know, he said. "So much has been written and published on every dimension of the digital potential."

Companies need to consider whether to invest in a new solution, knowing that if they wait a little longer, there might be a better version on the market. So the decision making can take a great deal of expertise.

If digital improvement managers are enabled, they could also keep track of which technologies are providing crucial benefits, because it is not always obvious, he said.

Bringing analytics to the control room

Sometimes control room people need 'analytics' – or deeper insight into what is going on than their control systems tell them, for example, a warning about an emerging problem, said Julian Pickering, CEO of Geologix Systems Integration.

"Analytics doesn't need to mean petabytes of data, the important thing is to understand the physics interaction of what is going on. Analytics can present data to reveal information not immediately apparent. Perhaps things that look disconnected are not," said Julian Pickering, CEO of Geologix Systems Integration.

As an example, consider a gas cooling system, with heat exchangers and a cooling liquid. Over time, the heat exchanger plates will gradually get fouled (dirty) so they are less effective at transferring the cooling. The system will see that the outlet gas is warmer, and pump more cooling liquid through to compensate. No alarms are sounded and the control system operator does not necessarily know.

Over time, the heat exchanger fouling gets worse, and the pumping rate of the cooling liquid gets higher. Eventually, the cooling liquid is pumped at its maximum flowrate, the system is unable to do anything more to cool the gas, the gas is not cooled to the desired outlet temperature, the alarm sounds and the whole system shuts down, leading to enormous cost.

Julian Pickering, CEO of Geologix Systems

It would have been much easier to fix the problem earlier, when there was only a small amount of fouling, similar to how it is much easier to unblock a sink when it only has a partial blockage, he said.

Any system for an operator needs to be simple to use. "People have a lot of pressure and responsibility on them. Anything which slows them down is seen as negative," he said. There's a danger from giving people too much data.

Any warning must be given early enough to enable someone to make a decision with it.

The data must be clean. "Decisions are only so good as quality of data. If errors creep into data they proliferate through the system," he said.

The analytics system needs to either be embedded in the operations system, or to sit alongside it. It must also show people what they need to do, not just tell them what is happening. It needs to be very usable, perhaps not needing an instruction manual.

A similar approach could be applied to other scenarios where problems develop slowly, such as non-productive time in drilling, kicks in drilling, premature bit wear, loss of drilling fluids and wellbore instability, availability of critical equipment.

Some companies manage losses by adding in safety margins, but "it tends not to be the way to operate in the modern world," he said.

PPDM – Improving Trust in Data

"Many companies are investing in data analytics but soon discover that their data quality is not good enough to get the most out of them – and a discussion about data quality quickly gets to the toughest subjects, trust and standards," said Trudy Curtis, CEO of the PPDM Association.

"Many oil and gas companies have spent large amounts of money on analytics software based on promises of better drilling prospects or improved efficiencies," said Trudy Curtis, CEO of PPDM. "They quickly discover that their data quality is not good enough to run the analytics properly. A discussion about improving data quality gives rise to two very tough subjects; how to get people to trust their data, and what kind of standards are important to building trust."

PPDM, the Professional Petroleum Data Management Association, based in Calgary, started a standard data model for upstream oil and gas , and has grown to lead the industry's development of semantic and data quality standards for data, and data management as a recognized professional discipline. Ms Curtis was speaking at PPDM's London Luncheon on September 6.

The overall objective, Ms Curtis said, could be described as turning data management from a "Me" world, where companies only do work which is in their interests to do, to a "We" world, where the industry works together to keep data well managed, and treat data as a strategic business asset.

"When people lose their trust in corporate data, or the data received from third parties, it isn't enough to just "fix" the data – you need to find ways to get that trust back," she said.

At the same time, there is a big move to bring more data analytics tools in the industry. Companies are hiring data scientists. But often the data scientists don't understand the data they are working with, and, often encounter problems with data.

Ms Curtis defines three mechanisms for building trust in data – subjective (e.g. someone has a personal knowledge about the data, discipline centric knowledge (experts in the appropriate data domain have sufficient discipline knowledge to assess how trustworthy data is), and objective validation (in which rules to assess data trust have been established, measurement of the data against the rules has been completed, and the results are included with the data).

Standards and practises

"The best way to build trusted data is to make sure the data is developed, used and transmitted in alignment with the factors that build trust – which means managing it according to industry wide standards," Ms Curtis said.

And studies have shown that it is typically much more expensive for a company to develop its own standards for data than to follow industry standards, such as the ones developed by PPDM.

'The trust in data can return when the data is seen to be consistent with appropriate expectations about what "good data" should look like," she said. "Industry needs to follow standards and best practises. PPDM helps develop and

share knowledge about what those best practises are."

"The accounting sector has, largely, managed to develop standard ways of doing things, which leads to widespread trust in accounts data," she said.

Proper use of standards can prevent data quality degrading over time, as it is moved, absorbed into other calculations, or as the sources are lost. "Capturing meta data about the provenance and quality of data is critical", Ms Curtis said.

PPDM's data model includes fields for holding metadata about how the data was created, and what audit process it was put through, who did the work on it".

Business rules

Companies often use data rules to try to maintain data quality, the data rules "tell us how well-formed data should behave and why," she said.

For example, the deepest depth of a well must be greater than the deepest depth of a well log made in that wellbore. But if the well log appears to be going beyond the bottom of a well, it raises another question of why it is wrong – has the wrong wellbore been logged, is the log associated with the wrong wellbore, or is there damage to the tool?

PPDM has created a global repository of data rules, and continues to expand the reach and depth of the rules. It is asking companies who develop data rules internally to share them.

Status codes

People create status codes for well status like "plugged back, no perforations" – an example from the State of Louisiana is online at http://bit.ly/wellstatus

But these status codes can create confusion if it isn't absolutely clear what they mean, and there is a possibility that important information may be implied.

PPDM has created what is known as a "faceted taxonomy" for describing the status of a well or wellbore, where each kind of information is explicitly captured, for example the direction of fluid flow (if it is an injection or production well).

The process can be called "disambiguation" – understanding that people don't all mean the same thing by the same word, she said.

Developments at PPDM

PPDM has set up three "professional development" subcommittees, looking at careers, the "value proposition" of a data manager, and a professional development catalogue.

There is also a PPDM led Regulatory Data Standards Committee, which works to help regulatory agencies converge on some standard 'language' , such as a disambiguating definitions of the word 'Completion'.

Well managed data ideal for data analytics

"Data which was well managed in the 'old' or pre-analytics world is very suited to the 'new world' of data analytics," said Jamie Cruise, president of digital services with Target Oilfield Services.

It will be well looked after, stored using open standards rather than proprietary formats, and not wedded to any particular software.

Trudy Curtis, CEO of PPDM, speaks at the London Luncheon on September 6

Mr Cruise noted that it is becoming much easier to convince people to spend money on data than in the 'old' world – particularly after the Economist magazine's cover story "data is the new oil" in May 2017, people recognised the value in it, and universities wanted to do data studies. Today, Target is "getting the most interesting projects we've ever had".

People are starting to think beyond silos, and looking to get all of their data in databases, Mr Cruise observed. They are also trying to automate more business processes.

The cost sensitivity has also come of help. Mr Cruise's former company, FUSE IM, struggled for many years trying to get established as a foothold in the oil and gas information management ecosystem, dominated at the time by Schlumberger and Halliburton's Landmark. But a couple of years ago, companies became more cost sensitive, providing an opportunity to gain customers.

In 2014, FUSE IM was acquired by TARGET Energy Solutions of Oman.

New types of unstructured data

When companies talk about unstructured data, they are no longer referring to PDFs and other documents; they are talking about data lakes and large clusters of 'unstructured' content, said Kay Sutter, Product Specialist, EDM for Energy, at IHS Markit.

While the digitalization of data provides new storage and access mechanisms, it does not address the issue of data quality, said Sutter, so you still need robust data management.

IHS Markit provides the Enterprise Data Management (EDM) for Energy software, which can consolidate data from vendor data subscriptions, large software tools like Kingdom, OpenWorks and Petrel, and proprietary systems. EDM for Energy cleanses, validates and pulls all the data together on a central system. This means you can compare data, spot problems, getting different data sources working together. You can translate data into different formats or enrich it.

EDM for Energy can run on any data model, including PPDM's data model.

IHS Markit sells services together with its software licenses, to help companies get running. 14 oil and gas upstream companies are using the software, and IHS Markit offers EDM for other industry sectors as well as energy, with the largest customers on the financial side. There are 250 staff within the EDM business.

Silixa – what you can do with more sensitive well fibre optics

A distributed fibre optic sensing company Silixa has been exploring what you can do with more sensitive fibre optic cables in wells – including using them to track fluid flow, detect strain in wells, and monitor fracs

A distributed fibre optic sensing company Silixa has been exploring what you can do with more sensitive fibre optic cables in wells – including using them to track fluid flow, detect strain in wells, monitor fracs, and understand neighbouring walls.

The advances are helped by Silixa's Carina Sensing System, an engineered fibre optic system, which uses a special fibre optic cable which has much brighter light scatter. The system has about 100 times higher sensitivity than the predecessor system, the intelligent Distributed Acoustic Sensor (iDAS).

The systems have been used to detect strain (pressure changes) in the overall formation or wells, for example to detect possible changes in caprock integrity. This because small changes in pressure show up with a different light scatter pattern.

The system has been used as flowmeter, because different flow rates of fluid through the well will make a different acoustic signal due to different eddies (vortexes) in the flow.

The cable can be wrapped around pipe to form a flowmeter, which does not require any inhibition of the liquid flow (as a propeller flowmeter within the pipe would).

Silixa has a demonstration model, which it often shows at trade shows, with a fan blowing air through a pipe. There is a fibre optic cable laid along the pipe, which picks up a different acoustic signal depending on the air flow rate.

It is possible to detect the gas volume fraction of a liquid flow, from the different noise the fluid makes.

The system has been used to monitor hydraulic fracturing, with the acoustic signals analysed to understand how much frac fluid has gone into each frac cluster.

It can be used for microseismic analysis, recording where and when rocks have been fractured. This data can be put together with pressure data to see what pressure was required to fracture the rocks.

When used together with knowledge of the location of sound sources, the fibre data can be used to determine the speed of P and S waves through the rock, which can then be used in seismic interpretation.

You can use fibre in one well to monitor what is happening in a neighbouring well, and understand how one well affects another, such as frac in the neighbouring well increasing pressure in the monitored well.

The quality of the recording is similar to placing geophones on the well, says Mahmoud Farhadiroushan, Executive Director of Silixa.

Locating the cable

A common problem with fibre optic cables in wells is that it is impossible to know where the cable is located around the well.

This is important to know if you want to perforate the well (blast holes in it to allow fluid through). You don't want to perforate the cable.

Sometimes a well is perforated a number of years into its life, for example a well which passes through two hydrocarbon zones, has the lower zone perforated at the beginning of life of the well, and the upper one perforated when production from the first declines.

To solve this problem, Silixa has developed a disposable device, the Cable Orientation Beacon (COB), containing accelerometers which is attached to the outside of the casing, next to the fibre cable.

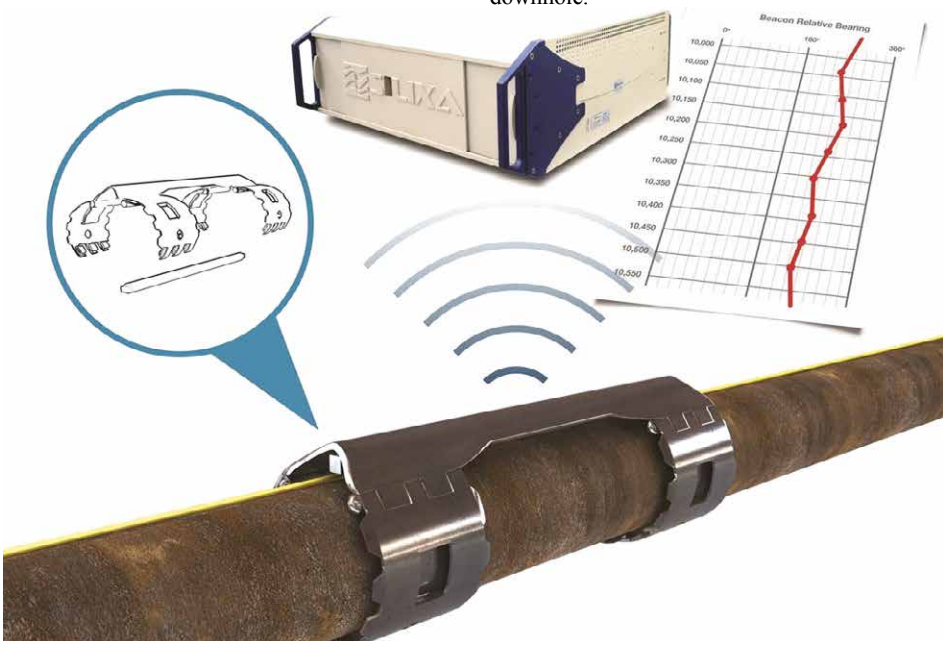
The Silixa device monitors how many times it has been turned as the casing is inserted into the well, so it knows its orientation. It then communicates this data with an acoustic signal (noise), which is picked up by the fibre optic cable, and can then be reverse analysed to get the orientation data.

The device does not make the acoustic signal continuously, it can be programmed to sound (for example) every 30 minutes, to conserve battery power.

The device can be programmed to only switch on when it reaches a certain temperature, thus conserving its battery life when the system is being installed.

Without this device, the only way to locate the position of a fibre optic cable was to encase it in a metal tube, which can be detected with magnetic sensors in the well. But this metal tube can obstruct the flow of cement around the well, leading to a poor cementing job, Mr Farhadiroushan says.

Silixa is considering developing the technology to install other sensors, such as for pressure or presence of certain chemicals, which might give useful data about what is happening downhole.



Silixa's Cable Orientation Beacon - enables you to keep track of where the fibre optic cable is placed on the casing, to make sure you don't break it in perforating

ABB – how to do cybersecurity on industrial systems

Industrial systems ("OT") cybersecurity requires a different approach to cybersecurity for the office – the dangers are greater, the threat is growing – but you can't lock the operators out of their systems. We interviewed ABB's head of cybersecurity in the UK

Industrial cybersecurity requires a different approach to office or IT cybersecurity.

The dangers are higher, with reports of attacks on safety equipment and ransomware finding its way onto offshore installations, so the hacking could cause a loss of life or disaster.

But at the same time, conventional approaches to cybersecurity, such as the "two failed password attempts and you're locked out" approach to preventing password guessing attacks, cannot be used, in case it leads to people not being able to operate systems when they need to.

Encryption, a common security measure in IT, is not necessarily appropriate for OT, because it can add latency – a control systems command to close a valve probably needs to be carried out immediately, not after a few seconds.

And conventional firewalls and virus detection systems are not designed to work with industrial protocols such as HART, IEC 60870-5-104, OPC or IEC 61850.

You can't just analyse the communicated data to detect threats, because a malicious command to shutdown plant equipment looks the same (in control system language) to a legitimate command.

The right approach to industrial cybersecurity can be described as all about understanding – knowing how your network can be breached, knowing what assets you have, knowing what data you are usually sending and who sends it, and what the normal pattern of communications looks like, says Ben Dickinson, recently appointed as head of ABB's team of industrial cybersecurity specialists in the UK.

Mr Dickinson previously worked at UK's National Cyber Security Centre (NCSC), part of GCHQ, and specialises in understanding unique challenges posted by securing Industrial Automation and Control Systems. ABB has recently expanded its cybersecurity team, adding another 20 roles.

Attacks on a petrochemical plant

In December 2017, the first publicly known cyber attack on a large safety system took place, on a (name undisclosed) petrochemical plant in the Middle East. It had the specific aim of disabling system safety functions, Mr Dickinson says, targeting Schnedier's "Triconex" safety systems. It reprogrammed the safety controller, trying to change safety limits in the system.

Ben Dickinson, head of ABB's UK team of industrial cybersecurity specialists

The attack was thwarted because some of the code it tried to run was defective, and caused the system to shut down. But whoever was behind it clearly knew what they were doing, and trying to create a catastrophic incident or harm to life, he says.

The attack was called Triton/TRISIS. The two names to the threat are due to two people discovering the attack at about the same time, and a protocol among cybersecurity experts that whoever discovered the attack getting naming rights, Mr Dickinson says.

What to be aware of

One of the first steps in doing cybersecurity on industrial systems is to understand how you are changing your vulnerability landscape when you digitise a system. For example if a retail petrol station installs tools to remotely monitor tank levels, the same system can be used to hack into the system and perhaps change the price it charges for fuel.

It helps if your systems are built as transparently and clearly as possible. Too many systems just end up with tons of data going through wires nobody understands, Mr Dickinson says. Cyber attacks often involve manipulation of data, so you need to understand your data in order to detect it.

The more sensors and data you have, the more complex your cybersecurity will be. Don't be impressed when companies tell you how much data their sensors generate a day – it is more important to know whether they are just collecting the data they need, and they understand it, Mr Dickinson says.

You need to make sure whoever implements the system knows how to implement it securely.

You need to be aware of whether your electronic devices are still supported by their manufacturer, issuing 'patches' if anyone discovers a vulnerability in their software. Otherwise, they need to be replaced, like with Windows XP computers. The idea of replacing equipment which seems to be working fine does not sit comfortably in the oil and gas industry, which is used to finding ways to extend the life of old products and systems.

Operational systems often use PC software (Windows) and so are vulnerable to the same threats, such as ransomware. But people trying to collect ransoms will often search for people they think will be most damaged by losing data, and so most willing to pay a ransom, Mr Dickinson says. They can see that if they can stop oil and gas operations, the company will pay a big price, so the oil and gas industry looks attractive to them.

Strategies for installing ransomware can include finding the name of a suitable target operations person on LinkedIn, guessing their e-mail address from company e-mail conventions, and sending a clever e-mail designed to get them to click on a link to install the ransom ware. "Humans are the weak link in your security system," he says.

Companies can do more to try to detect intrusions, rather than only being aware of attacks after they happen. Companies planning attacks can have communications on your system for a long time, so you can have time on your hands to carry out analysis.

Many organisations get a false sense of security from their antivirus, he said. But all antivirus can do is detect known malicious software. The best way to detect unknown malicious software is to look for unusual patterns in your communications, such as an unusual command, an unusual time of day, or a command sent by an unusual person.

LA12 – finding new applications for virtual reality

LA12 Ltd, a company founded by ex HP director of oil and gas Paul Helm, is finding new applications for virtual reality, including supporting virtual collaboration rooms, and helping children to learn

LA12 Ltd, a company founded by ex HP director of oil and gas Paul Helm, and working with established industry partner Geologix, has developed virtual reality (VR) models for an integrated operations centre, for clients in Australia and Canada. It is also experimenting with VR to support learning for children.

With an VR integrated operations centre, you can put together a 'virtual team' of experts, all looking at the same data, but working from any location, even their homes. Instead of the large screens commonly seen in collaboration rooms displaying data and information, the same objective can be achieved through immersive experiences with their headsets, Mr Helm said.

People can walk around the virtual environment and see their colleagues as avatars represented in that same virtual space. If someone talks, the other person can hear their voice on a headset and, with spatial sound, knows immediately where that person is within the virtual space and can then join them in reviewing the information they are commenting on.

Any sounds (such as from machinery) also have their noises adjusted by computer to take into consideration how far away they are from the listener in the virtual world, and how the sound might be attenuated by the distance if they were objects in a real world.

The system can construct virtual worlds of offshore platforms, taking data from CAD designs or LiDAR scans, for example, and annotating the model with real-time data from the control system or analytics packages.

It is also possible to have spectators watching what is happening in the virtual world, without actually joining in.

The system can support real operational decision making, providing better situation awareness.

It can be used for training or staff monitoring, watching how people are making decisions.

Schools

Mr Helm has developed similar technology for schools. A game was developed for 9-13 year olds, where they would be given a short list of instructions (pull the lower lever and dial "C"), told to memorise them in 10 seconds, then shown a dark screen. Then they were shown levers and dials in a virtual world.

This was a good way to teach them about situation awareness and virtual reality.

The children's teachers also observed how the system quickly brought out personal characteristics of the children which would otherwise take several months for a classroom teacher to identify, such as their spatial awareness or ability to follow instructions even though each child is only exposed to VR for a maximum of 45 seconds.

Demonstrating virtual reality: Paul Helm (left), founder of LA12 Ltd

The best way to mitigate cyber threats

Richard Holmes, head of cybersecurity services with CGI UK, shares his advice on the best way oil and gas companies can be prepared for the cybersecurity threat today

By Richard Holmes, head of Cyber Security Services, CGI UK

Richard Holmes, head of cybersecurity services with CGI UK

As companies focus on digitising every area, from supply chain to the back office to customer interaction, the potential for cyber security breaches grows.

The oil and gas sector is the second-most targeted industry by cyber threats. A recent survey from Siemens found that nearly 70 percent of oil and gas companies have endured security compromises. These breaches have resulted in exposed confidential information and even disrupted operations.

Unlike other industries, there is a broad spectrum of incentives for attackers, and a wide margin of risk for oil and gas companies. In recent years, cyber attacks have increasingly been designed not just to steal or destroy data, or even shut the plant down, but – in rare cases – to trigger explosions or create other dangerous situations, highlighting the sheer power and variety of attacks the oil and gas industry faces when it comes to cyber security.

But recognising cyber security as a risk is one thing: acting on it turns out to be quite another.

Research from CGI found that in 40 percent of utilities firms, the issue of cyber security makes it to the boardroom just twice a year – despite 56 percent of executives believing their IT system security may be compromised within the year.

Like most industries, attackers in the oil and gas sector can be financially motivated – but unlike most industries, attacks can also be motivated by politics, environmental concerns and even espionage between nation states.

Some nation state attacks can have a more disruptive impact on organisations, as it is not instantly known that the attack has occurred and as a result has long term impact. This can be avoided by good monitoring. Unfortunately, this is rarely the case as nearly 50 percent of operational technology attacks go undetected.

Attacks can also result in short term disruption, which has the potential to be very costly and challenging to rectify. Pipelines are especially susceptible to attacks as the pipeline networks are often much older. Historically, hackers were able to shut down the gas pipeline networks by interfering with just a few strategic interconnections. As organisations recognise increased cyber security threats, local utility and gas transmission lines are now designed with improved resilience to mitigate such risk.

From a financial perspective, CGI found that following a severe breach, share prices can fall by an average of 1.8 percent on a permanent basis. Investors in a typical FTSE 100 firm would be worse off by an average of £120 million – in extreme cases, breaches have wiped as much as 15 percent of affected companies' valuations.

But it is the prospect of attackers accessing 'the crown jewels' that is most worrying to oil and gas companies. Theft of geological mapping and reserves have the potential to be very damaging to an organisation and while companies have historically looked after themselves, increased integration has meant that they are sharing more and more data with third parties, further spinning the complex web of where data is stored and who has access to it.

All of this considered, energy companies, including E&Ps, pipeline operators and utilities, spend less than 0.2 percent of their revenue on cyber security. With cybercrime on the rise it is clear that the oil and gas industry has a lot of work to do when it comes to considering and managing cyber risk.

How

But the question remains, how? It is time for organisations to view cyber security as an enabler, allowing individuals and teams to use technology with confidence and encouraging an agile approach. It is important that organisations adopt a holistic approach to mitigating threat, including:

Appropriate governance: The case for introducing robust cyber governance is undeniable and urgent. Only by asking the right questions can senior executives understand what they know and what they do not know, where there is confidence and where there is not, where plans are prepared and where plans rest on hope. Understand and split responsibilities amongst business information systems, security and operational systems that manage and control production.

Know what can be stolen: knowing what data you have and who has access is vital in maintaining a comprehensive cyber security strategy. What are your major assets, and can they be stolen? Ensure due diligence when vetting third party suppliers and contracts. More importantly, conduct regular risk assessments and third-party audits.

Network monitoring: consistent monitoring is vital to ensuring that if there is a breach, it is addressed as quickly and efficiently as possible. This will limit the time data is exposed and minimise the breadth of damage.

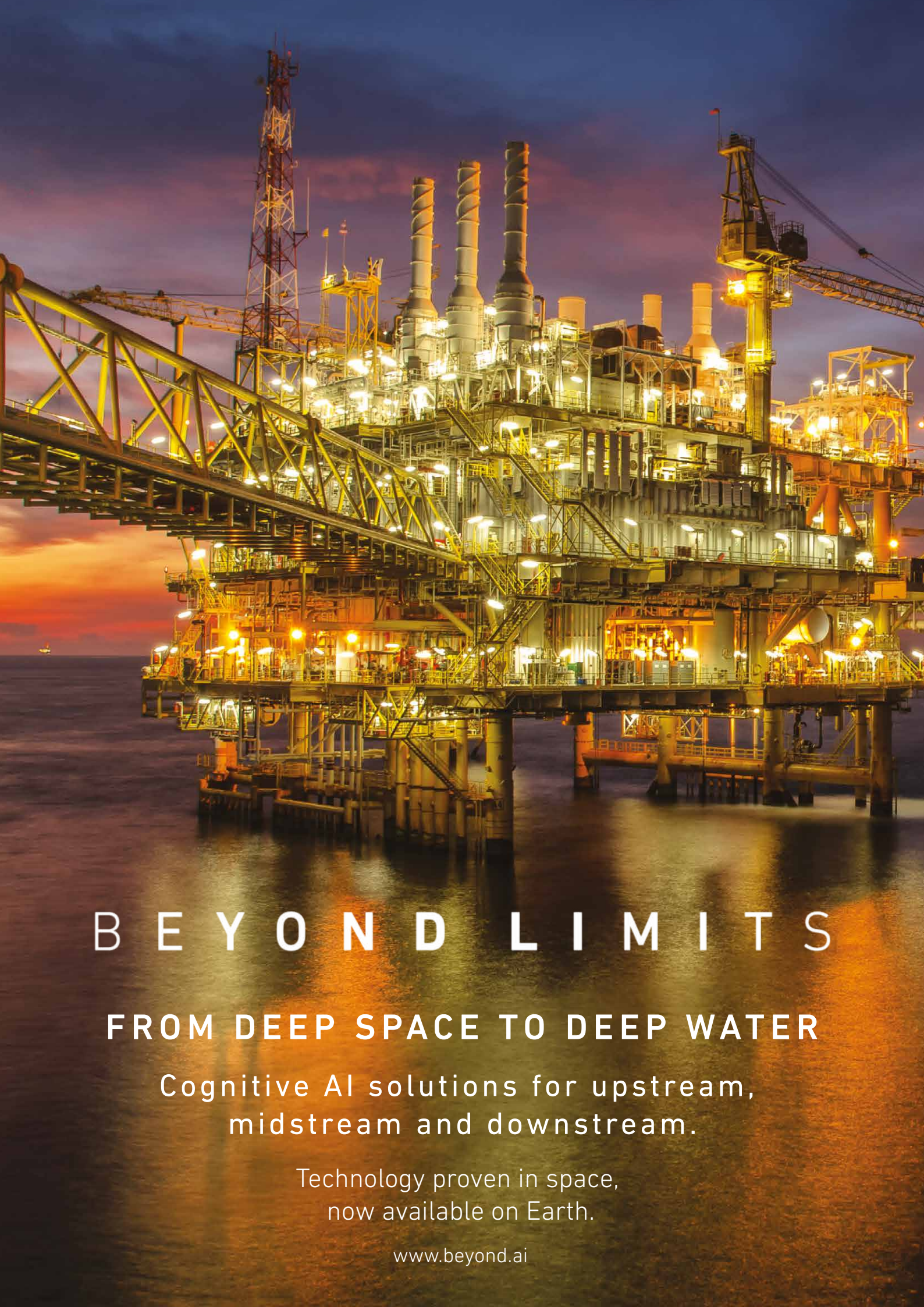
Practice incident response: having an incident response plan in place is not sufficient in preparing for the event of an attack. Companies must also carry out trials and exercises to ensure people are aware of their responsibilities and appropriate actions in case of a breach.

Know the legal and regulatory requirements: the birth of GDPR and other legislation means organisations need to know their responsibilities when it comes to managing their data. The consequence of not doing so can result in additional financial damage in the form of fines, and further reputational damage.

Technology is rapidly evolving, and as we move forward, machine learning and data analytics will continue to evolve the sophistication of monitoring and the prevention of potentially damaging breaches.

In addition to this, there was a recent proposal from the Energy Expert Cyber Security Platform (EESCP), suggesting the European commission encourage EU energy regions to share information on cyber security, as well as create a cyber response framework for the energy sector.

Whilst some progress is being made, it is critical that oil and gas organisations are investing and taking appropriate steps to protect themselves against cyber risk. As organisations begin to thoroughly evaluate their risk and prioritise cyber as an area for investment, the industry's response to cyber will strengthen.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