digital energy journal

journal

When senior managers discuss subsurface digital

Machine learning on geophysics data

ExxonMobil - using innovation to support human performance

Cybersecurity gets tougher for offshore operations

Finding Petroleum

Cover image: Aberdeen Drilling Consultants (ADC) has developed a software tool to gather data from inspection and analysis of drilling rigs. See page 13.

"Future of energy is electric and digital"

Dieter Helm, Professor of Energy Policy at the University of Oxford, observes that the macro trend in energy is for it to become more and more electric, and more and more digital, and often both at the same time.

He shared his ideas at the 2018 European Conference in London meeting of oil and gas standards organisation PIDX on June 5.

For example, the shale gas revolution was driven by advances in 3 technologies – horizontal drilling, seismic data and fracking. Of those, one is digital and another (horizontal drilling) is achieved with the help of digital technologies.

Electric transport and oil

A move to electric transport would mean a drop in demand for oil. As oil demand starts to reduce, it could have a big impact on investment in future oil and gas projects, because investors see that there may not be a demand for oil in the future at all.

Gas can run for much longer, since it is "pretty good for power generation" and "pretty good for making petrochemicals," as we have seen in the US, with the big switch from oil to gas as a feedstock for petrochemicals.

Some people are sceptical about how fast the move to electric vehicles will go, but you can see how much investment is going into the sector, he said. Some people say there are limits to batteries (manufacturing and mineral mining), but there are also "plenty of alternatives to lithium ion," for making batteries.

There are always people who say that you can't do aviation or shipping without oil, but there are companies developing solutions there too. One company is converting hydroelectric electricity into hydrogen, which is then pelletized to make a solid fuel for ships.

It does not mean that 100 per cent of oil demand will immediately disappear, but these are the changes which will happen 'at the margin', he said.

Carbon

But, "If you ask me we are going to make a switch [away from oil] fast enough to address climate change [I would answer] not a chance," he said. One university study estimated that a lot of oil would be 'stranded' by 2035. Dr Helm thinks this will probably not happen.

Bear in mind that very little has happened so far with reducing carbon emissions, except that Europe has moved some of its manufacturing to Asia, effectively shifting from carbon production to carbon consumption, he said.

Renewables and zero marginal cost

A problem which gas power generation faces, and renewables do not, is that, in an electric grid system where companies try to bid the lowest price to supply electricity, the agreed price is the cost of the last unit of output needed for supply to equal demand.

Renewable energy, unlike gas, does not have any marginal cost to provide a little more electricity, so long as there is surplus renewable capacity already built.

This destroys the economics of gas power stations, because the renewables sector will always be able to provide additional output cheaper than the gas sector can, provided that the turbines have been built. It means that no-one will build gas power stations without a capacity contract offered by the state (the state guaranteeing to buy a certain amount of gas).

To put it another way, investors will be reluctant to fund gas power stations when they don't know what the demand is going to be. "In this world, there aren't variable costs, just fixed costs," he said.

The business model for renewables can be 'project development businesses.' Revenues over the lifetime will be very predictable, so they can be securitised, like bonds, at very low finance cost.

The problem of intermittency in supply and demand with renewables could be resolved by various methods, including electricity storage (batteries) and demand side reforms (where electricity customers agree to reduce usage when they are asked to). By 2040, 2050, this "won't be a worry," he said.

When senior managers take an interest – EAGE panel discussion

A "digital transformation" panel discussion at this year's EAGE in Copenhagen showed how everything can change when senior managers take an interest in digital technology

A "digital transformation" panel discussion at this year's EAGE (European Association of Geoscientists and Engineers) in Copenhagen on June 11 showed how everything with digital technology changes, once senior managers take an interest.

The panel included the SVP E&P for North Sea and Russia with Total, the director of geoscience with Repsol, and the EVP technology with Schlumberger. Also a distinguished advisor for seismic imaging with BP and the head of the subsurface functional excellence group with Woodside (Australia).

The reason everything changes is because senior managers are primarily interested (or solely interested) in the organisations' overall performance today. Digital technology is a component of that, but so are people – whether good people can be recruited, motivated and continually developed. Probably, in their minds, people are much more important.

So they can see digital technology in a way which technology and IT people don't – as a tool to support people. They observe that the best business results often come from computers and people working together, maximising the strengths of both.

The aim of business is "to be the most efficient provider of primary sources of energy, not necessarily be in the forefront of machine intelligence," BP's John Etgen said. "If you want to be the most efficient provider of primary energy – you need ways to combine machine and human performance,"

They recognise the importance of making data more widely available to people, rather than locked up in software applications only available to a handful.

They recognise that advanced technology can play a role in making the industry more attractive to the top students, but also that the industry does not have to be a world leader in technologies such as cloud and AI.

They ask if technology is making work more enjoyable, such as helping test out the hypotheses which people develop. They ask about maximising the capabilities of the human brain. They ask how technology can do more to reduce the less interesting work, and they care about how easy the technology is to use.

They ask which vendors of technology are most capable of delivering this, observing that both gigantic cloud system vendors and small oil and gas specialist IT companies have something to offer which the traditional oil and gas large software companies and consultancies don't have. These seem like important questions but are not asked very often in the pages of Digital Energy Journal.

We heard how Total is evaluating where specifically analytics can add value to the business, in a program called "DAVE" (Data analytics Value Exercise, and also the name of one of Total's asset managers). The program found that the fastest payoff for analytics was in predicting production from wells.

We heard Repsol's director of geoscience and

digitalisation saying he sees data adding value to subsurface analysts similar to how it adds value for oncologists interpreting cancer images, where in experiments typically computers get it right 30 per cent of the time, people get it right 70 per cent of the time, and people plus computer get it right 90 per cent of the time.

John Etgen, seismic imaging distinguished advisor to BP, recommended that oil companies should not necessarily just look for the large IT contractors to solve their problems. "If you only look at big companies you will miss stuff," he said. "There is a whole ecosystem [of small IT companies] out there."

John Etgen, BP

John Etgen, distinguished advisor for seismic imaging with BP, noted that seismic data was the original "digital" part of the industry, being digital since 1955.

The 'digital' emphasis at BP today has three components – connecting people and data (and making data available to many different people across BP); connecting physical and digital assets (including reservoirs, wells and facilities); and connecting machine intelligence to business decisions.

There are about 50 machine learning experts and data scientists in BP's Houston office (out of a staff of about 5000), and probably their work 'touches' about 2500 people.

Mr Etgen stressed that you should not just go to big IT companies.
"There are things they are knowledgeable and capable in and have a track record," he said. "But if you only look at big companies you are going to miss stuff. There's a whole ecosystem out there [with lots of small IT companies]. The question is figuring out who to work with."

Ashok Belani, Schlumberger

Ashok Belani, EVP Technology, Schlumberger said that until now, most work in oil and gas has been structured around software applications – a large software package which includes database, processing and the user interface.

In the future all of these layers will be separated, with data kept in various storage systems, and made available all the time to different applica-

Senior managers at EAGE discussing digital technology. John Etgen, Distinguished Advisor, Seismic Imaging, BP; Ashok Belani, EVP Technology, Schlumberger; Darryl Harris, Chief Geophysicist, Woodside; Francisco Ortigosa, Director of Geoscience & Digitalization, Repsol; Michael Borrell, SVP E&P North Sea & Russia, Total.

tions. This brings about new capabilities.

The oil industry is still not able to work with all of the data that it has. For example, "We should be able to work with all the North Sea data, but we don't do that," he said.

Mr Belani thinks artificial intelligence could enable a computer to copy the way a person does a task. So a person could do 10 per cent of a salt interpretation, and that 10 per cent could be used to train the computer to do the salt interpretation for the rest of the data set.

It could be possible for computers to make decisions if you had a stack of technologies which together can work out all the parameters to make a decision. In this case, computing is an 'enabler' of the whole thing, performing tasks seamless to a user.

But today, an operator is directly pretty much every part of the task. "In the future system will do the task and serve up to the user."

Mr Belani said that for technology development, Schlumberger engages with many different companies. ""There is no way to keep innovation in house any more," he said. "You have to have an ecosystem."

Darryl Harris, Woodside

Darryl Harris, chief geophysicist at Woodside (based in Australia) and head of Woodside's subsurface functional excellence group, said that his company sees digitalisation as a drive to "collective intelligence", where it can have access to all of its company experience all at once. It means the company can be more data driven, with a "show me" [the data] rather than a "tell me" approach to making decisions. "We could make decisions a lot faster if we had this collective intelligence, make decisions based on data."

Francisco Ortigosa, Repsol

Francisco Ortigosa, Director of Geoscience and digitalization, Repsol, said that the company is keen to use digital technology to help reduce "time to first oil", and one component of that is the time taken to process data and make decisions around subsurface.

Repsol also sees that digital technology can help make work more enjoyable, similar to the way that people enjoy a new smart phone.

At the moment, the fragmentation of digital technology means that key decisions, such as to apply for licenses, do exploration drilling, are made on seismic interpretation, reservoir characterisation and so on, are not made using the core data.

Repsol sees cloud technology as a way to improve this. For example, until recently, only 12 people could directly access Repsol's supercomputer for subsurface data. Now, all of its 500 geology / geophysics professionals can access it through the cloud.

Mr Ortigosa also believes AI can make a big contribution to reducing "time to first oil". He showed an example of a seismic cube "interpreting itself," with a computer mapping out the faults and horizons in a few minutes.

Repsol plans to stop using the name IT and call it "operational technology" instead, emphasising that the technology is support the operations. IT has "a sort of history in every company," he said.

It will also employ specialist "data practitioners", handling everything related to data, including the infrastructure and cybersecurity.

Michael Dorrell, Total

Michael Borrell, SVP E&P North Sea & Russia, Total, said that company has a research budget of $1bn a year, and about 10 per cent of that is specifically spent on digital. That's about a third of its exploration and production research budget.

Mr Dorrell sees digital as all about the interface people have with the 'digital world' – which should ultimately "make the operator more effective, with better safety, having better performance and profit. That's what we are about as an organisation."

Total puts its digital development in three areas – "subsurface" (including drilling), "industrial" including platforms, pipelines, refineries and terminals, and "work practises" – how people work.

One of the most interesting applications for Mr Dorrell is when digital technology can help "flatten our organisations", by making data available to all staff.

Total recently embarked on a project called "Data analytics Value Exercise", to work out where data analytics could add value. The acronym "Dave" was also the name of one of Total's North Sea asset managers.

The most promising use was making predictions of production from "cyclic wells", he said. The project started three months before the conference (April 2018) and was expected to make a payback by July 2018.

Maersk Drilling [part of Maersk Oil, acquired by Total in 2018] had a long standing relationship with IBM to develop predictive drilling.

Total also has a collaboration with Google to try to generate "digital assistants" to help its geoscience and geophysics staff, automatically doing some of the number crunching and data sorting.

Mr Dorrell estimates that geoscientists typically spend about half their time doing repetitive tasks and about half their time doing value adding tasks, and it would prefer if the amount of time on value adding tasks could be increased. "So it is not just about digital it is also about people," he said.

The company has a special "digital officer" in the role of keeping a connection between the operations teams and the digital teams, working out if it is possible to develop solutions in different areas.

Cloud or not?

There were many interesting comments about the decision making process of moving data and software to the cloud.

Schlumberger's Mr Belani sees it as a one way street. "One way or another, most computer infrastructure will be in the cloud in future," he said. "You can take it slower or faster – the faster you move the better off you are. For each company to maintain its infrastructure is a thing of the past." In future, "no-one will own a HPC in their own."

Also bear in mind that the oil and gas industry's needs for cloud computing today are miniscule compared to the needs of industries such as social media. He estimates that the entire oil and gas industry only needs the equivalent of 0.1 per cent of the computing power which Google and Microsoft have. "For them, to handle this part for speed and performance is a piece of cake. We can let these industries invest in the cloud infrastructure and feed on it. "

In terms of security, Mr Belani believes that cloud companies will always have much more competence in managing a data centre safely than an oil company. "It is just like that, the rest of the industry doesn't have a shot at this," he said. "Gmail is one of the safest e-mail platforms in the world."

For standard computing requirements, it will always be cheaper to do it in the cloud than on your own computers. But it may be better to have your own computers if you have a special need, such as full seismic wave conversion on a computer with a ratio of 8 GPUs to 1 CPU. Woodside's Mr Harris agreed. "Sometimes in

oil and gas we get a bit arrogant. The IT companies have been working on something a lot harder than we have. We think we have better security than Google."

Mr Etgen portrays the cloud vs in-house discussion like the decisions people make about their own toasters or printers. Nobody cares about sharing printers, but when it comes to toasters, it is different. When we want toast, "you want it right now, exactly as you want it.

Taking the same argument to cloud, if you want to do very specialised research and development, you may find the ability to finely control your computer power as still valuable.

Recruitment

The panel was asked what kind of skills and young people they need. "That's easy, we want people who run towards problems, as simple as that," BP's Mr Etgen said. "Jobs are always changing. We want people curious, eager.

Also, "domain expertise is not going away. We'll want people trained classically and all that stuff. We need people who understand how the earth works – that's not going away. People who are domain experts but know how to play in the data science world."

There could be a trend towards even more specialisation, for example instead of being a geophysicist we will have subdomains of geophysics like "signal processing geophysicist. I don't know how you function with that many specialists. Perhaps people will need multiple skill sets," he said.

Repsol's Mr Ortigosa said there is something of a bidding war for data scientists, with stories about some making billions of dollars. "The people you recruit, they know this," he said.

Total's Mr Borrell said that the sort of people the industry needs are "obviously well qualified, but also the right mindset, open, inquisitive, looking for solutions, able to work in a collaborative environment, people who can concentrate on a new problem. We want people passionate about data, because they can find value for us."

As a starting point, you want "People with an education which enables them to fit into our organisation." But beyond that, you want people who can be "open, inquisitive, demonstrate they are open to change."

But oil companies also need people who are "absolutely passionate about rocks," like the ones he saw at a recent university talk he gave to geology students. "Reserves will be found by

people not machines," he said.

Mr Borrell believes it is important that companies like Total are perceived to be in the forefront of technology – in particular for recruitment reasons. The industry was in the forefront in the past, and has "certainly been caught up" by other industries now.

This view was echoed by Woodside's Mr Harris. "I think it is important we are leading in terms of attracting the right capability. "If you don't attract the right people they are going to go to places where they can see clear leadership."

Future of geoscientists and machines

The panel were also asked what they see as the future role of geoscientists, and whether they expect people to be replaced by machine.

Schlumberger's Mr Belani noted that a great deal of work is already done by machine. For example, machines are used to do the initial processing of seismic data, getting it to a point where a person can start to understand it, perhaps reducing the file sizes by 10,000 times.

It is very difficult for someone to make any understanding of the so-called "first break" raw seismic data. "People are going to find reserves that will continue for a long time."

The question is more whether machines can help make people more "performant", and perhaps also make their work more enjoyable. For example, a computer can enable a person to generate and test out more hypotheses, and provide better visualisation.

Another future concept is that computers will do most of the work, and people will be in a quality control role. But this is a continuation of something which has also been happening for many years, with people doing quality control of seismic, said BP's Mr Etgen. And also, "I can't say it's so satisfying as an occupation."

Computers can be more useful if they present information in a way which is easier for people to work with, or which "maximises our brain bandwidth," Mr Etgen said.

"The human's value is understanding what's really going on down there.

Not messing with mice and data. Our carbon based computer is actually really well suited to some of these problems"

Computers should be put to use going through large data volumes. "No-one ever looks at all the data we make, it's not possible," he said.

Total's Mr Borrell agreed that for now, and in the medium term, the company sees computers as a tool to help geoscientists to achieve more. "We are trying to take some of the grunt work out. "We're about people having time to create value from data."

Woodside's Mr Harris said that a computer could test out a hypothesis, but "Coming up [with a hypothesis] is still in the realm of the geoscientist."

"Maybe we get to a point where a hypothesis can come from a computer. I can't see that, it may be out there."

All decisions and work could be described as algorithmic, but the more complex algorithms can only be followed by people, not programmed into computers.

Repsol's Mr Ortigosa said he had seen a number of studies showing the strengths of computer plus machine, for example showing that a computer can diagnose cancer 30 per cent, the best oncologist, 70 per cent, together 90 per cent. So we should see something similar in oil and gas, empowering people with machines.

Note: the full panel is on YouTube at https://youtu.be/I5Y2ym1fP8I

"What we think we know" main barrier to North Sea exploration – Neil Hodgson

One of the biggest barriers to finding more reservoirs in the North Sea is a psychological one – people think they know everything, said Neil Hodgson, VP geosciences with Spectrum

"It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so."

This quote, attributed to writer Mark Twain, illustrates the main obstacle to finding more oil and gas in the North Sea, said Neil Hodgson, executive vice president of geosciences with seismic company Spectrum, speaking at the EAGE Annual Event in Copenhagen in June.

People think they know where all the oil and gas is – and their minds are closed to trying out new ideas, he said.

And in case you 'knew' Mark Twain said that line, Mr Hodgson pointed out that historians have never found any evidence that he actually said it.

Another illustration is that many people think they know that oil and gas will soon be replaced by renewables. But the data shows that there is still too much coal being burned for renewables to replace even the coal. Demand for oil is going up, requiring the discovery of the equivalent of another US oil shale play every 6 years, Mr Hodgson said.

In the North Sea, there is a reason to hurry in finding and developing new reserves – because otherwise fields will be decommissioned, and infrastructure will disappear. This will make it harder to develop new reserves, he said. What we really need to do is put what we think we know aside and try out new ideas.

There is a famous quote from Parke Dickey, a geologist who died in 1995, "several times in the past we thought we were running out of oil [gas], but we were actually only running short of ideas."

"Ideas" can come from new technologies, new play concepts, new commercial ideas, or a mixture of all of these.

One example is the development of stratigraphic traps, developed using sequence stratigraphy technology to better understand the rock layers, and using seismic to de-risk the places where there could be oil reservoirs.

Another example is the Norwegian Ekofisk field, which was discovered from someone's decision to drill a gas cloud in the middle of the North Sea, he said.

There are many such developments in the history of the North Sea, which all led to a jump in the available oil and gas – and before they happened, no-one imagined that they were possible, he said.

Mr Hodgson showed a seismic image from 1966, which was used to find the giant Brent field, although it was barely possible to see the top of the Jurassic on the image.

Today the images are much clearer, of course. "Another level would give you more prospectivity. "The more resolution on your image the more resolution you have on your ideas."

We also have data sets covering a much larger area today, such as a seismic image going across the entire North Sea, including the edge of the basin. "The bigger the data set, the more understanding we have of how the basin works," he said.

Mr Hodgson worked on the Central Graben of the North Sea in the 1990s, exploring the flanks of salt diapirs. "We thought we had the Judy Field nailed in the 1990s, but drilled two wells into a fault block," he said. "The seismic data we were using wasn't up to the job."

At the time, people believed that there was just one source rock, the Kimmeridge Clay, from the Jurassic.

But one well, 29/10-3, in the Puffin field, went a little deeper than the others, and produced some oil with "weird geochemical markers" which didn't fit to the Jurassic, indicating it could be from another source rock, he said.

Conventional wisdom says that there is only one source rock in the region, he said. But maybe the source rock is in the Carboniferous. "No-one drills the carboniferous, why would you, it is so far beneath the Kimmeridge clay?"

Mr Hodgson also showed a map of fields in

Neil Hodgson, VP geosciences with Spectrum

the Southern North Sea, superimposed on a map of the salt walls. There is not much of a match between them. "The reason is seismic imaging," he said.

Hard salt horizons mess up seismic images.

But this indicates that it might be possible to see much more, with a full azimuth seismic image. "Just think what you could find," he said. "Think about doing that on a massive scale."

Mr Hodgson suggested that it might be better if the Southern North Sea infrastructure was publicly owned. A government owner might be happy for new reserves to be brought online, Only if the production revenues were greater than the drilling and lifting costs, which should be an easier bar to reach.

The government could take ownership of the infrastructure without any payment to the current owners, because it could say it was accepting the decommissioning liability instead. If the decommissioning costs are (for example) £50bn, and there are £50bn of oil and gas yet to be extracted, "there's a deal to be had there". By pushing the decommissioning further into the future, the net present cost of decommissioning would be much lower.

"I think we should set up a National Oil Company, and nationalise the Southern North Sea," he said.

"It means we can go to small operators and big operators and say "produce into this infrastructure at cost," he said.

How to use machine learning in exploration

Machine learning can be used in exploration to help identify potential hydrocarbons in seismic data, map out geobodies and pick facies and faults, said Rocky Roden with Geophysical Insights

Machine learning can be used in exploration to help identify potential hydrocarbons in seismic data, map out geobodies and pick facies and faults, said Rocky Roden President and Chief Geophysicist at Rocky Ridge Resources, also consulting to Geophysical Insights.

Mr Roden said he had been using machine learning himself since experimenting with early facies classification techniques that used neural networks in the 1990s, and "it got me hooked".

Definitions

The first challenge is defining machine learning, with many misconceptions around, he said.

Machine learning is software that learns from the data, typically identifying patterns in large volumes of data. It can analyse large amounts of data simultaneously, identify the relationships between different types of data (a task which can't be done by humans), and then render the results back into three dimensions that humans can use. When applied to seismic data, machine learning can reveal geologic features, properties and trends. And "this is just the beginning", he said.

Data volumes are growing so large that the traditional analysis techniques are not effective.

Rocky Roden, senior consulting geophysicist, Geophysical Insights

Today in seismic processing complex mathematical algorithms in the prestack time/depth migration process are utilized and machine learning approaches are starting to be employed. But machine learning will be an indispensable tool in interpretation, and will complement traditional analysis methods.

Machine learning can be considered a sub-category of artificial intelligence, a label which can be given to "any technique which enables computers to mimic human intelligence," he said.

Machine learning is often confused with classical statistics. Machine learning is a class of algorithms in software that learn without being explicitly programmed. The capabilities of machine learning are now practical and economical with modern computing hardware and software architectures. Classical statistics is looking for properties and distributions based on certain assumptions about the data and has been around for centuries. But they come together in that machine learning is rooted in statistics, he said.

Modelling the relationship between different variables is not in itself machine learning. But machines can learn something from the results of it, he said.

"Deep learning" is machine learning which typically employs a number of hidden layers in a neural network.

Machine learning is often applied to a data set indexed by a person. For example if a person has classified a number of images or features about an object, the computer can create an algorithm which 'reverse engineers' the classification, for example to understand that an object with certain features (such as wheels) could be a car.

With deep learning, the computer looks for commonalities in the data set and identifies the features of the object itself before going through the classification process. Deep Learning has gained much interest in the last few years.

"It is confusing sometimes," he said.

Then there is supervised and unsupervised learning.

Supervised learning means starting with a known set of data and known responses (i.e. you know these are pictures of cars and these are pictures of trains) and use that to train a model, or system which would then be used to identify a picture showing a car or a train. In the business of seismic interpretation, known conditions such as well logs (ground truth) are often calibrated with seismic data to determine reservoir properties. The supervised learning process can help identify those properties within close proximity of the well control.

"Unsupervised learning" looks for natural clusters in the data without the use of well logs. This approach has proven to reveal geologic features in seismic data difficult to interpret previously or not seen at all. Both supervised and unsupervised methods have their place

"Seismic interpreters don't necessarily need to be machine learning experts, they just need to recognise when it can give them a better answer", he said. "The Paradise machine learning software is equipped with user-guided workflows – 'ThoughtFlows' – to enable every interpreter to apply machine learning technology".

Direct hydrocarbon indicators

Machine learning can be used to help look for direct hydrocarbon indicators in seismic data.

The work starts with a number of seismic attributes. These are various properties calculated from the seismic. Each attribute has a purpose for highlighting different aspects of geology and stratigraphy, but analyzed together, far greater insights can be obtained. The machine learning process identifies patterns among multiple attributes simultaneously, which is not something a human can do beyond three attributes.

Given a set of 20 seismic attributes that may be candidates to a study area, it would be very time consuming to draw graphs showing how each attribute changes with every other attribute. But instead Principal Component Analysis (PCA) is used in the Paradise software by Geophysical Insights to quantify the variance among the whole set of 20 attributes. PCA is a linear mathematic

algorithm which determines those attributes that vary the greatest over a given region, thereby identifying those that are most important.

The more variance an attribute has in a region, the more energy it is imparting. This is a way of the interpreter obtaining a sense of which attributes to use in an interpretation project. The attributes that are contributing the most to the region are good candidates for the application of machine learning.

For the identification of direct hydrocarbon indicators, the most prominent seismic attributes determined from PCA are employed in an "unsupervised learning" method.

The type of unsupervised learning here is "Self-Organising Maps (SOM)." The application of multiple attributes in Self-organizing maps produces results in classification and probability volumes that can reveal direct hydrocarbon indicators.

The analysis has proven to reveal flat spots (hydrocarbon contacts), attenuation zones, and anomalous zones associated with hydrocarbons of whatever is in that space is different to rock around it.

Picking geobodies

The seismic analysis can be used to pick out "geobodies". There is no firm definition of a geobody but it is usually a specific geological feature, such as a channel or karst.

Employing the results from a SOM analysis, the connectivity of neurons from the classification often reveal geobodies and their areal extent which can be quantified. This quantification can significantly impact reserve/resource calculations.

Picking seismic facies and faults

Convolutional Neural Networks, deep learning, has shown to be an excellent approach to identify seismic facies and faults in seismic data.

This supervised neural network approach is applied to a series of seismic lines in a volume where the interpreter has identified specific reflection patterns (facies) or faults. The classification process will take this information and identify seismic facies and fault patterns in all the data.

The same process can be applied to "well control", using well log data to classify

lithofacies (rock layers). If a geoscientist identifies the facies in 3 or 4 wells, a computer can apply it to more wells in the same section.

Re-using attribute relationships

An interesting question is whether specific combinations of seismic attributes employed to reveal certain geologic features, be employed in other areas. The answer is a qualified "yes", as long as the geology and stratigraphy of the two regions being compared are somewhat similar.

For example there is a combination of 6-10 seismic attributes employed in a SOM analysis that routinely reveal thin beds and detailed stratigraphy.

It is important to always keep in mind that data quality, noise, and acquisition and processing issues can impact machine learning results.

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KADME launches Whereoil version 4

KADME, a company which develops software that acts as a data-integration platform, has launched version 4 of their Whereoil application, moving to an architecture which not only utilizes state of the art technologies but also allows for the software to run in the cloud.

Whereoil is used for the Norwegian national data repository DISKOS, which will be moving to version 4.0 shortly.

Whereoil has two core advantages. Firstly it is able to break down the silos that have been established over the past years with companies using specialized software in their respective field by making it accessible through a single interface. Secondly it allows companies to make use of the collected data through a REST API (Application Programming Interface). This allows KADME's customers and third parties to produce their own KPIs, data dashboards, reports, and integrations with other applications.

Compatible data sources include a variety of domains; subsurface applications such as Petrel, Openworks or IHS Kingdom; general file systems within companies,

document management systems such as SharePoint, and many online data sources such as the NPD Fact Pages. In total WhereOil has over 100 such connectors.

WhereOil 4 has many new functions, one of them being the ability to automatically place unstructured data on a map as well as enrich that data with information relevant to that location. Users can use 'spatial filters', only looking at data within a certain region. For example, if there are wellbore names in the data, and there is a dictionary of company wellbores, the documents can be "geotagged", to say that the data relates to that particular wellbore.

Version 4 of Whereoil can also automatically index well logs files, allowing it to detect possible errors in those well logs. For example if the software spots that the diameter of a well (measured by caliper

tool) is a certain amount greater than the bit size (used to drill it), that would indicate that the wall of the hole has collapsed in that part of the well. In this case the software will augment the well log data, adding a QC flag of the type "washout" or "estimated washout". There are currently 40+ flags available and the number is growing.

Data can now also be a packaged for someone in a specific discipline to use (such as a petrophysicist), rather than ask them to search for data from different places.

Via the use of the REST API, data exchange with other applications is greatly simplified. This means that all the employees in a large oil company can access all kinds of company data from a single software platform.

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PIDX – how e-commerce standards should evolve

Oil and gas e-commerce standards organisation PIDX had discussions about how commerce technology is evolving and how e-commerce standards should evolve with it, at its 2018 European Conference in London on June 5

Oil and gas e-commerce standards organisation PIDX had discussions about how commerce technology is evolving and how e-commerce standards should evolve with it, at its 2018 European Conference in London on June 5.

The basic idea is that there is an enormous amount of transacting which goes on inside the oil and gas industry, and companies would reduce the administration cost of this if they all used standard systems. Companies do not get any competitive advantage from handling transactions in their own way.

But we are seeing big evolutions in the way that companies are working with trading partners, including transactions handled on a software-to-software basis (rather than from sending electronic documents), suppliers providing richer information about their products which can automatically populate oil company systems (and help analyse purchases), and effort to standardise part numbers between suppliers for the equivalent item.

PIDX sees that the quest for more digitalisation in industry should go together with a quest for more standardisation, and PIDX provides a platform for "mature discussion" about how that should be done.

The three core services of PIDX are providing standard legal frameworks (behind e-business), providing standard ways to manage digital catalogues, and supporting systems integration between buyers and suppliers.

PIDX standards describe how electronic documents such as invoices can be transferred between buyers and suppliers in a standard XML format. But we may see a growth in communications made between one software package and another.

Chris Welsh, board member with PIDX, suggested that PIDX could also develop API standards, describing how different software systems should integrate together. Some other standards bodies have moved in this direction – he cited FHIR Healthcare (Fast Healthcare Interoperability Resources) a healthcare data standards body, which has extended its scope from just XML standards to also doing API standards.

PIDX could also broaden its standards to include communications with suppliers in the after-sales, including about performance of their equipment and analytics, he suggested.

PIDX is also interested in in finding ways to make it easier to map together different part number systems and taxonomies. Currently every buyer has their own taxonomy. There needs to be a format to manage one supplier's part numbers within another company's taxonomy, he said.

Andrew Mercer, BP

Andrew Mercer, CIO of BP for Middle East and Africa, and also a PIDX board member, emphasised that the oil and gas industry is massively interconnected and so there is a lot of communication between different partners, and the standardising of this communication can make life more efficient.

Oil majors like BP only get competitive advantage out of a small part of their overall activities, where they get better overall business results as a result of doing something better than their competitors. For the rest of their activities, there is no reason for an oil major to do things its own way – it would be easier for everyone if it adopted standards. Included in this is the way of creating a purchase order number or sales order, he said. There is no reason for an oil company to do this its own way.

He noted that BP is keen to move to more general-purpose software tools, rather than specialist packages. It has many specialist software packages it has bought from different companies, and has challenges integrating it all together. "You end up with all these siloed systems," he said. "The number of data solutions we've got and data standards is a real barrier."

Another theme with BP's technology development is moving systems to the cloud, but it is proving "not as easy as people make out," he said.

Sparesfinder – business translation

Sparesfinder has set up a spares numbering translation service, which aims to connect numbers in a buyers' system with numbers in a suppliers' system.

It scans the description of items and makes suggestions of what might match with something else, for example comparing every centraliser casing in the database.

It is too common to have suppliers asking questions of buyers about different parts, and nobody knows they are talking about the same thing, said Tom Cave of Sparesfinder.

The international retail industry solved this problem in just 4 years, after realising how much money was being spent on managing data about items (including stock keeping). It led to standard bar codes, and standard devices to read them. But the oil and gas materials industry has not yet managed to do the same thing, and it is leading to a significant cost, Mr Cave said.

Siemens

Power and automation company Siemens conducted a survey of people from upstream oil and gas operators, and found that 50 per cent think digital technology leads to faster decision making, 45 per cent think it leads to better asset management, and 46 per cent think better real time decision making. 59 per cent think it can help improve productivity and 25 per cent think it can improve training.

Siemens' "AX4C Cloud" software is intended to help companies in a supply chain better collaborate. It maps the processes along the delivery chain. Companies can use it to share information.

Phil Lavin, development consultant for IT at Siemens AXIT, sees the main challenges to digital roll-out as improving collaboration between business and IT, overcoming reluctance to share data, fear of change, challenges convincing people to participate, and a "wait and see what others are doing" attitude.

He sees a varying degree of maturity of digital business models in different sectors – perhaps with the highest in media and trade, and lowest in process management and energy.

Automatic classification systems

Preminor of Canada has developed a system to automatically classify purchased items in a rich way, using machine intelligence.

The purpose of the classification is that it enables companies to analyse their spending in different ways. For example, they might want

to work out how much they spend on a certain sort of valve every year, which they can use as part of a negotiation with a supplier. They might want to see the value of components in a certain completion, or how much they spend on renting certain items each year and whether it would make sense to buy them, said Andy Ross, founder and principal of Preminor. (The company was formerly known as ACT Consulting).

Purchasing systems commonly allow companies to categorise or "bucketise" spend into different areas, but doing the sort of analysis above requires much more granular classification.

Some companies have developed rules based classification, for example if the item contains the word valve it is categorised as a valve. The problem with a purely rules based approach is that it is hard to define something in the real world just using rules – you can end up with rules conflicting, saying that an item should be described in two different ways, or no applicable rule at all.

An algorithm / machine learning system can be much more expressive than a rules based engine, better able to find the right solution when there is a conflict (an item could be in 2 different categories, or it isn't obvious which category it should go into).

Another approach has been to send the data to an offshore processing centre (such as in the Philippines), which apply a combination of rules and lower cost labour. But doing this is still "time consuming, expensive, inconsistent and inaccurate," he said.

Human categorisation is not particularly consistent, with different people classifying in different ways, he said.

The experiment by ACT involved taking a year's worth of purchase data from one company, 3m line items, and trying to build an automated classification system. ACT developed an algorithm for how items should be classified.

Ultimately, it led to a 10 per cent increase in accuracy from labelling by computer, vs labelling it by people.
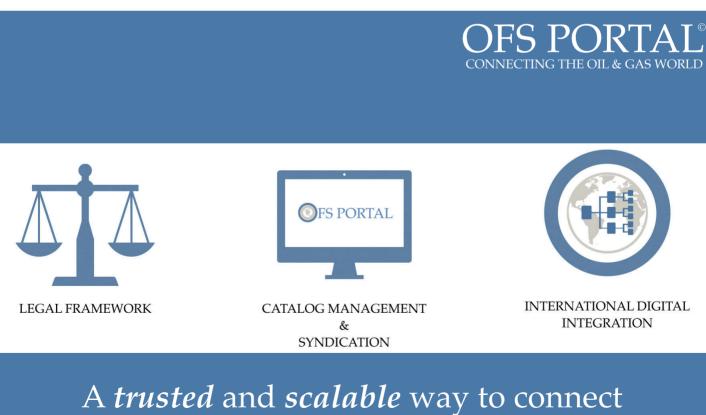
There was quite a lot of work involved in training the system – it can be more labour intensive training an AI based classification engine than doing the classification yourself, Mr Ross said. But of course once it is trained, the need for human support reduces.

A basic AI system can be put together in 2-4 weeks, and then takes another 4 weeks to be improved. There may be a need to write some rules on top of that, stating that in a certain situation the machine should take a certain answer.

To 'tune' the model, ACT put together a matrix showing when the choices between people and machine are most likely to diverge – then a human expert could check who was actually making the best choice and tweak the computer model If the computer's choice was the worst one.

One challenge was that the classification used the vendor's description of the product (as shown on the invoice) as the starting point, and many vendors did not have a very precise description of their product. However, the project did make it possible to identify which vendors provided the worst product definitions on their invoices, so they could be asked to improve.

After many years of looking for a "use case" for classification for machine learning, this is the first time ACT has found one which looked like it might provide strong real world value, he said.

AVEVA - managing contracts, combining metal + process, and brownfield

Engineering and industrial software company AVEVA provided an update on how their software is being used to manage contracts and costs of engineering projects, how it's combined portfolio now spans from plant design to process and operations management software, and how it is being used in brownfield deployments

At its AVEVA World Conference UK in London in June, engineering and industrial software company AVEVA provided an update on how the software is being used to manage contracts and costs of engineering projects, how it's combined portfolio now spans from plant design to process and operations management software, and how it is being used in brownfield deployments. We also heard from customers Costain and KBR about their experiences with the software.

Contract management is a big area of interest, because there are so many reports of cost escalation in construction projects – with a main cause being fragmented systems for communication and data management, rather than a single integrated system with structured processes. AVEVA's software can help improve the situation.

Combining plant data and process data is also an area of big interest, because it allows the generation of a digital computer model covering the control systems / fluid flows to be exactly aligned with the physical production process. Referred to as a "Digital Twin", this process became further enhanced following the merger between AVEVA and Schneider Electric's industrial software business, occurring earlier in 2018.

AVEVA has also made it easier to use its software on brownfield sites where there may not be any electronic files describing the structure, or where paper documents might be out of date – by making use of laser scanning.

We heard from smart infrastructure solutions company Costain about their experience of implementing AVEVA software including E3D and Engineering, the challenges faced and the

Rick Standish at Aveva World

benefits they are experiencing.

AVEVA software is used at over 100,000 sites around the world – including sites within the oil and gas, chemicals, food and beverage, mining, materials, power, water and smart city / infrastructure industries.

One of the most impressive recent installations, said Rick Standish, VP Innovation at AVEVA, is a customer in the UAE, which has its entire control system managed in AVEVA software. The customer has a gigantic 150 feet long, 10 foot high screen in its control room, where it can see the entire operation from well production through vessel scheduling and sales, covering 3m boepd, and 151 tankers and support vessels.

Improving contracts management & effective resource management

Engineering, Procurement and Construction firms (EPCs) are today experiencing shrinking margins as their customers (such as oil companies) increasingly break big projects down into smaller elements to contract them out separately, Ivan Siksne-Pedersen, VP digital business solutions with EPC projects at AVEVA said. Engineering companies are seeing increased competition from companies in India and South Korea. The best profit margins are probably available on seabed and renewables projects, he said.

Facing these conditions more and more, EPCs & Owner Operators are looking into ways to improve the various concepts within project execution and control to maintain competitiveness, while at the same time securing a decent profit margin.

AVEVA's "ProCon" software is designed to help manage the contracts in big projects, as a centralised system to keep everything under control and understood by the people involved.

In order to avoid excessive cost overruns, companies need to get better at identifying where changes to cost may occur.

A recent study by Ernst and Young found that risks often develop in areas outside the formal documentation, or in complex communications between different project stakeholders.

If you don't have a governance over communications set up at the start of a project (what information you will receive at what time), you will typically only receive partial information. This means it is potentially much harder to protect your rights if you get into a dispute.

Projects can get very complex, particularly with joint ventures with multiple teams. There will be contract, cost management, planning, engineering and finance teams. Interests can be aligned at the start of the project, but gradually diverge as the project proceeds. For example, planners want to reduce time, engineering want to avoid delays and knock-on effects, contract teams want to reduce liability.

AVEVA's "ProCon" software can be used to keep track of obligations, see what is due. After the contract award, you can manage communications, track payments, manage claims and keep track of lessons learned. It gives you efficient and transparent tender management. You have the evidence you need to prove what was decided (in any dispute).

Owner Operator and EPC customers using the ProCon solution report massive cost savings through the governance that ProCon helps to establish.

A typical EPC project will spend 7 per cent on engineering and design, 40 per cent on the purchases, 45 per cent on fabrication / construction, and 5 per cent on commissioning / handover, with 3 per cent spending on the project support services such as data and document management.

Companies often report they lose millions of dollars on the purchases – from incorrect ordering, ordering too much, lack of integration with design & engineering solutions causing data inaccuracies, paying additional charges due to client changes while the project was underway.

AVEVA's Enterprise Resource Management (ERM) software aims to help companies reduce this, also making it easier for companies to develop specifications for what they want, including managing catalogues and materials data. It aims to help them keep their processes consistent and integrated, from procurement, planning to construction.

A typical problem could be that a client decides they want a change in the diameter of a pipeline partway through a design project. This impacts purchase orders, fabrication work, installation work, subcontracts with other companies, a "cascade of things," said Mr Siksne-Pedersen.

The ERM system holds data from different sources and will typically receive Engineering & Design data which is then further processed into Materials Take Off (MTO), Requisitions, Purchase Orders, Site Material Control and eventually into the area of Construction Management.

The system supports the concept of multi-d planning, which is effectively the combination of the 3D model, Schedule, Supply Chain and Cost. This helps drive down cost by identifying issues at an early stage, where no or very little cost is incurred.

The software can interface directly with ERP systems many companies use, such as Oracle, SAP and Microsoft and can also link to document management systems.

Software role play

AVEVA's integrated software was demonstrated in front of the conference audience with a live role play, with different team members playing the roles of someone in procurement, 2D design and 3D design, showing how they would each work with the software to resolve a problem of a supplier going into administration during the late design stage of a project.

First, the procurement department received news about the supplier going into administration, they needed to know how they were affected. The software presented a visualisation of the plant design, with colour-coding highlighting the two pumps which this supplier was due to provide.

The Enterprise Resource Management (ERM) system presented the purchase orders issued to this supplier, which could then be copied and sent on to a new supplier.

Then the design team took over and identified that the pump from the new supplier had slightly different specifications – increased weight and reduced inlet size. This meant a requirement to install 'reducers' to reduce the pipe diameters. This was added to the design, with checks to make sure the new design would all fit together.

Then the team updated the list of parts required – additional reducers, and cancelling of the order for some flanges and gaskets. The procurement department could see these changes and how existing orders were impacted.

Finally, the procurement department could see an updated Gantt planning chart for the project, and check that the new supplier was able to deliver the pumps by the time they were required.

Tying metal and process world

AVEVA recently merged with Schneider Electric's industrial software business, which makes software for engineering, operations and process management. Bringing the two software portfolios together enables organisations to better tie together the physical / metal / fluids worlds with the digital world, through a concept now referred to as a "Digital Twin."

The heart of the Software is the graphical human machine interface, which is used to control the processes, said AVEVA's Rick Standish. The software keeps records of operating data (historian), provides dashboards and KPIs, and can be used to monitor asset performance, which takes advantage of advanced analytics, machine learning and artificial intelligence capabilities.

It can also generate work orders, check them against Safe Operating Procedures (SOPs), and be used for planning and scheduling, and immersive operator training.

More and more customers in the oil and gas industry are looking for more "autonomous operations" of offshore facilities, where you have the same view onshore as the people offshore, he said. Making decisions is easier if you have a digital twin, enabling people to get a better understanding of the asset.

Integrating engineering data on brownfield sites

Many brownfield facilities (older assets) have a patchwork of software systems in place to manage their engineering data – sometimes hundreds of software applications and several data management systems on top, which can be quite complex and resource-intensive to manage. AVEVA software can now help streamline this management by providing operators with a complete "digital thread" of information about the asset that is readily visible and easier to manage.

Its "AVEVA NET" software brings all engineering data together - including structured and unstructured data, 2D drawings and 3D models. The data can be validated, and then made available through a web browser type environment. Then people can work with it via mobile, desktop PC, or AVEVA's Engage software, said Gary Farrow, VP global product sales with AVEVA.

One oil company set itself a goal of being able to access every piece of critical information from the company's databases in 3 minutes or less – a goal that was accomplished. Previously, it might have taken days or weeks to collect all this information, to ensure the company was within compliance of certain rules and regulations.

Better data systems can also help get a new project in production at its planned "name plate" capacity as fast as possible. It is very common for oil companies to have problems during handover, with 30 per cent of projects saying they have seen a delay of between 1 and 4 months in start-up due to waiting for information," Mr Farrow said.

Costain

Derick Roylance, manager – engineering IT solutions and Ben Gifford, principal support engineer with Costain talked about their recent implementations of AVEVA software. Costain recently implemented Everything3D, AVEVA's plant design software and AVEVA Engineering, which manages multi-discipline data for tagged engineering items. The company had a requirement for an integrated systems environment covering both engineering and business systems.

The key drivers to change were to improve efficiency through integration and reuse of data, also the company's legacy software system was proving difficult to maintain. So, it made the decision to move to new software in 2016, a process which took about 5 months.

Today, designers of all disciplines work with the 3D software, including structural, piping, electrical and instrumentation. The feedback from structural engineers is that creation and modification tasks are 30 per cent quicker than with the previous software. Training is faster, and data entry and checking has been reduced by 60 per cent, Mr Gifford said.

AVEVA Engineering was implemented in 2016 but the company switched to a newer version of the software in 2017, in the middle of a project, with only a few minor issues.

Challenges faced during the implementation of AVEVA Engineering included the building and modifying of the underlying data structure. This was a complex process. Workflow design and development also posed a challenge. Mr Gifford suggests looking at the larger workflow more deeply would have helped to overcome this.

The main benefit of the software is the huge potential it creates for data reuse and Mr Gifford estimates data entry and checking has reduced by 50 per cent. Also, it is very easy to integrate the software with other systems and Costain are looking into how they can exploit this.

EPIM – a standard supplier registration system for NCS

EPIM, the Norwegian data standards body, together with Norwegian Continental Shelf operators, is setting up a standard supplier pre-qualification system

Oil and gas standards organisation EPIM of Stavanger is building a standard supplier registration system, or 'Joint Qualification System', for oil and gas suppliers working on the Norwegian Continental Shelf (NCS). It will be operated under the governance of Norwegian Continental Shelf oil companies.

It will replace the FPAL / Achilles system they were previously using on the Norwegian Continental Shelf.

The system acts as a central repository for supplier information, so oil companies can research many suppliers and do some basic vetting, while suppliers do not have to provide different data to multiple potential customers.

The new system makes big effort to make life easier for suppliers. For example, if their financial data is already available with information provider Dun and Bradstreet, the EPIM system can take it straight from there.

The software will also find further information about the supplier automatically, for example crawling the internet for recent news stories about that company. It will also crawl your company website to find information about staff members and contact information.

The system will be active from October 1 2018, called 'EPIM JQS'. A number of Norwegian oil companies are expected to require that their suppliers use it, including Equinor, AkerBP, and other NCS operators. This means that about 4,000 suppliers will be expected to have a registration on the new system, including suppliers not based in Norway.

Development is driven by Norwegian companies but usage is not restricted to Norway. For example Equinor has stated that it would like its suppliers around the world to use the system, not just the Norwegian suppliers, or suppliers to its Norwegian operations.

The system includes a self-assessment capability where suppliers describe their own services, and self-assess what quality they are.

Companies will also categorise their services according to the UNSPCC classification system - and that can also be used to search for relevant supplier by category. The UNPCC system is used outside the oil and gas industry, so its usage will help operators and suppliers working outside oil and gas.

One hoped for aim is that the system will make it easier for smaller companies to do business with big oil companies, by making it easier for larger companies to access data about more suppliers, without giving suppliers a large administrative burden.

At the moment there is a negative 'catch 22' where many small companies say it is not worth the trouble of registering themselves on an oil industry supplier system, because they never get invited to tender for work anyway, and operators say that with current systems, a lot of the data is so poor it is of little use, says Yngve Nilsen, Senior Advisor - EqHub with responsibility for the Joint Qualification System, at EPIM.

Capturing rig inspection data

ADC, a rig inspection services company, has developed Technical Rig Audit Management System (TRAMS), which captures and analyses the findings from every rig inspection ADC has carried out over the past 10 years. This includes land rigs, jack ups, semi submersibles and drillships.

With this data, it is able to target known areas of risk by conducting a trend analysis on everything from the background of the drilling contractor, the rig type, design or age, to the operational status, the maintenance history, equipment and systems assessment, crew competency, the ability to comply with regional legislation and even the geographic location where the rig was stacked.

For instance, if a rig was stacked for a period of time in particularly sunny, hot and dry climate, it can often experience heat and UV degradation of perishable compounds such as rubber and elastomer components.

Using data to identify non-conformance trends allows for the optimization of time on board for each rig option, so that a fully transparent and consistent inspection can be conducted.

Digitalisation of the process provides the operator with a relatively quick, holistic and comparative analysis of the rigs, underpinned by the potential technical and/or financial risk of each option.

Each section of the TRAMS rig selection checklist carries a weighting based on potential financial risk. The sections include rig capability requirements, client specific requirements, management systems and operational status, equipment, 3rd party equipment and modifications.

Upon completion of each rig visit, a report on the suitability of the specific rig for the planned operations is undertaken, before then comparing all rig options on suitability and potential financial risk based on the inspection's findings.

It also provides a streamlined reporting environment for the completion of all workscope-related tasks, the collection of data and the delivery of interactive visual reports.

The operator can identify the potential for equipment or systems failure and give an accurate assessment of spares requirements, thereby avoiding costly over or under conservatism in spares purchases.

The inspection can also look at cybersecurity issues, a particular issue for mid generation rigs with potentially outdated software systems which have been stacked for a couple of years.

Case study – BOP inspection

On a recent inspection of a blowout preventer at the end of a well operations, ADC witnessed the functional operation of the BOP ROV intervention system as well as a third party's ROV pumping skid equipment.

It observed that the ROV intervention type C stab may have fitted the Type A receptacle on the BOP.

However the porting of the receptacle and the 1/2 inch hosing fitted to the BOP would have restricted the flow of fluid from the stab, therefore preventing the intervention skid operating the critical BOP functions as designed, and in compliance with API S53 maximum ram closure timings.

The timings for the operation of critical functions would not have complied with API S 53 and could have delayed the shut-in of a well if operated in a real time well control situation.

Lloyd's Register's Safety Accelerator seeks new digitech

A new "Safety Accelerator" program launched by risk services company Lloyd's Register seeks to encourage the development of new digital technologies to solve specific safety problems, working together with a Silicon Valley investor

A new "Safety Accelerator" program launched by risk services company Lloyd's Register seeks to encourage the development of new digital technologies to solve specific safety problems in marine and offshore, working together with a Silicon Valley investor, Plug and Play. The challenges are outlined below.

Finalists will be invited to "pitch" their solutions at quarterly Innovation Days, with the most promising proposals awarded trial funding by Lloyd's Register Safety Accelerator. It will also help them to collaborate with major industry partners to pilot the technology.

The program was launched in London on June 27 2018, focussing on safety of life onboard ships and floating platforms. The first Innovation Day will be in Hamburg on September 6.

Maurizio Pilu, VP Digital Innovation, Lloyd's Register said that one of the biggest technology opportunities he sees is in "human analytics technology" – such as technology which can track fatigue, heat exhaustion, whether personnel are wearing safety equipment, voice analysis (detecting for stress) and mindset analysis from people's written communications. He acknowledged that these technologies come with complex privacy concerns.

Risk assessment to life

The first challenge is to "bring risk assessments to life", and was presented by James Pomeroy, group health, safety, environment and security director at LR.

It would be better if risk assessments were dynamic, to changing when a situation changes. For example, if people are about to do an offshore task, but there is now the possibility of a cloud of hydrogen sulphide, a different risk assessment needs to be made.

The common situation today is that risk assessments are made by people in the office, and given to offshore / marine workers as a 'set in stone' document.

Managing vessels in gas

The second challenge, presented by Anji Welleman, Corporate QHSE Manager, Kotug International, a towage vessel operator in Rotterdam, was for a better safety system to shut down vessel engines in the event of a gas cloud while towing.

If a tug's vessel is automatically shut down due to a gas cloud while towing, the vessel in tow may continue moving and collide with it.

Ms Welleman envisages that there could be a more sophisticated system for tracking where exactly a gas cloud is, so it can be seen on an electronic chart. Then a better decision could be made about which engines need to be shut down.

Methane leaks

Are Jacobsen, head of HSE with midstream oil and gas operator Gassco, is keen to have a better technology for managing methane leaks, including reducing false alarms, which can lead to the entire plant being shut down at great cost. "Methods are not reliable enough," he said.

The company would also like a better way to measure its total emissions from a facility, to check they are within limits.

The company does periodic 'campaigns', taking gas sniffing devices around equipment to look for leaks. But it takes a consultant about 6 months to compile a report based on the data, he said.

Crew competency

The fourth challenge was to find ways to enhance marine and offshore crew competency, also presented by James Pomeroy, group health, safety, environment and security director at LR.

"The weakest link is the human," he said. "There hasn't been sufficient focus on human performance."

"The traditional approach is training and crew competency. But crew competency can be much wider. What does crew competency mean beyond training? [For example] We see fatigue, stress, health, coming through more clearly."

"Think about big accidents and driving incidents, almost always there's a human involved," he said.

One proposed solution is a computer which can detect when someone's attention lapses or they are getting tired, by monitoring their eye motion.

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James Pomeroy, Group Health, Safety, Environment and Security Director at Lloyd's Register; Maurizio Pilu, VP Digital Innovation, Lloyd's Register and Serena Connor, safety accelerator manager, Lloyd's Register Foundation

ExxonMobil – using innovation to improve human performance

ExxonMobil is interested in innovative ways to improve human performance, and sees technology as an enabler for that, said Paul Schuberth, Corporate SSH&E Manager, Exxon Mobil Corporation

ExxonMobil is interested in innovative ways to improve human performance, and sees technology as an enabler for that, said Paul Schuberth, Corporate SSH&E Manager, Exxon Mobil Corporation, speaking at a Lloyd's Register event in London.

There is a tendency to think innovation means technology, or "things we can touch," he said, rather than think of it in terms of improving human performance.

In human performance, ExxonMobil focusses on quality of leadership.

ExxonMobil's focus areas for health, safety, security and environment cover containment of hydrocarbons (avoiding leaks), reliability of equipment, environmental issues, health, and global security (where it is seeing increased focus), Mr Schuberth said.

The company is clear that biggest concerns are workers on the field site, not in the office. "It is very rare to have a high severity incident in the office," he said. So its main focus is on the individuals who use the tools, and the first and second line supervisors.

Technologies of interest

Following this logic, Mr Schuberth sees safety technology ExxonMobil might be looking for in 5 categories.

Enabling field workers, and enabling them to get out of hazardous situations (e.g. drone inspections of flare tips and derricks, confined space areas.

Providing right information at right time to right people - e.g. real time advisors, dashboards, sensor data, so people have information they need when about to do a job. "We are still with tablets for field workers. Wearables are very important, detect if you are fatigued and need a rest".

Predicting outcomes with technology. "We're just starting in this space," he said. "Can we look at trends and identify based on historical incidents if this trend will lead to a bigger incident"?

Knowledge and learning - "how can we ensure greater competency for those in the field?" Digital twins and immersive learning might help.

The fifth category is **improving ease of use of the technology**, he said. Technology for field workers can be cumbersome to use.

"From my perspective we're trying to fail forward and learn quickly. That's not comfortable. But otherwise nobody is going to lead."

Technologies of interest

ExxonMobil is introducing digital technology in its maintenance turnarounds, when large complex pieces of plant are shut down to do a large amount of different maintenance tasks. The aim is to do as much work as possible during the shutdown, because shutdowns are very expensive. There can be 4,000 people working on one turnaround project.

In a recent turnaround at a facility in Baton Rouge, all of the personnel were provided with RFID tags, and there were tag readers around the plant, enabling people's location to be tracked. So it was possible to check that everybody was in a safe location, and see activities on a large dashboard, so make better decisions.

The company is also developing an app for sharing and learning around safety, which can also provide "just in time" learning to field personnel on mobile devices. The information can also be provided to contractors.

ExxonMobil is interested in data analytics, in particular if they can identify near misses, which often go unnoticed. A near miss can be considered "free learning", Mr Schuberth said. It can include near misses on personnel and process safety, and equipment performance and reliability.

ExxonMobil has also trialled the use of fatigue management systems, for operators of large vehicles in Canadian oil sands, where people work a 12 hour day. The computer scans their facial expressions and eyelid blinks, and advise them to get out of the cab of their vehicle if they are getting tired. Some operators have said "I had no idea I was falling asleep at the wheel," he said.

Human performance

ExxonMobil is using interesting methods to improve human performance.

To help people understand the difficulties of overcoming bias, it uses technology you would never guess – a trick bicycle, where the handlebar turns anticlockwise and the wheel turns clockwise.

Paul Schuberth, Corporate SSH&E Manager, Exxon Mobil Corporation

People think it would be a simple matter to train the brain to move the handlebar in the opposite direction to the one you want to turn the wheel, but "no-one can do more than a foot," he said. This is a good way to demonstrate that we can't overcome our biases easily either just by trying to compensate for them he said.

The company also wants staff to understand Daniel Kahnemann's idea about fast and slow thinking – fast thinking is instant, slow thinking is more considered. We have to think too much during our working day to do everything with 'slow thinking', and that's fine, but we should also recognise when we need slow thinking, he said.

Injuries often happen in 'fast thinking mode', where we are doing a lot without thinking. One way to break fast thinking is to have interruptions, he said.

ExxonMobil also encourages staff to better understand their decision making styles, and how they compare with others. Most engineers are heavy in analytical thinking, or heavy in the directive side (make a decision and then pass it along). Other styles are conceptual (thinking deeper at different approaches), or behavioural, where someone makes a decision intuitively based on what feels right.

The point is that a decision can improve if you bring in someone else with a different decision making style.

Doing more with data for offshore structures

We could do more with data for offshore structures if it was in standard formats, integrated into a 'digital asset', convenient to collect, consistent and collected, says Steven Coull of DNV GL

How do we best leverage the power of data to facilitate more measured decisions about the safe operation of offshore structures?

The job of a structural engineer is to make informed decisions about the condition of the structure and decide if it is it still safe to operate.

These decisions require information about the current condition of the structure.

The structure will be installed in pristine condition, with everything exactly as it was designed, but much like your new car, fresh from the dealer, it does not stay that way. Offshore, environments are harsh and the structure will corrode, it will be damaged, new parts will be added and old parts taken away.

Working with data

To do this, a lot of data will be collected and assessed. The data comes from a diverse range of sources and includes weight management data, inspection findings, structural integrity models, and data from motion sensors.

All of this data contributes to the decision-making process in different ways. The only common thing about the data is that it is all different.

Data is a term that is frequently used, but not always understood. It can be considered as just one part of an overall model that captures how knowledge is collected, processed and acted upon. A common name for this is the Data, Information, Knowledge, Wisdom pyramid. The model describes the ability to make a wise decision.

Data is the first step in the process. It is the raw unrefined product, collected at source. Much like iron ore, it is of no use by itself.

You can't build a bridge with iron ore, and you can't do anything useful with data.

Data must be refined and organised, set in context, and connected to other data. The process yields information. Information is useful. Information is the carbon steel structural beam. It has purpose, but has yet to fulfil that purpose.

To make decisions with information, you need to assess it and understand it.

You build the knowledge based on the information you are presented with, or in the case of our steel beam, you build your bridge. Knowledge is the basis for "wisdom", or the choices you make.

Steven Coull, Fixed & Floating Structures Team Leader, DNV GL – Oil & Gas

Connected, consistent, convenient

To achieve the maximum value from data, and generate high quality information, Data must be connected, consistent and convenient.

Connected data means being able to describe its relationship to other things in clear and unambiguous terms.

The singularly most challenging aspect of data is the lack of consistent formats. There are standard formats for some data, but a lot of data is supplied inconsistently. Different suppliers use different formats and some data lacks internal consistency.

A lot of these problems stem from the collection method. It is collected by humans with no thought to the wider application. Data also needs to be convenient. Too often the value of data is reduced to zero when we can't access it when we need it, which is unfortunate considering there is usually a cost to collect it.

The digital asset

The concept of a digital asset, or digital twin, has been around for some time.

These digital assets are usually presented as a 3D model of the structure, but that itself is not the digital asset, it is merely an interface.

The digital asset is the infrastructure underneath the 3D model, and is a simple concept.

It is simply a list of things, but with a structure and a consistent way of describing things.

This is like your home address, a simple common way of describing where you live that allows different companies to deliver your mail.

What if each company used a different system to identify your location, or if different systems were used for different parts of the country? This is where we currently stand, with several different ways of describing the same thing.

Interoperability

This exposes another problem. How do you share data effectively between different systems, providers and consumers?

Different organisations invariably develop their own products and ways of supplying data.

This is a frustration to consumers of data who must adapt their systems to deal with different formats. Converting data is sometimes simple, but fidelity can be lost by the limitation of various formats.

The data we deal with today is mostly unstructured and disconnected. This significantly reduces the value of it as it cannot be used immediately.

What is needed are standards for data interoperability. This is a common ground that allows all data providers and consumers to speak in the same language without having to translate or interpret it. These standards must be developed outside of commercial enterprises. They must be open and adopted by all. The oil and gas industry must come together to achieve this, to agree the standards and to promote their use.

Data is there, we have been collecting it, but we have not been harnessing the power of it.

Instead we lock it away behind inconsistent formats, poor access and incomparable frames of reference. To unlock this data, we need a digital asset model that gives us a common frame of reference and standard data formats to allow the development of tools that will work together seamlessly. Most of all, it must be easy, and it can be if we build the correct foundations before we start.

Lone Star – predictive analytics on ESPs

Lone Star Analysis of Texas has a unique approach to predictive analytics on electrical submersible pumps (ESPs) in wells, based on "snap-on" modules and simplifying data streams

Lone Star Analysis of Texas has a unique approach to predictive analytics on electrical submersible pumps (ESPs) in wells, based on "snap-on" modules and simplifying data streams.

The "snap together models" are computer models for ubiquitous components such as electric motors, hydraulic pumps, hydraulic actuators, variable frequency drives. These can be put together in a family.

By combining together these 'snap together modules' you can put together a "digital twin" or virtual model for the whole system, says Steve Roemerman, CEO of Lone Star.

The company also uses data analysis at the well site (so called "edge computing") to simplify the data streams from the well, so the data is much easier to work with. Doing analytics does not necessarily require rich data. "It is amazing what you can do with a sparse data set," Mr Roemerman says.

Lone Star aims to be as transparent as possible about the processes, methodologies, algorithms and outputs, to help customers be more confident using the output in their business decisions.

Another feature of the company's approach is trying to ingest the expertise of the oil workers in how the models are built. "Blue collar workers carry around enormous knowledge about

Steve Roemerman, CEO of Lone Star.

how the equipment works," he says. If you ask workers questions like, "what are the top 5 failure mechanisms you've seen," the answers provide a good basis for an analytics project.

The company serves a number of industry sectors, including transport and logistics, and industrial analytics, as well as oil and gas.

ESP project

Lone Star was asked by an oil company oper-

ating large numbers of electrical submersible pumps (ESPs) if it could find a way to use digital technology to improve uptime of the pumps.

The company had extensive operations in the Bakken oilfield of the U.S. and Canada and many similar wells around the world. It wanted a straightforward way to build a 'digital twin' of its set-up.

A challenge with the project is that there was a big variation in the configurations of the ESPs in the company's portfolio. They were not all running on the same frequency electricity, and did not have the same sensors. They had been configured by whoever had been in charge of constructing the well at the time.

Also the ESPs are rarely perfectly matched to the flows of the wells, because they need to be ordered and inserted while the well is being constructed, before the typical flow rates and composition is known.

"The odds that the pump will patch perfectly the characteristics of the well is pretty low," he said.

One common cause of pump failure is poor quality electric supply, with a lot of distortion in the phase, which can damage motors. Also the pump can be subjected to higher levels of heat than it is designed to withstand.

The cost of replacing pumps is very expensive, involving a well workover.

The amount of data available from pumps is limited, with usually only slow data bandwidth available from the pump to the surface.

But there is a lot of understanding about how pumps behave. For example, companies know what temperature on the motor windings will lead to a breakdown of the motor, a key failure mode. You can also monitor the quality of electricity going down to the pump at the wellsite.

Lone Star creates what it calls "cause and effect models." It means looking at the well as a system, and trying to optimize it as a system, rather than the ESP as an individual piece of equipment.

Ideally, you will have lots of sensors providing live data streams which can be added into the virtual model to keep it up to date.

But often, some of the sensors will be broken or not transmitting. It might be possible to simulate what the data might look like from others, or it might be necessary to remove faulty data.

Many of the inputs look fairly random from second to second, but when smoothened out over a longer time period (such as day), they show much more useful information and clearer trends.

Sometimes the input data ends up being very sparse – although much of the data processing can be done on the devices themselves (or "edge gateways"), reducing the amount of data communication and storage required.

With small volumes of data, it becomes feasible to operate thousands of separate "digital twins" for each of your wells.

This also means that one of the labourious tasks associated with big data anlaysis, cleaning up data, is avoided, because all the input data is already cleaned and nicely formatted.

Uptime prediction

Where computers could really add value is in uptime prediction, or predicting when failures may occur.

The computer models can be used to try to understand the top 20 failure mechanisms for pumps, and the causes behind them, and the symptoms which lead to these causes.

In one example the motors were warming to a temperature out of the standard operating range for two hours in the middle of every day, leading to a slow degradation but not damage. The computer model could be used to work out how much the degradation would lead to a reduction in the life of the motor.

"A human can't focus their attention long enough on the data to really figure out what's going on," he said. "It would be boring to look at that temperature sensor for 3 days."

In one test project, it was able to identify ways to increase production on a well by 800 barrels a day.

Lone Star works together with Accenture and Wipro as "system integration partners."

EU / UK's network security regulations – and oil and gas

The EU Network and Information Systems Directive has an impact on how offshore oil and gas operators apply cybersecurity. Here's how it has been implemented in the UK
By Andrew Wadsworth, PA Consulting Group

On 10 May 2018 the Security of Network and Information Systems Regulations (2018) (NISR) came into effect in the UK. It is the UK implementation of the EU Network and Information Systems Directive which was adopted by the European Parliament on 6 July 2016.

Oil and gas companies who operate production facilities pipelines, storage or processing facilities which meet the criteria in Schedule 2 of the regulations are covered by NISR.

Companies must meet mandatory requirements regarding network and information security and to inform the Department of Business, Energy and Industrial Strategy of reportable incidents.

At it core, it is about improving the resilience of the essential services on which we all depend and expect to "just work".

NISR will require all essential services organisations to take a fresh look at their cyber security to address the increasing threat from cyber attack, and increase their resilience to such attacks.

Depending on the companies' current security status and processes, implementing the required organisational and technical security capabilities may require significant investment, both financial and managerial. These requirements are to be enforced with a notification and inspection regime that can lead to penalties of up to £17m.

NISR seeks to provide legal measures to protect societal essential services such as fuel and energy supply by improving the ability of company networks and information systems that support production, transportation and processing to resist interference that may impact the supply, quality or sufficiency of oil, gas and fuel.

Such interference may be cyber or physical in nature, internal or external to the organisation and may be targeted at company IT or OT systems (collectively referred to as 'electronic systems').

The Regulations mandate 'security duties', meaning companies take appropriate and proportionate technical and organisational measures to manage security risks and to prevent and minimise the impact of security incidents to ensure the continuity of the essential services.

Oil and gas companies are very used to reporting safety and environment incidents but NISR introduces a completely new requirement to report certain security incidents within 72 hours of becoming aware of the incident.

Operators of Essential Services (OES) are also encouraged to voluntarily submit information reports to the National Cyber Security Centre (NCSC) regarding incidents that do not qualify as a NISR Incident but would otherwise help inform the NCSC of threat activity in the oil and gas sector.

For example, the company identifies interference (external, internal or otherwise) within IT or OT or physical security, but there was no impact on the essential service.

Five steps

Companies can demonstrate they are able to meet the new regulations by following five steps.

First, companies must identify whether they are an operator of essential services (OES).

They are an OES if they operate any asset which, annually, produces more than 3 million tonnes of oil equivalent, any pipeline transporting more than 3 million tonnes of oil equivalent or 500,000 tonnes of crude oil based fuel, or a refining, treatment, storage or transmission facility handling more than 500,000 tonnes of crude based fuel.

Having decided they are an OES, companies should then identify what network and information systems the services rely on.

Second, companies should assess whether the current security measures and management meet the NISR requirements.

Third, having identified any gaps, design and execute a programme of improvements in whatever areas are lacking.

This may need to address any of the four NISR areas of systematic management of cyber security risks, proportionate security measures, monitoring of networks and systems, and incident response capability.

The two areas where companies are likely to be weakest are in the monitoring of operational technology systems to detect cyber incidents, and the ability to evaluate and, where necessary, report security events within the 72 hour limit.

Fourth, establish capability and processes to respond to a security event to minimise potential or actual impact on the essential services and to report events to the relevant competent authority (BEIS in the UK).

For example, loss of an OT system due to a security incident and which results in a loss of more than 8,219 tonnes oil equivalent production over a 24 hour period would need to be reported.

A simple desktop run through may not be sufficient and realistic exercises, similar to the emergency response exercises commonly done in the industry, may be more appropriate. In a really serious incident, it's possible that both the security and emergency response plans may be needed.

Fifth and finally, companies should periodically carry out an assurance exercise to give management confidence that the company can meet the demands of NISR, and that the essential services and, therefore, the company's key business activities, are resilient to cyber security events.

NISR will give a push to many companies to up their game on cyber security, placing demands on their organisations, budgets and people.

With all the safety and operational pressures inherent to the oil and gas industry, finding the time and expertise to do this could be challenging. Breaking it down into smaller steps makes it easier and ensures each step is built on solid foundations from the previous work.

digital energy journal

Palo Alto Networks – cybersecurity getting tougher for offshore

Oil and gas companies are getting increasingly aware of cybersecurity challenges for offshore operations since the Ukrainian electric grid cyberattack of 2015, says Palo Alto Networks

Since Ukraine's electricity supply was cut in December 2015 due to a cyberattack, there has been increasing awareness of the susceptibility of industrial installations to hackers, says Del Rodillas, director, Industrial Cybersecurity Product Marketing (ICS, IIoT) with cybersecurity specialist Palo Alto Networks.

Cybersecurity has become a challenge for operational technology, such as automation and control systems, not just information technology, as it had largely been before, says Mr. Rodillas.

There have been a number of attacks on oil and gas operational technology, including offshore rigs, Mr Rodillas says, including with ransomware, although the details are confidential. It points to the need for organisations to "bake in cybersecurity as they modernise their OT infrastructure."

A cause of the increased cybersecurity threat is the increased connectivity between offshore and onshore, driven by increased desire to shift work onshore, or move offshore computer infrastructure onto cloud systems, for example to do data analysis to try to optimise maintenance scheduling.

Companies also want to open up operational technology so they can have more flexibility in general, including enabling control system vendors to service equipment remotely.

Understanding your network traffic

It would help if companies could get a more fine grained visibility over user-based and machine-to-machine network traffic which are going to and from the offshore platform as well as within production control systems, and what they are for, Mr Rodillas says. In the past, understanding was "quite coarse grained," with knowledge usually limited to the less intuitive parameters such as port number and destination and source IP addresses.

Palo Alto Networks has technology which enables oil companies to understand the specific users on the network and what they are doing with IT and industrial applications and protocols, and so only allow authorised individuals and devices to do certain things. Similarly, machine-to-machine traffic can also be controlled consistent with business policies. Any other traffic would not be allowed access.

The network traffic between onshore and offshore and within offshore control systems are gradually changing from serial data flows (like a river of data) to data packets. There are "deep packet inspection" technologies available, he says. For example, it is possible to identify if someone or a machine is trying to "write" via the MODBUS protocol, which may be indicative of a cyberincident if that user/machine should only have read only access.

To have such a system, first of all you need to build a model of your system, with an understanding of who and what should be doing which task.

Some companies are setting up "directory services", with a database of people with specific roles, which can then be used to enforce role based access.

Segmenting the network is the next basic, but very effective step, to making offshore networks more secure. When it comes to segmenting the data traffic, you need to find something between "no segmentation" and "extreme segmentation", getting something in the middle where you create the right level of visibility and risk reduction, without obstructing work.

Another key component of user security is multifactor authentication. "People say I have a VPN so I'm secure, But what happens when your credentials get stolen, which is typically the first step for a lot of these targeted attacks?" he says.

Palo Alto Networks is also looking at using machine learning to easily detect anomalies in the network traffic, which could be indicative of a hack, and automate remediative action. For example, machines utilizing previously unused applications or machines establishing connections to other machines they never talked to before could be automatically detected.

Companies also need to develop better ways to take quicker and more automated action, Mr Rodillas says. Taking an action against a threat often involves much manual work, from staff

Del Rodillas, director, Industrial Cybersecurity Product Marketing with Palo Alto Networks.

who are already very busy. It should be possible to quickly lock a suspected malicious user out of the system. "Part of the responsibility we have as a security vendor is to make it easier for users to deploy and administer the more sophisticated security technologies," he says.

Another useful approach is to have an integrated security system, rather than multiple point solutions that don't work well together. "The more products you get, the harder [the system] is to administer, the risk of misconfiguration is higher, the non-correlated traffic and security logs masks possible cyberthreats and increases administrator analysis and response time," he said.

An integrated system can provide better performance for users, better intelligence about the threats, and better overall understanding of how the network is being used, he says.

Palo Alto Networks also makes a "virtual firewall" which can run on cloud servers, making sure that only the right sort of traffic is accessing the company's cloud data. The cloud is becoming increasingly relevant in offshore computing, with some companies diverting all traffic between onshore and offshore through a cloud system, or using it for storing and analysing offshore data, such as sensor data.

Palo Alto Networks is working with Oil and Gas companies such as Schlumberger to develop "perimeter" security systems for its exploration, production and processing equipment, including giving it a centrally managed security architecture across the plant floor, corporate networks, and cloud systems.