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United House, North Road,
London, N7 9DP, UK
www.d-e-j.com
Tel +44 (0)208 150 5292

Editor
Karl Jeffery
jeffery@d-e-j.com
Tel +44 208 150 5292

Advertising and sponsorship sales
Richard McIntyre
mcintyre@d-e-j.com
Tel +44 (0) 208 150 5296

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E-mail: subs@d-e-j.com

Cover image: Using a drone to do a laser scan of an offshore platform, by Texodrone Survey. It turns out that managing the laser scan is much harder than flying the drone, which the company sees as just a "taxi" for its technology. But laser scanning by drone is a lot easier than doing it with a handheld camera. See our article on page 22.

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Is 'business transformation through digitalisation' a useful term?

We are hearing the phrase "business transformation through digitalisation" more and more. While it is good to see the industry taking digitalisation more seriously, it might be useful to question how helpful this phrase actually is. It is describing a destination, not a means of getting there.

There have been a few big "business transformations" in the past 100 years - including the dot com era, the world wars, electrification and the industrial revolution. We can see the results of these transformations today, but it would have been pretty hard to predict in advance what the results of the transformations would have been.

And if you were steering a business through the introduction of say electrification in the early 1900s, it might not have been too helpful to think of yourself as "transforming business through electrification" - you were actually trying to find a way to make this new technology work for your business. And the same applies with digitalisation today.

We can also say that business - any business - is ultimately about buying and selling, or working with other companies. "Transforming" a business means finding much better ways to do this than the ones which existed before. Even with the introduction of a major technology, it is very hard to predict how this will work.

In today's era, if we look at businesses which have already been completely transformed through digitalisation, it is hard to see any patterns which indicate how the same processes could occur elsewhere.

Uber and Airbnb made businesses which basically monetise our under-used personal assets - our houses and our cars. People have tried to apply the same business model to other assets - but there are not many assets many of us have with equivalent value to our houses and cars. Even our time is not worth so much.

Some companies have managed to get all of their suppliers working together on a digital platform and sharing drawings so the various parts work together better to make a more complex whole. This hasn't happened much in oil and gas, but it has happened in aerospace and automotive manufacturing. Suppliers are often nervous about these systems because they don't like to share their own data with competitors. Note that one common factor of aerospace and automotive manufacturing is a large 'mother' company which has a lot of power over many suppliers.

In this issue we'll look at many interesting examples of business transformation through digitalisation in the oil and gas industry - but which were achieved by people trying to solve a problem, not to 'transform' anything at all.

We'll present an idea for using Bitcoin to make the process of managing water haulage from onshore wells more effective, enabling hauliers to get paid faster.

We'll look at how governments around the world are improving their oil and gas national data stores "National Data Repositories") and identifying important people-skills needed to do it better.

We'll look at how companies are finding ways to improve equipment reliability and uptime, maintenance effectiveness - by combining human expertise with analytics in ways which were very different to how it was predicted.

So next time you hear the term 'business transformation' - perhaps it would be useful to think, we have a lot of problems in our industry, can we find ways that digital technology might be able to contribute to solving just one of them?

Karl Jeffery, editor,
Digital Energy Journal

Where blockchain might help with oil and gas purchasing

A blockchain-type transaction management system could add value in oil and gas purchasing, perhaps if there are many complex low value transactions with multiple companies which are difficult to keep track of, such as in water collection from onshore wells, says says Amalto's Bruno Griede

A blockchain-type transaction management system might prove very useful in the oil and gas industry, where you have a fragmented system with multiple providers, multiple customers, low value and a difficulty keeping track of transactions.

This is the case for water collection from onshore oil and gas wells, says Bruno Grieder, CTO and founder of Amalto, a company specialising in oil and gas e-commerce software and document handling, based in Paris, Houston and Calgary.

Mr Grieder presented his ideas with a talk in the 2017 European conference of oil and gas e-commerce standards organisation PIDX, held in London in June.

A blockchain system might be far more accurate, fast, tamper-proof and less manually intensive than the current field ticket + invoice + payment system.

To explain the logic will probably need an explanation of both the water haulage business and how blockchain can work.

Water haulage business

Oil wells can produce up to 10 times more water than oil by volume. For onshore operations, the water is usually separated from oil close to the well head, stored in tanks, which are then emptied by road tankers (called tank trucks in the US).

There are between 50 and 100 million water tank truck trips every year from oil wells in the US, Mr Grieder estimates. It is a $37bn industry.

The process is arranged manually. The oil company requests a water tank truck, the tank truck arrives and empties the tank, the oil company issues a 'field ticket' to say that the service was purchased, the tank truck company issues an invoice, and it gets paid.

Payments can often be paid 80 to 100 days after the visit, so water hauliers can have enormous cash flow problems.

Bruno Grieder, CTO and founder of Amalto

And there is very little verification into what was carried. If there isn't a full truck load of water to collect, the tank truck will empty whatever is there, but still invoice for a full truck collection ("120 barrels"). There are often no level gauges on the tanks or flow meters on the trucks so no-one knows, anyway.

To add to the complexity, both the oil and haulage business can include many independent operators. So each haulier can work with multiple oil companies, and each oil company can work with multiple hauliers. It can be tricky making sure the right invoices go to the right companies.

How blockchain can work

Blockchain, in short, is like a log file which is synchronised between the parties involved in the transaction, with a record of what was agreed, which can never be changed after the transaction has been entered. The data is synchronised with a "consensus algorithm" running on each party server.

A computer system generates a short (eg 5 character "hash code" from a block of contents of the log file, and the hash code of previous transactions. The hash code is generated in a way that, if anything in the log file is changed, the hash code would also need to change. So, if the hash code doesn't change, that gives security that the contents of the log file has not changed.

The hash code system takes into account the previous hash code, which was generated from all the previous transactions, also put into blocks. (This is why it is called a 'block chain'). So the only way to change the log is to change the hash codes of all subsequent transactions, and change the record on every computer system which stores a record of the file. Since this is quite hard to do, the system is considered secure.

If a blockchain system was applied to water haulage, then it could create an automatic record of the transaction, which both parties agree to, at the point the water is collected. This record would be computer readable and un-tamperable.

All the administration beyond that could be automatic – because there is no dispute over what business was done, and a solid record of it, there is no need for any manual work – even the bank payment can be made automatically.

And once this solid digital infrastructure was established, it could easily be extended to include gauges and meters. Water tanks would be equipped with sensors which will trigger the Service Request when they are getting full and will measure the quantity of water lifted by a truck to establish the correct values on the electronic Field Ticket. So bring in the 'internet of things' into the system.

It would also be possible to bring in other parties to the system – banks, regulators and other kinds of service providers.

Avoiding central hubs

Another appeal of this sort of system is that there is no need for any central 'hub' system

to manage it – it can be entirely decentralised.

Developing 'hubs' has been a central feature of the e-commerce business landscape for years – with companies like eBay and Uber in the consumer world, and companies like ccHubwoo in the oil and gas industry.

Theoretically, a service like Uber, Airbnb and eBay could be set up without any central organisation, just a data standard system, where buyers and sellers send messages about what they are looking for, or have to offer, using standard data formats. Everybody has software which brings together the information each person needs onto their screen.

A blockchain type system which would keep an untamperable record of what two parties had agreed on (services offered and the price), which would then trigger automatic payment by the bank, that would add to the appeal of a decentralised system.

"No doubt the taxi drivers would prefer talking directly to their clients rather than via Uber or via Lyft and be subjected to their unilateral and changing rules and fees," Mr Grieder says.

Often hubs provide much more in the way of services, for example providing tools, software and checks – and these add value. But it is possible to provide these without being a hub.

If there was no hub, there would need to be an organisation which can put together data standards which are acceptable to all parties, and define the message 'choreography' – when messages are sent to who, and what messages must be made in order to trigger payment.

Role for PIDX?

In the oil and gas industry, e-commerce organisation PIDX could fulfil this role, defining data standards and message choreography for blockchain based transactions, such as the one outlined above, Mr Grieder said.

Until now, PIDX has focussed on how the electronic messages in e-commerce transactions should be put together, defining standard XML formats, so all parties understand exactly what has being transmitted.

So this would be something of an extension of PIDX's role, but a very interesting one, Mr Grieder suggested.

Amalto is going to write the first version of the Blockchain code itself, which it calls "Ondiflo Water Hauling," and after that provide the code to PIDX to run it, and hopes it will be taken up by the industry.

The biggest oil and gas cybersecurity challenges

The cybersecurity threat landscape for oil and gas companies is changing, with new groups making attacks in different ways, and companies increasingly working with data on the cloud. But companies are not always tackling the problem in the best way, said Vinnit Patel*, head of cybersecurity at Infosys Consulting.

The cybersecurity threat landscape for oil and gas companies is changing for multiple reasons, with data increasingly stored on the cloud, different groups making attacks in different ways, and new types of malware in circulation.

Vinnit Patel, head of cybersecurity at Infosys Consulting provided an update, speaking at the 2017 European forum of PIDX, the oil and gas e-commerce association, in London in June.

Vinnit Patel, head of cybersecurity at Infosys Consulting

"At many times, investment in security is being made in the wrong place," he said.

Many companies have invested in security "dashboard" type software, which will give them colour coded scores for performance, for example saying they are "green" in patch management and "amber" in vulnerability management. But these tools cannot be relied upon, and not all software will assess systems in the same way, Mr Patel said.

Meanwhile it has been estimated that 46 per cent of cyber-attacks go undetected – so companies might be better off investing in methods and systems which can better tell you if something is going on (such as a hacked video-conference camera sending streams of data when you don't expect it to).

The biggest cybersecurity threats usually stem from user behaviour and lack of security awareness, and whether data is being managed and secured effectively.

Phishing, tempting people to install files or click on links leading to malware on their computers, is the "most common form and easiest way to get inside an organisation," he said.

Who is the threat?

Understanding the groups making threats can be hard. For example, the hacker group "Anonymous" once announced a plan to target oil and gas companies, but it never materialised. "But that doesn't mean the threat is not real," he said.

You might be targeted by anonymous hackers or "hacktivists", government sponsored attackers (which is less common, he said), your own employees (who might leave the company and notice their accounts have not been disabled), or organised cyber criminals operating as a business.

"Insider threat is very common, it happens all the time, it is very difficult to stop," he said.

Cyber-criminal behaviour can be lucrative. "Victims in the U.S. paid over $24m in 2015 to recover data from ransomware."

Common ways for code to find its way onto systems include phishing (persuading you to click on an e-mail link and install code), other social engineering attacks, and stealing physical devices.

An example of phishing could be for someone to look up the names of all the database administrators at Shell on LinkedIn, guess their e-mail addresses, and send them an e-mail saying "click here for details of your pay rise", and 1 in 200 will click, he said.

An example of social engineering could be if a hacker looks at your Facebook page and can see you like soccer, and then can send you an offer of cheap football tickets, which you click on and get an "exploit".
Another concern is physical devices being lost or stolen. You should not believe that your device is safe because it has a password - it is possible to get around password controls on a laptop very easily, he said. Once password controls have been bypassed, the attacker has a device which is authorized to access the company network. A better way is to keep your entire disk encrypted, so nothing can be done without the encryption key.

Mr Patel sees cloud data storage as a "new attack vector" – a new way for people to hack in. Data can be secure in the cloud, but it depends on how you use it.

Most cloud data providers can transfer data encrypted if you activate it, he said.

Malware

Malware, which can do nasty things with your computer, is always advancing.

The Stuxnet attack of 2010 managed to include four "zero day" vulnerabilities, aimed at programmable logic controllers (PLCs). It would allow someone from outside to execute commands on your network.

Another big attack in 2011 was Duqu, a collection of malware thought to be connected with Stuxnet. In 2012 we learned about BlackEnergy, a Trojan that is used to conduct distributed denial of service attacks (flooding a target computer with instructions from multiple computers to bring it down), cyber espionage and information destruction attacks, based on some of the same code. In 2014 we saw a Trojan called Havex.

A Trojan, in computing terms, is a computer program which misleads in its true intent, for example a software which pretends to be cleaning your computer of viruses but is actually planting a virus on your computer.

Standards and policies

A corporate cybersecurity policy might start by looking at what corporate assets could be objects of desire from hackers, often personal data. You should see if you have any data which other people might be interested in – and if your methods of collecting, storing and using personal data are safe. You should also consider if a breach in your IT systems could lead to any danger to individuals.

Then you put in corporate policies and standards in place – and methods to make sure they are followed.

Many organisations get too comfortable, thinking that because they have a security policy and standards, and aren't seeing too many incidents, they are OK, he said.

A policy statement is normally just a high level statement, like "we promise to protect your data." (Although whether the data is actually being protected is another question).

Your "standards" go into this in more detail, such as how often you patch computers, how you keep aware of vulnerabilities, how you handle mobile devices, how you prevent intrusions, how you connect control system devices to the internet (if at all).

Then these standards should be underpinned by processes, each with accountable process owners.

You need to check your IT contractors are all adhering to the same level of security, doing security audits if necessary. "It doesn't matter how many tools you have deployed, if people with access to systems are not aware what to look out for, the risk increases," he said.

A common source of threat is the disgruntled ex-employee – so you need a procedure to make sure employees' logons to corporate systems are disabled quickly after they leave.

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** This article is based on a speech written jointly by Vinnit Patel, head of cybersecurity consulting, Infosys, and Simon Tucker, head of energy consulting Europe, Infosys*

Report from the Stavanger National Data Repository forum

The 2017 National Data Repository forum, a meeting for people who run government oil and gas data repositories, was held in Stavanger in June, organised by Energistics. Dan Brown, of UK NDR Common Data Access, provides this report

The 2017 meeting of the National Data Repositories forum was held in Stavanger in June.

Governments are the custodians of oil and gas data worth many billions of dollars. National Data Repositories (NDRs) are where governments store that data, to preserve and protect it, and to exploit it for the benefit of future generations.

National Data Repositories sit at a confluence of information technology, regulations, energy policy, and internet commerce.

They contain terabytes of data, some of which must be kept confidential, and all of which must be made available to the right people in a simple, secure, and speedy fashion.

They are the embodiment of regulations that set out how oil and gas data must be submitted to the regulator, stored, and preserved over a period of decades for future uses we cannot yet imagine.

The data can be used by governments to craft energy policy, prioritise areas for licensing, and ensure current licensees carefully steward the nation's natural resources.

And one way or another, NDRs must pay for themselves. A combination of drop box, internet shop, trading floor and Library of Congress does not come cheap. Arguing for, and securing the money to set up and run an NDR is neither quick nor easy.

It takes a special kind of person to run an NDR. Someone that understands data, IT, contracts, laws and regulations, has the vision to build and grow a user community, and is

Delegates at the June National Data Repository forum in Stavanger

willing to do all this as a public servant, rather than as CIO of a multinational corporation.

NDR2017 meeting

165 delegates from 30 countries came together for three days of discussion about NDR at the Norwegian Petroleum Directorate in Stavanger, Norway.

We heard from the oldest and the youngest NDRs on the block. The Energy Regulator in Alberta, Canada, has been collecting data since 1938, and had a wealth of experience and expertise to share with the conference, such as how to handle the permitting of over 500 wells per month. Zanzibar's NDR has been in existence for just 56 days, and its delegates attended to make their first steps on this long journey.

New Zealand shared its efforts to keep track of the whereabouts of oil and gas resources when an earthquake can move one part of the country relative to another by tens of metres. From Sudan, we learned of their dedicated work to keep their NDR running in the face of overwhelming international sanctions. Greenland (population 56,500) shared its solution to the problem of gaining access to skilled resources, by partnering to create an NDR through outsourcing rather than trying to build one from scratch.

The Director General of the Norwegian Petroleum Directorate, Bente Nyland, talked about the benefits Norway's oil and gas industry has received from easy access to open data. "Companies compete on the use of the data, not by limiting access to it. This 'open data' policy gives us a competitive advantage in attracting global investment", she said.

Sessions on standards in E&P data transfer and seismic data storage emphasised the benefits of adopting common, standard approaches, including seamless interoperability between software packages, lower cost delivery of required data to regulators, and certainty of access to high value data, even decades later.

Delegates expressed frustration that so little subsurface oil and gas data is "analytics ready". It is either represented as scanned images of paper, stored in formats that are not consistently followed, or lacking the software tooling and programming interfaces needed by data scientists to get going. Together, these pose a real barrier to moving subsurface data science to the next level.

Data quality

There is a NDR Data Quality Project, which began at the NDR 2012 meeting in Malaysia, gathered pace at the 2014 meeting in Azerbaijan, and is now approaching a conclusion.

Three documents written by the project are soon to be published by Energistics, and cover the business case for data quality management, the core concepts of data quality (standard business rules and metrics), and their place in a data quality framework. Also guidance on how to implement that framework within an NDR or an oil company.

Regional groups

Regional groups have emerged within the NDR community.

Around the North Sea, the regulators of Norway, Denmark, the Netherlands, and the UK have formed the North Sea Data Management Forum, to establish common data standards across all North Sea countries, particularly where interchange with the regulator is concerned. Through a Memorandum of Understanding, the countries will agree an annual programme of work that starts to tackle these shared issues – making the North Sea a simpler and more cost-effective place to work.

Regulators in Africa have formed the Africa Petroleum Data Management Forum. Composed of representatives from Angola, Ghana, Kenya, Mozambique, Southern Sudan, Tanzania and Uganda, and backed by the NPD's Oil for Development programme, the forum provides a venue to tackle the challenges of running an NDR in Africa, and for each of the individual member countries to share their talent and expertise, both regulatory and technological.

Technology

The conference was sponsored by a number of technology companies including Schlumberger, CGG, and Target.

Technology approaches hold answers to some of the long-standing challenges identified in the breakout sessions considering the future of well and seismic data management - how do you build a collection of national data that is of known quality and completeness, and that is accessible to current and future oil & gas explorers and, increasingly, directly to the computing systems they use?

People

NDRs need people to oversee them, and those people need a solid foundation of skills and training to get their job done well.

Common Data Access, which runs the UK National Data Repository, talked about their efforts to improve access to education in data management, including the undergraduate level course developed at the Robert Gordon University in Aberdeen and delivered by distance learning.

AI in science– think of it like a "co-worker"

Perhaps the best way to understand the value AI can add to geoscience is to think of it like a co-worker, says David Holmes, CTO – energy at Dell EMC

Perhaps the best way to understand the value artificial intelligence tools can add in geoscience is to think of them as a co-worker, suggests David Holmes, chief technology officer – energy with digital technology company Dell EMC.

David Holmes, CTO - Energy at Dell EMC

In a geoscience working environment, there could be AI systems trying to spot patterns on a seismic image, or having a go at interpretation, but they would need expert geophysicists to tell if it was any good or not.

So geoscientists could be considered like "team leaders" of an AI computer team, with AI systems effectively saying, "I've done an interpretation, what do you think."

The AI systems will also be able to handle any task which looks remotely like drudgery, such as picking horizons on seismic, and data quality control.

So the role of AI sounds a little bit like a droid in Star Wars. The AI can make suggestions and analyse data, but the human expert is still making the final decisions.

However, it is important not to overestimate how good image recognition is in 2017.

Mr Holmes tells a story about an experiment with Google's image recognition tool, where the system analysed an image which a person would say is obviously a panda, and the computer was "57 per cent sure it was a panda". But when 0.05 per cent noise was added to the image, which a human couldn't even notice, the computer became "97 per cent sure it was a gibbon."

We can expect AI technology to come up with many new and interesting insights, although we can't predict what they will be, Mr Holmes says. An example is the Google DeepMind computer which won the Go! game, which (as well as winning) also came up with many new ways that the game can be played.

The AI world has many other surprises. Another one is how fast it was possible to model the human genome. It took 6 years, when experts had expected it would take 20, Mr Holmes says. "They didn't anticipate how quickly they could scale up human performance. We can do these things in minutes."

So we should probably not make predictions on what kind of contribution artificial intelligence could make to curing cancer, he suggests.

Deep learning can work on the physical world at any scale – from modelling entire galaxies, to developing high resolution image of a 6inch core from a well, scanning in high resolution at 20 different wavelengths, he says.

The AI tools can provide data analytics capabilities, data lake (big data) processing capabilities, process automation tools, and all hosted on cloud infrastructure.

Hackathon

Dell EMC supported a "Subsurface Hackathon" event which was held in Paris in June on the weekend before the annual event of EAGE (European Association of Geophysicists and Engineers).

The Subsurface Hackathon was organised by Agile Scientific, a company based in Nova Scotia, Canada, which specialises in solving subsurface problems in the natural resources industries, including with analytics, data management, using machine learning, geophysical interpretation, seismic modelling, geodata maniupation, uncertainty anlaysis and knowledge management.

The hackathon was also supported by Total, NVIDIA, Amazon Web Services, Teradata and Sandstone Oil and Gas.

There were 40 teams, with about 70 people in total, spending the weekend trying to come up with machine learning projects. This included teams from oil companies and software companies. By Sunday afternoon, "every team had a plausible demo," Mr Holmes says.

Companies were asked to present a 4 minute "pitch" of what they had done. "It was absolutely inspiring," he says.

There were projects to train deep learning neural networks to understand seismic, to analyse historical groundwater in the Netherlands, to look for traps in seismic data using pattern recognition technology. "The geologist knows what a trap looks like and teaches it to a machine," he says. "You could do something similar for faults."

Mr Holmes loves the culture where someone in their 20s can use statistical programming language Python to get some fast visualisations of data, while big software companies take six months doing market assessments before doing anything.,

"I see a new way of oil company internal development, hiring 'agile developers ' who can code and create a new applications," he says. "It's going to be an exciting time."

Teenagers

Mr Holmes is also excited that 16 year olds today treat the virtual world as second nature. You can start to wonder what they might be able to do when they enter the workforce and work with virtual tools in the oil and gas industry.

It is like when children are used to touch screen tablets and don't understand why someone is using a mouse to navigate with.

Dell EMC has demonstrated its own virtual reality systems of oil and gas reservoirs to teenagers, and often found them less than impressed, because computer game virtual reality has more exciting imagery, he says.

However 16 year olds have been very impressed by a geological map of the UK in Minecraft, which has been made by the British Geological Survey, he says.

Oman's "living data room" to encourage licensees

The Oman Ministry of Oil and Gas has placed large amounts of subsurface data for free perusal online, in order to make it easier for companies to understand what is on offer and consider making bids.

The website, https://ldr.omanbidround.com provides basic information about the blocks on offer free of charge. After registering interest (and paying a $5000 registration fee), you can get access to data review packs for the blocks on offer. Then you are able to purchase full data packages for each block, for $20,000 each for "raw", "ready to interpret" and "interpreted" data.

The data can also be provided as completed "projects" which can run in software packages Petrel (Schlumberger) and Kingdom (IHS).

The data can all be viewed online using the "Meera" platform, developed by Oman company Target Oilfield Solutions. The data servers are in Oman.

The bid rounds are now closed with bids being evaluated by the Ministry, with bid decisions to be made at the end of 2017.

OCTIO – Seabed 4D gravity and subsidence monitoring

Reservoir monitoring and subsea surveillance company OCTIO, based in Bergen, Norway, reports that its technology for measuring gravity and ground subsidence on the seabed is applied in eight oil and gas fields on the Norwegian continental shelf.

The technology was developed internally by Statoil, and taken over by OCTIO in 2013, with an aim to achieve a wider roll-out of the technology.

The technology has been applied on the Ormen Lange field since 2012 with excellent results. Ormen Lange is the second largest gas field in Norway.

Gravity data is recorded in dedicated surveys, by high precision gravity meters that are placed at a set of predeployed concrete platforms above the fields. 4D gravity is especially useful for mapping gas depletion and water influx from the aquifers.

Once gas is produced, its place can be occupied by water which leads to a higher gravity reading, as water has a bigger density, says Martha Lien, senior geophysicist at OCTIO. In cases with weaker aquifer support, gas takeout will show up as a reduction in gravity. Hence, gravity data is used to predict water breakthrough in wells; and, thereby, to optimize production.

By recording gravity on the seabed, the accuracy is "orders of magnitude" better than recording it from vessels or from aircraft, Dr Lien says, since the recording is performed under stable conditions at the seafloor. Moreover, by conducting the measurements closer to the reservoir, mass changes are monitored with higher resolution and with better spatial resolution, both laterally and vertically.

The system measures ground subsidence by monitoring changes in water pressure at the seafloor, once corrected for tidal and environmental effects. The final accuracy obtained across the entire field is as small as 2 mm.

The high accuracy in both gravity and pressure measurements is achieved by comparing the measurements above the field with measurements away from the field, Dr Lien says. This provides a way to calibrate the readings and a way to correct for any systematic uncertainties in the data.

The subsidence data is useful on both gas and oil fields. It provides a measure of how the reservoir compacts during production and is valuable to identify undepleted compartments within the field. In field development planning of, for example, infill wells this information is crucial. Information on seafloor subsidence is also important to secure the safety of seafloor installations. There are several examples of seabed subsidence as the oil in reservoirs below is produced, causing problems with the platforms, sitting on legs on the seabed.

Both the gravity and the seafloor subsidence data is collected at a fraction of the cost of a seismic survey. Each survey lasts for about 2-4 weeks depending on the size of the field with the first processed datasets being delivered three weeks after the survey ends.

Octio recommends the following papers on seabed monitoring:

Ruiz, H. et al., 2015, Monitoring of Offshore Reservoirs Using 4D Gravimetry at the Seafloor - State of the Art: 77th Conference and Exhibition, EAGE, Extended Abstracts, Tu N101 08.

Ruiz H., et al., A New Method for Field-wide Real-time Subsidence Monitoring with subcentimeter Accuracy, 78th EAGE Conference & Exhibition 2016, Extended Abstracts, Tu LHR2 04, 2016.

Lien, M., et al., How 4D Gravity and Subsidence Monitoring Provide Improved Decision Making at a Lower Cost, First EAGE Workshop on Practical Reservoir Monitoring, 2017.

Vatshelle, M., et al., Monitoring the Ormen Lange Field with 4D Gravity and Seafloor Subsidence, 79th EAGE Conference and Exhibition, Amsterdam, June 2017

Silixa – acoustic sensing with much less noise

Silixa has developed a fibre optic cable for recording seismic in wells, which is 100x more sensitive than the current Silixa iDAS seismic system, leading to improved imagery of the sub-surface.

UK company Silixa has developed a way to treat fibre optic cable so it is much more reflective – so it can record seismic data in wells with 100 times more sensitivity.

Companies record seismic data in wells so they can monitor what is happening in the reservoir around the wellbore.

One of the first installations is in Australia, where the well is being used to inject carbon dioxide into a reservoir. With repeated seismic surveys, it is possible to monitor the spread of the CO2 plume within the reservoir. The CO2 does not show up directly on the seismic image, but shows up indirectly, as extra distortion on the image.

The well is near Melbourne, run by the Otway Research Facility, part of research organisation CO2 CRC.

The company has been selling IDAS services for four years on over 80 wells, onshore and offshore.

This newly developed technology is called "Carina" that increases the sensitivity by 20 dB.

Silixa's Mick Longton

Silixa does not disclose the details of how it is treating the fibre optic cable, but the result of its treatment is that more of the light going through the fibre is reflected by the seismic events. This allows the upgraded laser interrogator to deliver the improved sensitivity signal.

Silixa in general is seeing growing interest from the industry in installing fibre optics in wells for permanent reservoir monitoring.

For seismic monitoring however, it is much cheaper to trench the fibre at surface, than install in a well, says Mick Longton, commercial director of Silixa.

The fibre optic system provides a geophone equivalent repeatable seismic recording at a much cheaper cost than using geophones down the well on wireline, which to date has been the standard way to record seismic inside wells.

The technology might make it viable to do permanent monitoring on some wells for the first time – it would probably be too expensive to monitor something like CO2 injection using conventional surveys, he says.

The challenge now becomes changing industry culture – because the industry is very accustomed to recording well seismic using geophones on wireline. "Is the industry open enough to recognise a geophone isn't the only answer?" Mr Longton asks.

Silixa uses its fibre for a range of different areas in the oil and gas industry, including frac operations and monitoring well integrity. It also has a business unit focusing on other industries, with applications such as leak detection, power cable monitoring, and flowrate measurements.

Find information on your computer like articles on eBay

In the oil & gas industry opportunities are missed and unnecessary risks taken because digging key information from reams of legacy documents takes too long.

Pinker, a low cost software tool, allows you to find information on your own computer as easily as finding articles on eBay. It was developed by Pinkerfind UG, a company based in Dresden Germany.

Taking the same approach as eBay in terms of using categories and filters to refine your search, Pinker lets you define your own categories called "topics". (Technically, Pinker allows you to incrementally build ad-hoc ontologies and use them to speed up the search process.) As you apply filters, Pinker shows how many files match each of your topics, so you can quickly narrow down your search.

You can save useful combinations of filter settings and use them again the next time you look for the same or similar documents. This is akin to creating "logical folders" based on topics, independently of where files are stored.

"Pinker was not designed specifically for the oil and gas industry but I believe the industry could find it very useful for data room screening or sifting through legacy documents when decommissioning", says Christoph Ramshorn PhD, co-founder of Pinkerfind and a former consultant and scientist with Petrotechnical Data Systems BV and Schlumberger. "Pinker search is fast and flexible. It can even deal with homonyms (two words spelt the same but with different meanings) such as "article" in the header of this article. And you don't have to upload your data anywhere."

You can install Pinker on your own PC and index the drives and folders of your choice - including USB, network, and cloud drives. Free trials are available from the website www.pinkerfind.com.

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IFS and Songa Offshore – upgrading IT systems to "sell by the well"

Some drillers are experimenting with new business models, such as selling services by the well instead of drilling by the day – and finding that they need to upgrade their IT systems to do it, says Hege Wroldsen of software company IFS, which is working with driller Songa Offshore

Some drilling companies are starting to experiment with new business models, such as charging by the well, rather than by the day – and discovering that they need to upgrade their IT systems so they can better manage their costs, says Hege Wroldsen,, managing director of the centre of excellence for oil and gas at Swedish enterprise software company IFS.

As a result, the oil and gas industry may see the 'step change' improvement in drilling efficiency, including from reducing non-productive time (NPT), leading to the overall decrease in drilling costs which will make it viable to drill many more smaller reservoirs, thus keeping marginal and mature fields such as the North Sea in operation for many more years.

IFS provides software to Songa Offshore, a Norwegian-Cypriot offshore drilling contractor which describes itself as "midwater", active in the North Atlantic.

If the drilling company agrees a fee based on wells drilled rather than days drilling time, that means that the drilling company's costs increase if there is non-productive time (rather than the operator's costs). So the drilling company has a bigger incentive to look hard at how to reduce them.

When there were good margins available with day rate drilling, companies were not under pressure to change how they worked. Now fewer wells are being drilled and there is bigger competition.

Drillers have realised that one thing which would make them more attractive to their clients is for them to take on more of the risk, Ms Wroldsen says.

Other industries, such as automotive, went through similar change decades ago, and are now working much leaner.

Oil company managers have said that they find NPT a very difficult cost to tackle – everybody knows what the NPT is, but finding the actual root causes of the reasons requires a deep dive into different systems. Often drilling companies do not have a clear idea themselves, and can have a strong incentive not to reveal it to the operator, if there is an indication that the driller may have been at fault.

But the reasons for NPT can only be that one of the factors required to drill was not present – personnel, functioning equipment, spares or other deliveries – and these are things which a good enterprise resource planning system ought to be able to fix. In particular, better use of data and software might enable commonly occurring faults to be identified and eliminated, thus reducing unplanned downtime.

The idea also fits with a current general business trend of 'servitisation', where suppliers make use of digital technology to be able to offer a service geared around something a customer specifically wants (wells, production, blow-out protection), rather than providing a service which the customer only wants indirectly (drilling time or contractor hours).

For drillers to 'servitise' their offering, they will often discover a need to bring in much more flexibility in their offerings, and this also drives a bigger need for IT systems, Ms Wroldsen says.

"Your backbone has to be up to speed and flexible enough for you to change the way you work and adapt your processes to what you are wanting to provide to your end customer. You can't really do that without having your IT in order."

Oil and gas companies have proven very good at 'operational technology' for many years, including how they work in subsea, downhole. But they've had a different approach to 'information technology' for a long time, she says.

Companies which haven't kept their IT systems up to speed have to decide whether to keep on patching their systems or put in a completely new one. But if you have a large system of different pieces of software, it will increase your complexity, she says.

Songa Offshore

Drilling company Songa Offshore has a number of contracts with oil major Statoil. It has 7 "midwater" rigs (for depths between 'deepwater' and shallow water), of which 3 were cold stacked as of June 2017.

Songa Offshore has been working with IFS since 2013 – they implemented an ERP system which includes asset management, logistics, operations, all in one system.

"They are basically really well equipped to have full visibility of all their data, transactions, assets, in one system," Ms Wroldsen said.

Songa started small with some simple optimisation exercises, trying to find ways to use the available data to improve running hours, taking real time drilling data gathered by Kongsberg. The data streams directly into the IFS software with no manual intervention. So there is lots of correct data with less errors.

"They are gaining the experience, learning about how this works, how does this change with the organisation – basically learning to kind of crawl before they start running," she said.

Drilling companies are looking for tangible benefits over the short term for any spending they make on software, and IFS is trying to help Songa staff be able to demonstrate this to their management.

In the next stage of software development, Songa may install a condition based maintenance system, which will enable the company to develop a "comprehensive maintenance strategy for all of their assets, instead of only going by calendar – the

more traditional ways of doing maintenance," she says.

And if you can do less maintenance, you also create less opportunity for damage to occur – since maintenance is a big cause of failure. This may also lead to longer lifetime for the asset.

"That kind of end to end understanding and approach is going to realty make a huge difference, and will allow for much leaner operations than we have been seeing."

IOT Connector

IFS has an "IOT connector", a set of software tools which can connect with sensor data, or analysed sensor data from various system providers. The data can then be fed into the IFS asset management system, where the data can be used for planning and optimising maintenance.

Songa has connected 600 sensors on each of its four "category-D" rigs. The sensors have been installed first of all in diesel engines and electric motors.

Songa plans to use the data to help meet a company objective of reducing the length of time rigs need to stay in repair yards, leading to cost savings. It also wants to reduce the amount of unplanned downtime (equipment breakdowns).

"Songa Offshore sees great strategic potential in leveraging IoT to reduce time spent on manual data entry, automate cross-functional processes, and to turn raw data into actionable business information that supports and enhances analysis and forecasting activities," said Mark Bessell, chief operating officer at Songa Offshore, in a press release statement.

"Implementing the IFS IoT solution means significant improvements in terms of asset reliability, service performance, and cost savings," said Vardans Saribekjans, senior technician at Songa Offshore, in a press release statement. "By feeding sensor-captured data into IFS Applications, we can act much quicker to service needs and even work proactively to prevent problems before they arise."

Using data quality and dictionary standards in purchasing

When you need to buy something from a new supplier, you need to know exactly what you are buying. Data quality and dictionary standards can ensure this. Peter Eales of ECCMA explained how the standards work

When you need to buy something from a new supplier, you need to know exactly what you are buying. Data quality and dictionary standards can ensure this.

Peter Eales, UK and Ireland representative of the Electronic Commerce Code Management Association (ECCMA) explained how the standards work, speaking at the 2017 European meeting of oil and gas e-commerce standards group PIDX in London in June.

Mr. Eales represents ECCMA in the UK and Ireland, and in across various locations in Europe. He is a specialist in MRO materials management with further expertise in computerised maintenance management system (CMMS) master data for equipment and spare parts.

He has experience in a wide range of industries including automotive, consumer goods, oil and gas and pharmaceuticals. He has track record of delivering successful projects for maintenance storeroom reorganizations, maintenance system data transition, and cataloguing.

He was formerly global subject matter expert for master data with oil company BG.

Peter Eales of ECCMA

There are two ways data is spread. One is by documents (typically text or spreadsheets). The other is by data in data standard formats – which machines can read.

At the core of any data standard format is the dictionary, which is a single definition of things – so one computer can understand what another is talking about.

Efforts to develop standard formats for purchasing have been going on since after the Second World War, when people wanted to be able to order something from a supplier and know exactly what they would receive, he said.

Saudi Aramco has asked for a complete technical specification of every item it is importing, in compliance with ISO 8000. If this is not provided, then you will need to pay an import tax.

This is to try to reduce the size of its "exemption database" of items it has imported in the past with no technical specification – which now contains 40,000 items in it.

ISO 22745 and ISO 8000

The core standard you need to know about is ISO 22745, which has guidelines on how to write a technical dictionary, so everybody is using the same terms with the same definitions, and any disagreements can be resolved.

ISO 8000 is the international standard that defines the requirements for data quality and portability of enterprise "master data". Master Data is typically "internal" business information about clients, products and operations.

ISO 8000 looks at quality of data from bottom up, from the smallest meaningful element. Unless you can get this right, it is

impossible to remove duplicates, because you don't know if something is exactly the same as something else, he said.

Understanding ISO 8000 and how it can be used to measure data quality is an important first step in developing any information quality strategy, he said.

By putting ISO 22745 and ISO 8000 together, you can have an electronic system which with a high quality technical description of what you are buying and what it can do.

The systems aim to make data "resolvable" – in other words you always know exactly what you are talking about, rather than having to discuss something on a telephone call.

Mr Eales sees the data standards as working like an onion. The core is the open technical dictionary, as defined under ISO 22745, which acts as a foundation. The data quality standard, defined under ISO 8000, goes around this, saying which data items must be presented.

Also, by specifying the data quality, you avoid problems like when somebody submits a handwritten or photocopied document which is impossible to extract any data from, when you actually wanted a specific machine readable database of items, he said. Instead of just saying in a contract "all data must be supplied," you can say, "Data supplied must comply with ISO 8000."

Note: Peter Eales offers consultancy services to help companies understand how ISO 27745 and ISO 8000 relates to their business, and how best to go about implementing them. He can be contacted on peter.eales@eccma.org

M-Flow - introducing carbon fibre flowmeters to oil and gas

M-Flow Technologies of Oxfordshire, UK, is introducing carbon fibre flowmeters to the oil and gas industry – which can tell you the composition (not the quantity) of flow without any device fitted inside the pipe

M-Flow Technologies of Oxfordshire, UK, has developed a flowmeter using carbon fibre pipe, which can tell you the composition (not the quantity) of flow, without the need for any device to be inserted within the pipe itself.

The measurement is made with microwaves sent through the pipe.

Microwaves cannot pass through steel pipe. So the flowmeter uses a length of carbon fibre pipe (which replaces a section of steel pipe).

Because the flowmeter has no moving parts, and the meter does not come into any direct contact with the fluids, it does not wear out or degrade – ensuring the calibration does not change.

The consequence of M-Flow's innovation means that operators do not have to deal with a common problem with conventional flowmeters – when the reading changes, they do not know if the flow itself has changed, or the flowmeter has somehow changed. Often the only way to check this is to physically remove the flowmeter and send it to a laboratory – and even then you might cause a change in the flowmeter's calibration when you re-install it in the pipe.

Traditional flowmeters also need a great degree of attention – cleaning, maintaining and repairing. Sometimes you can find that less than half of the pressure and temperature sensors in an installation are actually working, because the maintenance hasn't been done.

Giles Edward, CEO of M-Flow

The M-Flow meter can be used in any kind of harsh flows, including sour, heavy oil and solid laden flows (sand and wax).

The company claims accuracies of +/-0.14%, in a water cut range in field conditions of 0 to 2 per cent (including slugs up to 30 per cent) – and this flowmeter can cost a fifth of the price of conventional flowmeters.

M-Flow Technologies was founded in 2012, growing out of another company which had been developing carbon fibre composite pipe.

Composite materials for pipelines have only been available for the past few years. They are lightweight, reliable and corrosion resistant – and also which microwaves can pass through.

Giles Edward has been CEO of M-Flow since it was founded in 2012. He has a background in project and operations management, working for Total around the world – but then moved to research and development projects.

The device

The meter does not record actual flow, which cannot be done with microwaves, but it can record the composition of the flow – the crucial information of water-oil ratio and the gas-oil ratio. The sensors are placed around the pipe – so they can 'see' the fluids but are not physically in the fluids.

Microwaves and gamma measurements are "reasonably well established" way of measuring composition, says Mr Edward. But until now it has not been done together with carbon fibre pipe to make a new type of flowmeter.

The measurement is made with microwave sensors supported by gamma density gauges, along the full volume of fluid flow in the pipe section. So there is no "spot" measurement.

The system can run on a normal 24v oilfield instrumentation power supply, drawing 10-15 watts.

For remote sites, the company can use solar panels, batteries and GSM communications to create a standalone system. It can communicate data in standard industrial protocols.

Using it

The technology is designed to be installed at well heads or on any production line, where there is a mixture of different fluids in the

flow, and a need to understand the ratios between them.

It can be used to provide warning about water breakout into a production line, or slugs appearing in the line.

Understanding water is often the key to understanding reservoir production and well optimization, and being able to remove bottlenecks from processing facilities, getting crude oil quality to a level where it can be exported, Mr Edward says.

Oil company people frequently say they want flow rates, but actually the composition can be much more important – since companies need to monitor the water cut.

If you have 10 wells all feeding together, then you need to measure composition in each of the 10 wells in order to know which of them is putting water into the commingled stream.

The bigger 'digitalisation' picture is that it should help companies get a better understanding of their production at lower cost – so they are more likely to be able to (for example) immediately adjust for the impact of changes in water cut on a faster basis.

Multiphase meter

Operators are starting to recognize that it can be easier to improve their overall production by getting more production from an existing oilfield, than from having to drill new wells to find new oilfields.

And in today's environment companies can see that 10 per cent of production can be the difference between profitability and shareholder revolt.

There is a detailed case study on the company's website, of a trial project done with a "very large US company" and an oilfield service company, which currently prefers to remain confidential.

In the test, the flowmeter was installed on a tanker offloading buoy, carrying different oil types (API from 17 to 37). It collected 64 data sets, and the results were compared with readings from the client's standard Inline Sampler (ILS) data and Karl Fischer titration analysis of physical samples.

The meter could also identify slugging flow regimes and free water in the line.

Markets

M Flow has already made sales of the system to North American onshore operators.

M-Flow understands the importance of being an "industry facing company", not just a "bunch of engineers with a clever idea," he said. It recognizes that industrial products need to be easy to install, just like the way home internet routers have become easy to install.


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Tendeka – multiple applications from a single wireless completion tool

Completion solutions provider Tendeka has developed a wireless (pressure pulse) communications technology which can be retrofitted into existing wells, making it possible to receive temperature and pressure data from downhole and send instructions to open, close or choke Interval Control Valves (ICV)

Completion solutions provider Tendeka, headquartered in Aberdeen, has developed its PulseEight technology to communicate bidirectionally between the wellhead and downhole, using unique pressure pulse telemetry. It provides cable free control and monitoring for a wide range of applications.

The name PulseEight came from the 8 possible applications that can be performed with the one device. These are Water / Gas Shut-off, Interval Control, Pressure / Temperature Monitoring, Multi-lateral Well Control, Autonomous Gas-lift Optimisation, Gas Hydrate Prevention, Cross-flow Prevention and remote barrier for multi-stage frac applications.

An alternative way to communicate with sensors and controls downhole is to use cables. But cables can get very complex, with lots of work on the rig making connections, lots of complex downhole connections, and potential leak points. They can be very hard to retrofit in an old well, if the cable needs to pass through a well control barrier. By removing the cables, it makes operations much less complex.

Technology

The main criteria in designing the initial tool was coming up with a wireless gauge which could be simply retrofitted into an old well where the conventional permanent downhole gauge (PDG) had failed, says Gillian King, Vice President of Corporate Development and Marketing with Tendeka.

"Our client had previously installed cabled downhole gauges but they had failed or in some wells no gauges were run at all. They were planning infill drilling campaigns and had no data to monitor the depletion of the reservoir", she says.

"We were asked to come up with a device that could be hung off in an existing nipple profile and provide the pressure and temperature (P/T) data without any additional surface kit being required. As a result, operators with multilateral / complex wells can have access to data they wouldn't have before, the technology is opening up applications that weren't possible before."

Gillian King, Vice President of Corporate Development and Marketing with Tendeka

The advantage of using pressure pulse telemetry is that the data is sent using the wellbore fluid as a carrier so the device can operate at any depth. No boosters are needed to repeat the signal.

The company has installed the P/T gauge in several wells to date, trialled it in wells with high temperature, and wells with high gas volume fractions, to try to determine the 'operating envelope' of the tool – the range of conditions it can satisfactorily operate within.

You don't get high data rates with pressure pulse telemetry as it takes time for the downhole pulse to be seen on the surface recorder but our client didn't need them. This tool is designed to send a few packages of data a day – just enough for the reservoir engineer to plan the next drilling campaign with temperature and pressure or for depletion and cross-flow monitoring.

The hard part of the technology development was demonstrating the two-way data communications can work. A field trial was held near the end of 2016 showing it was possible to send pressure and temperature data up the well and send instructions downhole to communicate with a downhole device. The next step is multiple downhole devices communicating with each other!

Battery lifetime

The downhole systems are powered by battery which is probably the most critical and limiting part of the technology - because if there is no downhole power, it is impossible to send or receive data, or activate downhole devices.

The battery life depends on the temperature (higher temperature means lower battery life) and the amount of data which is sent, but at the moment Tendeka believes it can run for up to 5 years. The tool can 'hibernate' (so switch off power completely) when not sending data to enhance battery life.

In the installations to date the device has been hung off inside existing completions so it is relatively easy to change the batteries using a wireline tool, she says.

When you start looking at fully intelligent completions the devices will be run, and are required to function in the well over its lifetime, and operators would not plan to ever remove them. This is when you need longevity.

There is a lot of work going on by different organisations to try to develop batteries with a longer life, or even generate power downhole (for example by flowing fluids over a turbine) to recharge the battery, she said. Tendeka is also working on this.

The market

PulseEight was originally designed for use in offshore conventional wells to provide reservoir data as described above. When oil prices dropped, many companies decided that they didn't need a monitoring

system in the completion – and saw it as a "nice to have". But although oil prices are remaining low, we are seeing more and more enquiries coming through for our monitoring systems – both PulseEight and Distributed Temperature Sensing (DTS).

Tendeka sees a big market for monitoring in the shale wells in the US, where companies want a better idea of where the frac fluid is going in order to quantify the production from different zones. More and more operators are looking to run DTS, Distributed Acoustic Sensing (DAS) and microseismic to get a clearer picture of what is happening within the reservoir.

We have looked at installing PulseEight in onshore unconventional wells too. With the current emphasis of shale operators on well spacing and frac placement, there are more and more cases of frac hits occurring and nearby wells are typically required to be shut-in while fracs are being performed. Using PulseEight as an autonomous well plug (AWP) replaces the need for conventional bridge plugs and allows multiple operations from a single deployment by closing autonomously when an extended well shut-in is detected.

An advantage of PulseEight is the versatility of operations for example in multilateral applications to monitor which lateral, or zones within laterals are producing water or gas, and closing or choking the valve to optimise hydrocarbon production. The market is increasing all the time.

"And I think people are starting to focus more on production optimisation and efficiency, and understand that the more downhole data and control you can get from the well, real time, allows you to plan future wells more effectively."

Comparison with fibre

Tendeka also produces fibre optic systems which can be installed in producer and injector wells to measure temperature every metre along the wellbore, called Distributed Temperature Systems (DTS). These can measure temperature changes caused by the interaction of the fluid within the wellbore, geothermal gradients and cooling effects as a result of gas expansion. The data is used to determine the flow profile in the well, stimulation effectiveness, detect leaks and optimise gas lift.

Whether oil companies want to install downhole sensors communicating wirelessly (as described above), or fibre optic systems, will mainly depend on the amount of data required and what they want to do with the data – do they need single point data only or data along the whole well and do they need it for reservoir trending purposes only or for determining contributions from various points along the well.

And of course, fibre optic systems are solely for monitoring and cannot be used to control devices downhole.

Tendeka have installed DTS on several wells in coal seam gas (CSG) fields in Australia. These are very low temperature wells and because of the minimal temperature differential between the sometimes very thin coal seams it was unclear if the DTS would provide any powerful data.

"Working with our proprietary software FloQuest, to analyse data, it was possible to track production from different zones," she said. "Clients are not going to run fibre in every well but running it in a percentage gives a good portrayal of the reservoir and allows future campaigns to be planned more effectively."

Dassault Systèmes – using digital 3D worlds to support decom

Dassault Systèmes is building virtual models of oil and gas projects – which can be used to plan and optimise the real-life project. This could be a great help in making decommissioning projects go more smoothly and reduce costs

Dassault Systèmes, the 3DEXPERIENCE company, is building virtual models of oil and gas projects, which can be used to plan and optimise work. These could be a great help in making decommissioning projects go more smoothly, avoiding problems which might increase costs.

Dassault Systèmes develops industry solutions and applications that support 3D design, engineering, 3D CAD, modelling, simulation, data management, working in the aerospace and automotive industries among others. Over the past few years it has gradually evolved from just making design tools to making digital "experiences" where people can use digital 3D models to get a better understanding of the real (physical) world.

The company, headquartered in France with a global presence, describes itself as a "research and development based scientific company, which takes a systematic approach to the creation of knowledge associated with the physical world."

"We use the virtual world to observe, experiment and validate what is going on," said James Rosenshine, senior industry executive, oil and gas, with Dassault Systèmes.

As an example of how it can work, consider the "virtual model" of the city of Singapore, which Dassault Systèmes has been commissioned to create by Singapore authorities.

Dassault Systèmes is putting together all relevant and available data about Singapore to build a 3D model of the city and what is happening in real-time, as a "living model". It includes details about buildings, weather / air, people and vehicles as well as underground infrastructure.

Using this model, it will be possible to answer questions like, if we build a skyscraper here, how will it affect the surroundings and factors like the airflow around it, he said.

"If a city, which is a complex ecosystem, can do it, then the oil and gas industry can do it," he said.

If a similar approach was used for a decommissioning project (or group of projects), it would be possible for the people involved to see past and current progresses through on-

line visualisation, experiment better ways to do work and see where the gaps in available information are.

This virtual world is much more than electronic files stitched together – it means transferring the company's entire operation in digital version into a collaborative platform, he said.

There is often talk in the industry about making a "digital replica", a digital representation of what is happening in reality. This is a similar idea.

"You can create a 3D model which incorporates all the requirements, all the functions, logical information associated with an asset. Also, you can understand entire (eco) systems and behaviours associated with that asset," he said.

"This gives you a living model that you can use in late life and decommissioning."

Making decommissioning go better

A platform can help make decommissioning projects go better.
The platform is hosted online, so everybody can work with it, you don't need special software or computers. You can also link in customers, suppliers and partners.

The digital models based on the data available form a basis for multi-disciplinary collaboration, because everyone works on the same model and data basis. So, it can help break down the "silos" within organisations, where different departments don't collaborate as much as they could.

The consolidated data can be used as a basis for creating dashboards and tailored views on operations for the various stakeholders, so they can track progress (and the elements of it they need specific information about), and drill down into the information to find out more.

The data can be used as a basis to create "work packages" – lists of tasks which can be assigned to contractors. The contractors can then see the information they require. Similar scenarios have been developed for the aerospace and automotive industry.

A 3D model can be used to help check materials are in compliance with hazardous substances regulations, anticipate risks, and perform overall master planning. You can make a 3D visualisation of the project status which people can use to better understand what is going on.

Doing decommissioning virtually - a virtual image of a plant within Dassault's "3DEXPERIENCE" platform showing "Ergonomics At Work" functionality related to decommissioning

You can use it to better understand the pay-off between economics, performance and risk.

You can use it to understand where you have gaps in your information about your assets, and then perhaps fill them in with modern techniques, such as laser scanning.

A fully digitised approach would assist with many of the issues flagged up in a "risk and opportunities" matrix for decommissioning, developed by the UK Oil and Gas Authority as part of a 2016 "Decommissioning Strategy" document.

It identifies a number of issues as of "high significance" in decommissioning, which should be tackled early. These include "information transparency," "lack of true collaboration", "lack of robust data," "supply chain capability," and "execution schedule management."

Digital models can help a company to adopt what Dassault Systèmes calls a "product lifecycle management approach" to an offshore asset, over its entire lifetime from development to decommissioning.

Other benefits are that you can enhance the visibility, control and traceability of data.

Building the digital platform

The starting point for building a 'digital platform' is to integrate all the information you have.

Often companies say they don't have all the information, or it is scattered throughout the organisation, or in different systems, and the data is in different formats, and some of it is not in very good quality.

However, you don't need to actually feed your data into the platform, you can connect it to your data wherever it currently resides. You can build it up gradually and only put in data which you think is meaningful and useful, as you find it, Mr. Rosenshine said.

Creating a digital model "is not as big [a problem] as people think."

Dassault Systèmes also talks about customers creating a "book of knowledge" about the asset, or a single data repository which can be accessed by both operator and suppliers so they can collectively make decisions about what work needs to be done and how to do it.

Similar methods have been used in the nuclear industry.

"It comes back to having a systematic approach to knowledge management, having better visibility and control of your costs. That transparency is needed for people to collaborate together," he said.

Sometimes there are concerns about sharing competitive information, but maybe there shouldn't be, because the 3DEXPERIENCE platform includes robust IP and access control tools according to individuals' roles and functions across the entire organisation ecosystem.

Simply said, the "link to where the data is" method means that if engineers want to (for example) continue working with Excel, they can do, and the Dassault Systèmes 3DEXPERIENCE platform takes over any new data.

Transforming offshore operations – with better use of data

Digital Energy Journal held a forum in Aberdeen on June 20 "Transforming Offshore Operations" through better use of data – which covered improving maintenance schedules, making it easier to complete and change maintenance data, optimising logistics and requirements for vessels, laser scan by drone and using analytics to spot problems earlier

There is a big opportunity to save large amounts of money by optimising maintenance and maintenance strategies, by applying existing technologies, we learned at the conference.

Gerry Ward

Gerry Ward, vice president of Operational Excellence (OPEX) Group and a former offshore installation manager, noted that the average production efficiency on the UKCS is just 71 per cent (a measure of actual uptime divided by maximum possible uptime). This equates to 243m boe a year not produced, or $10bn a year. 44 per cent of the downtime is due to unplanned shutdowns (mainly equipment failure). Of these, 20 per cent are due to a single cause, gas compression systems. And 90 per cent of all failures are preceded by some kind of warning sign, he said.

Also, he said, 62 per cent of failures are associated with a period just after maintenance – so the maintenance work itself introduces failure modes. So doing unnecessary maintenance has more costs than just the labour and spare parts.

Also, the computerised maintenance management systems often don't help. These, we heard at the forum, typically are very rigid, and helping plan your maintenance tasks on a fixed schedule for each item (such as change the chain every 6 months). They are used for planning the work itself, and for people to record what they have done. There are often complex procedures to changing the maintenance plans on the software, and they typically provide no insight into how important the maintenance task actually is.

Maybe these problems are more due to how the software is used, rather than the software itself.

But companies are tackling the problem. RTAMO, a service from Lloyd's Register, is a part software part consultancy service to work with whatever data companies have to try to come up with a better maintenance plan. Operational Excellence (OPEX) Group takes a daily download of sensor data from all offshore systems, and uses their predictive analytics system to compare the data with what happens during normal operation to provide an early warning of emergent system failures. It doesn't just look at individual sensor readings, since an emerging problem does not necessarily show up there, but it looks at the relationships that exist between the readings to highlight any threats or vulnerabilities.

Other companies tackling the problem are ShareCat, helping companies to keep their asset databases more complete; HubHead Corp, making it easier to change asset master data, maintenance strategies, plans and work orders; and Texo Drone Survey, recording a range of information by drone which can be useful in improving maintenance plans, including laser scanning, thermal imagery and ultrasonics.

As speakers pointed out, the aviation industry has clearly found solutions to the problem of unplanned shutdowns - otherwise no-one would get on a plane - and they do it with better maintenance management systems. So perhaps the question to ask is – how can oil and gas maintenance systems be as good as those used in aviation?

ShareCat

ShareCat of Norway makes it easier for oil companies to complete 'tag' data, by keeping an online library of tag data from different pieces of equipment, which can then be shared between operators, so systems can be automatically completed. This leads to less time being wasted searching for information.

It puts together shared catalogues of maintenance 'tag' data. Its customers can use the database to automatically complete their maintenance systems, if the data has already been completed by another oil company.

It leads to big time and cost savings. If you have good quality information in your systems, it can take on average 8 minutes to find something. If you don't, it can take 100 minutes. And some of the people doing the searching are working offshore, and cost a lot more than £20 an hour to the company. It is very frustrating when you have highly trained people spending time searching for information, said Sturle Drageset, VP sales with ShareCat.

PlanSea Solutions

PlanSea Solutions, an Aberdeen start-up company spun out of Robert Gordon University (RGU), has worked out that Aberdeen operators might be able to safely cut the number of offshore supply vessels by 40-50 per cent, with a mixture of constantly updating schedules, human expertise, sharing space between companies and algorithmic optimisation.

PlanSea has already done work with oil company Nexen, and calculated that Nexen could have done all of its 2016 deliveries using two vessels rather than four, saving £6.5m a year on fleet hire.

NRX AssetHub

NRX AssetHub, a software package made by Toronto company HubHead Corp, aims to make it easier for companies to work with their asset and maintenance master data – including making it easier to update maintenance work orders.

The software aims to resolve a problem that many asset management systems have rigid work processes and make it very hard to update asset and maintenance master data, and end up serving more as a 'system of record' rather than providing useful insights, said Brendan Kelly, managing director EMEA with HubHead Corp.

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Lloyd's Register – optimising maintenance intervals

Many companies are finding that their offshore maintenance schedules are just impossible to meet – when companies are under intense cost pressure, pressure to avoid interrupting production, and there is less personnel available, limited offshore accommodation, and sometimes difficulty obtaining spare parts. But also companies might be doing maintenance tasks which are unnecessary.

Companies do not question the intervals between maintenance tasks which are recommended by the manufacturer and continue doing it for the lifetime of the equipment, said Nikkii Ng, principal consultant with Lloyd's Register.

It is far easier for staff to stick to the maintenance sequence generated by the CMMS, even if it means doing excessive maintenance.

To try to improve the situation, the company is offering a service called RTAMO (Real Time Adaptive Maintenance Operations Solution) to use a combination of data and technical expertise to help companies improve the intervals between scheduled maintenance.

The software does not replace companies' existing computerised maintenance management systems (CMMS). The idea is that they download data from the CMMS into RTAMO, do work (within RTAMO) to improve the maintenance intervals, and upload a revised plan into their CMMS.

The company claims that by using the software, oil companies might be able to reduce maintenance costs by as much as 30 per cent.

Gathering data

The hardest and most critical part of optimising data is gathering the data and working out what you can get from it. The biggest source of data is usually the CMMS.

There are various software packages in use in the offshore environment, including SAP, IBM's Maximo, SpecTec's AMOS and Star Information Systems. "Each platform has a different way of defining your tags, the location, the information you put in," she said. Even two companies using the same software might have it set up differently.

Nikkii Ng

Useful data can include the maintenance plan, the corrective actions which are done, how the company puts together its work plan over the next 90 days, and how much the maintenance costs, or how long it takes.

Some operators only record how much time they expect a task to take, not how long it actually took.

Not all maintenance databases have data which can help you improve – for example they might only store data about equipment failure, but not why the equipment failed or what was done.

So most maintenance software acts like a kind of library, it does not do this sort of analysis, she said.

Sometimes the systems capture data in a "maintenance report", but it is hard to look through it and see if it means that your maintenance performance is good or bad.

"So having collected all the information it is not easy to utilise the information in a good way," she said.

Also, sometimes the content in the maintenance management system is subjective, with operators giving their opinion on how well it went.

Sometimes the data can be enormous – for example, one offshore operator was collecting data for 10,000 pressure safety valves (PSVs). Just working out how to approach this data is hard, she said.

For the person doing maintenance, if you want to try to understand whether a maintenance task has historically been necessary, you have to do a lot of information digging.

Data quality is a big issue. A challenge is that data quality is a subjective matter. "The concept is easy to understand, we want clean data. In practise it is quite a mountain to climb for that."

Data volume is another challenge. There could be up to 50,000 individual tags (pieces of equipment separately identified) in an offshore asset.

Improving the data system

Data systems are not easy to improve. A maintenance system can be seen as like the foundation of a house. You can make changes to the house over its lifetime, but you will always be restricted to the main frame of the house, she said.

Sometimes companies decide they need more information to be added, and try to redesign the CMMS to collect it. "I have seen operators attempt to make a template, which says 'please fill in this blanks' to put in the CMMS. But the actual implementation again is challenging," she said.

They might train one group of staff to do it, but then the personnel changes. Or it could be implemented well for the first 5 years but not sustained.

"We want to know that the maintenance data is able to fit back into the business driving decision making," she said.

Ideally you would have real time information put into the maintenance system. It would capture all data about failures, and compare it to how many failures were occurring under a previous maintenance regime, and if it was a similar failure to the last one.

There are other commercial aspects, such as some equipment might take a long time to obtain replacements.

Texo Drone Survey and Inspection – gathering LIDAR data by drone

Texo Drone Survey is developing technology to scan offshore platforms by drone, gathering laser scan (LIDAR) data, and using thermal cameras, hyperspectral cameras and ultrasonic sensors. It should prove a useful way to gather data

Texo Drone Survey and Inspection Ltd, based in the UK, has multimillion private investment to develop technology and methods to harvest data and scan buildings, assets and offshore installations by drone, gathering precision data which can be incorporated into asset models for engineering and asset lifecycle applications.

It is putting laser (LIDAR) scanners, thermal cameras, hyperspectral cameras and ultrasonic sensors on drones.

The company sees taking photographs and video of offshore assets as relatively simple, and suggests that if companies only want video, they could just buy a drone themselves (although the company offers training in how to use it).

The drones themselves are "just taxis", said James Arnott, principal systems officer with Texo Drone. The hard part is gathering and working with the data.

Laser scanning creates a 3D 'point cloud' of data about the asset, which you can import into an asset model (or 'building information model') and used to monitor corrosion and other problems as well as plan maintenance schedules.

Typically, the data points are at 1-3mm distance – the widest distance is 5mm – representing the most accurate UAV-deployed LiDAR solution in the world.

hyperspectral camera systems work by recording colours from the full electromagnetic spectrum (including non-visible light, ultra violet and infra-red).

From analysing the colours in an image, you can (for example) spot asbestos, or spot rust appearing (before it can be seen as the familiar orange colour). It has already been used to identify Japanese knotweed on a railway embankment.

The company often demonstrates to clients how what looks like a "white tablecloth" can have 120 different spectral 'signatures' on it picked up by the camera.

The points in the 3D point cloud are accurate to less than 10mm in terms of positioning accuracy.

James Arnott

Texo Drone Survey and Inspection Ltd was founded in 2016, although many staff have operational experience of over 20 years. It anticipates a large market, including on-and-offshore installations.

The company claims to own the "world's most comprehensive fleet" of advanced UAV systems . There are other companies doing part of what Texo does, but no-one doing all of it, Mr Arnott said.

The company spends 25 per cent of its overall budget on research and development.

It is the first company in the world to successfully deploy a LIDAR scanner of these accuracies on a drone, he claimed. UAV Laser scan surveys "have never been done before to this accuracy," he said.

Offshore LiDAR Survey - The work process

When surveying an asset, the path of the drone is planned in advance, to ensure the necessary data is gathered. It flies around the asset at a distance of 30m, acquiring a million measured points per second.

The drone is piloted by a professional drone pilot with minimum 300 hours drone flying experience. Experience is very helpful flying drones – for example you will learn that the power consumption is much higher flying against the wind than with it, Mr Arnott said.

The data gathered by drone of the assets' exterior can be complimented by data gathered of the interior of an asset, with a LIDAR scanner fixed to a backpack carried by an offshore worker, walking around.

By putting the internal and external data together, you can see a full asset or building information model of the structure – providing unsurpassed data to inform engineering decisions.

Texo Drone Survey and Inspection Ltd also offers services to help you integrate the drone data into your bespoke asset models.

Benefits

The main benefit of putting laser scanners on drones rather than having handheld cameras is efficiency – it is much faster to do a scan by flying a drone around it, than by having people who need to access all areas. There may be a need to build scaffolds so people can access difficult areas, and associated safety hazards.

As an example of the typical time saving, a scan of a refinery, which would normally take 12 weeks if done by handheld cameras, was done in a week and a half by drone.

Other benefits are that you might be able to gather additional useful data. One refinery used the systems to put together a 'building information model', and discovered that it had 8,000 square feet of un-used space behind cavity walls. The company did not have any structural drawings of its facilities.

Technology developments

Texo Drone Survey and Inspection Ltd is testing out using an ultrasonic steel thickness testing device on a drone, with field trials in oil refineries. This could be used to test for corrosion, because the steel would be thinner if it has corroded.

The drones have also been used for deliveries – they can drop 5kg from an onboard winch, or deliver a 40kg cargo if there is a helideck available.

It has done inspections with a laser scan together with a thermal camera and 360 degree visual camera, so getting 3 types of data in 1 run

The company is also developing new ways to do scanning inside structures, perhaps with a base controller unit which the drone can communicate with.

The internal scanners can be carried in different ways, including on a trolley, or even pulled across the facility on a zip wire.

OPEX – Predicting failure to reduce unplanned shutdowns of offshore equipment

Aberdeen-based, predictive analytics company OPEX is focussed on reducing unplanned shutdowns of critical offshore oil and gas plant – by taking daily downloads of offshore system sensor data, and comparing the relationships to what might be expected, to expose warning signs and pinpoint threats/ vulnerabilities.

Aberdeen-based, predictive analytics company OPEX (Operational Excellence Group), founded in 2010, aims to help companies reduce unplanned shutdowns of critical oil and gas equipment – by taking a daily or twice-daily download of offshore system sensor data, and comparing the relationships between data points to what would be expected to happen, and thereby providing early warning if there might be a problem emerging.

Spotting a problem from the data from any particular sensor is very hard – and problems can evolve without any one sensor showing any anomaly, said Gerry Ward, vice president of OPEX.

But problems can be detected using OPEX's Predictive Analysis Service, known as X-PAS, by looking at how the relationships between data points change.

To give a real-life example – there was a problem with a diesel filter after maintenance work, which meant that dirty diesel was passing into the combustion chamber and burning unevenly, so different parts of the engine were at different temperatures. If unfixed, this would ultimately lead to thermal shock and damage to the engine parts.

Any individual sensor would just have shown that the engine was at a temperature within its usual envelope – but the X-PAS service highlighted the problem as the readings from all the sensors on the engine were starting to diverge, rather than all showing a similar temperature.

This way, OPEX is able to look at the entire operating system offshore, not just specific pieces of equipment. So it can look at both rotating and static elements, valves, turbines and compressors, and all process system instrumentation.

Tolerating unplanned shutdowns

An unplanned shutdown basically means an unexpected equipment breakdown.

Gerry Ward

We know that the aviation industry never has unplanned shutdowns during operation, because if it did, we simply would not get on an aircraft, Mr Ward said. So it must be technically possible to avoid unplanned shutdowns.

Consider the financial implications. The average production efficiency on the UKCS is just 71 per cent (a measure of actual uptime divided by maximum possible uptime), he said. This equates to 243m boe a year not produced, or $10bn a year. 44 per cent of the downtime is due to unplanned shutdowns (mainly equipment failure). Of these, 20 per cent are due to a single cause, gas compression systems. And 90 per cent of all failures are preceded by some kind of warning sign.

Also, he said, 62 per cent of failures are associated with a period just after maintenance – so the maintenance work itself introduces failure modes. So doing unnecessary maintenance has more costs than just the labour and spare parts.

Also – approximately 85 per cent of the shutdowns are associated with what is called "off package events" – which includes ancillary equipment and instrumentation. Problems with ancillary equipment could be harder for human experts to spot, because they would need an understanding of usual operations of the system to spot a problem. But a predictive analytics system can be a great help.

If there is a system shutdown, oil companies must then incur further risk, because the start-up might not go smoothly. It can take a while to restart, and you may discover that the maintenance or remediation work has not been perfect – for example you have a leaky seal – and you have to do it again.

Altogether, unplanned maintenance can cost seven times as much as planned maintenance, because you don't get the benefit of doing everything in a controlled and optimised way.

X-PAS

OPEX's core technology, X-PAS, compares current sensor data from the offshore equipment, with sensor data from a time when the equipment was known to be running normally, to see if it can spot any anomaly.

Each data download from offshore equipment might include several million data points, including temperatures, pressures, flows, bearing temperatures, axial displacement.

All of the data is generated by sensors which the oil company has already installed, so no capital investment is needed.

OPEX employs people from different disciplines who work with the data, including data scientists, rotating equipment engineers and process control engineers.

The data scientists analyse the relationships that exist and pinpoint any anomalies, whilst the engineers place these insights into context of the offshore operating environment

"We class ourselves as a bridge between data science and operational outputs," he said.

"The crucial bit is the interpretation, not flooding the client with 'I've found this,'" he said. "That's where we differentiate ourselves from other companies operating within the data science world."

The technology can also be applied to a new facility, comparing the actual data with a simulation showing what the data should be in perfect conditions. Then you can gradually change artificial data for real data, he said.

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For more information or to book your seat, contact:

Sonika Greyvenstein
sonika.greyvenstein@ite-events.com

Amanda Wellbeloved
Amanda.Wellbeloved@ite-events.com

Harry Harrison-Sumter
harry.sumter@ite-events.com

London: **+44 207 596 5065**
Johannesburg: **+27 11 880 7052**