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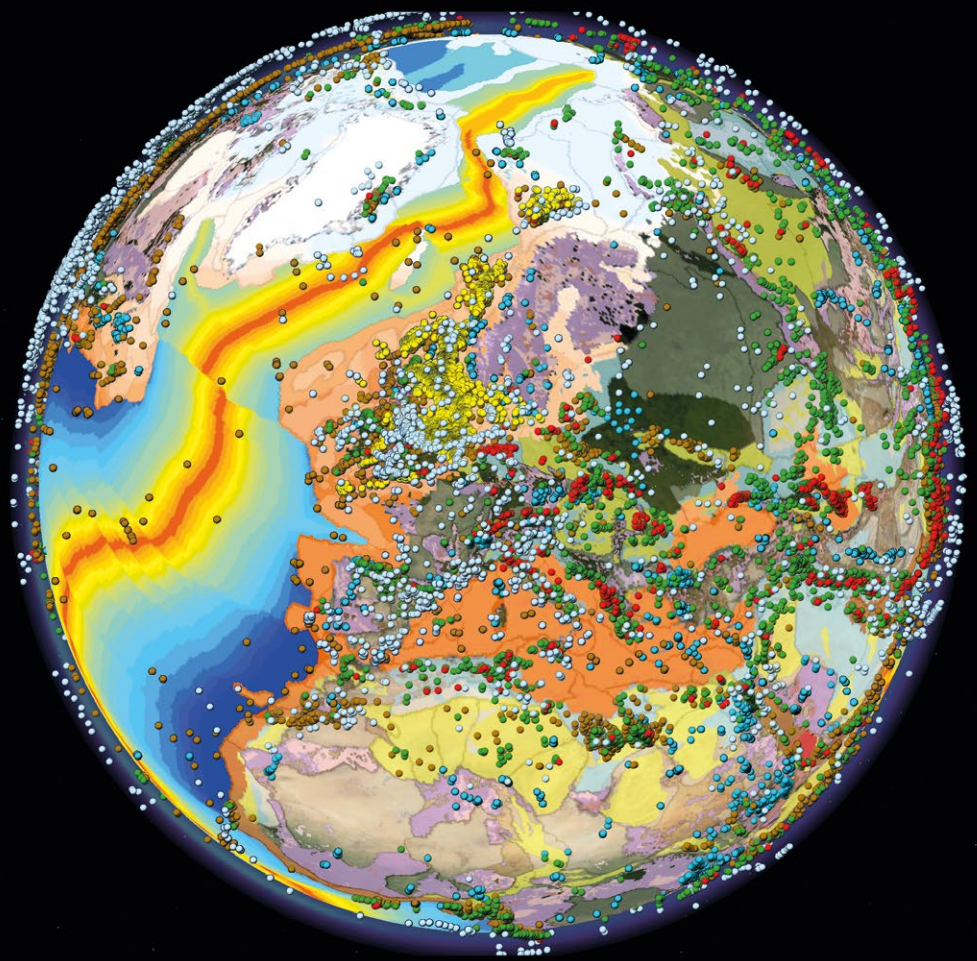
How manufacturers can embed analytics in their service

What 'digital transformation' actually means - and the challenges

June - July 2018



Re-inventing the geophysics contractor business model

Finding Petroleum

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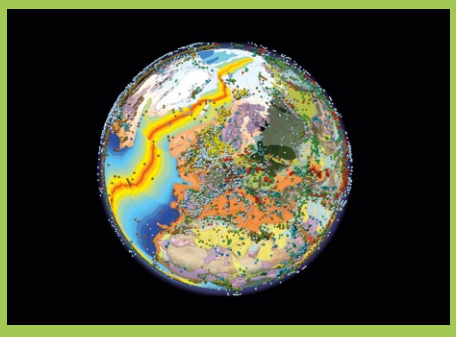

Cover image: A cloud of locations for data and analyses from component products of the Robertson New Ventures Suite, a collection of global geoscience tools to support a wide range of new ventures and exploration activity (image courtesy of CGG GeoConsulting).

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Can we make a digitisation maturity roadmap for oil and gas?

At our April conference in London, one of our speakers observed that the oil and gas industry is 'less mature' than the retail, banking and social media industries in its use of digital technology.

Can we unpick this – work out what 'maturity' actually looks like in the world's leading companies today, and see what that might look like in the oil and gas industry, and then create a roadmap to show oil and gas companies how to improve their digitalisation offering?

I have started trying to do this myself – it is quite a tricky task. You can see the progress so far at **http://bit.ly/digmaturity**

My starting point is that technology can be considered mature if it actually works to meet the business needs, not someone's idea of what might work. People are largely happy that it does as much as it could do to help them in their work, if they are making most use of the available data to improve decision making and the company's overall work.

We probably barely consider the amazing digital technology we use every day to power our supermarket supply chains, Amazon ordering and online banking. Perhaps we could say that mature digital technology is almost invisible. It just works and we don't need to think about it.

Going deeper, it is becoming clear that 'maturity' in upstream oil and gas digital technology tends to mean software and data hosted on cloud or cloud type servers, good data integration with other systems where necessary, software which is no more complicated than necessary to do the job (or help people do the job), and geared to the specific needs of the task (and upstream has many different tasks). All of this works well.

There is also a strong emphasis on quality of data, covering everything from the archive of well logs to the engineering database of what is currently in use on an offshore platform.

It may be interesting to consider how much of a mature corporate digital system is data management and how much of it is analytics. Considering the systems used by retail, banks and online e-commerce, my guess is about 80:20.

Perhaps mature digital technology in oil and gas will be the same. We'll see analytics in specific areas like condition monitoring / maintenance, subsurface analytics, supply chain and fracturing operations, but not much else.

For the workforce, a mature digitisation landscape ought to mean computers doing much more guiding and support (if not actually replacing people). We are starting to see this introduced into oil and gas, under the name "Robotic Process Automation". I imagine workers in retail, banking and online e-commerce have many such tools.

Will a mature digitisation landscape mean an enormous market for different software tools or 'apps' serving different needs – managing land rights data, choosing which license to bid for, optimising production, understanding fluid flows, managing a construction project, tracking drilling rig inspections? Or will most mature software ultimately be developed in house, as it largely is, in today's banking and retail industries?

For our digitalisation maturity roadmap to have industry value, it will need contributions from many other people too. Please send any suggestions to me at jeffery@d-e-j.com.

Karl Jeffery, editor

Digital Energy Journal, London

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DEA's CEO on the energy transition

The CEO of Hamburg oil company DEA Deutsche Erdoel AG, Maria Moraeus Hanssen, shared some interesting perspectives on how to do digitalisation in upstream oil and gas, speaking at the "Subsea Valley" conference in Oslo in March

Like all oil companies, DEA has challenges "understanding the energy transition," and working out how to make its company "proactive players in the transition to low carbon energy," she said. "While oil and gas is recovering from one of the worst downfalls in history, we need to learn to justify our activities to the public, and prepare to compete with a broader range of energy sources.

Ms Hanssen believes that the whole energy market will become much more electrified over time, citing data from a DNV GL forecast, saying that 40 per cent of the world's energy demand will be electricity by 2050, compared to 20 per cent today, she said.

This means changes in demands for oil. Currently oil has few competitors in transportation (whereas gas competes with coal and renewables for electricity supply). But if more of the energy system is electrified – including transport, this could also affect the demand for oil and so the price. "I think the price of oil and gas will trend downward," she said.

Ms Hanssen noted that some utility companies are positioning themselves to be more renewables companies than gas companies – emphasising decarbonisation and digitisation. But this creates a space for oil and gas companies to "become what utility companies were."

Maria Moraeus Hanssen, CEO of Hamburg oil company DEA Deutsche Erdoel AG

Companies like Statoil are not diversifying because they think the end of oil and gas is imminent, but because they see changes happening, she said.

Ms Hanssen believes that technology, rather than government policy, will be the main driver for the energy transition. "I am a technology optimist," she said.

Within the oil and gas industry, the challenge is not falling demand for oil, but exploration, "how to find more oil and gas to compensate for the annual decline. We need to do this at much lower cost and with a better footprint," she said. Before the oil and gas downturn, explorers were talking about "bigger, further, deeper". Now the conversation has changed to "value creation and improved footprint".

In all areas from seismic survey, drilling to operations, the industry will be "substituting models based on probability to models based on real time data," she said. There will be a new culture of data and information sharing.

There will be "more decentralised production, and decentralised access to information, and development of joint analytical models," she said.

DEA's positioning in technology is to be a "fast follower," she said.

"Next we need to see how future digitalisation can reduce CO2 and improve safety and strengthen license to operate," she said. "Companies that embrace technology and digitalisation will be the winners. I hope we can form these winning teams together.

Digitalisation "comes down to measuring and managing"

Digitalisation basically comes down to measuring and managing operations, says Duncan Irving of Teradata – but doing it in a much bigger way

"As far as I'm concerned, digitalisation is nothing new, it is the concept of measuring and managing your operations," said Duncan Irving, oil and gas practise partner with Teradata, speaking at the Finding Petroleum forum in London in April 2018, "New Geophysical Approaches".

Today's digitalisation can be seen as a retread of the efforts to control processes, made in many industries in the 1950s and 1960s, he said. But this time, companies are doing it with much more data, much more data processing, and using it to support decision making in more sophisticated ways, such as bringing data from different domains together.

Dr Irving is currently on assignment with an oil major, helping define its subsurface digitalisation strategy. He is a Phd geophysicist who went on to work in IT and technology consulting.

Maturity

The oil and gas industry is still somewhat behind other industries in its maturity in using data, such as social media, retail or banking, he said.

The problem is not a shortage of the right algorithms, such as for interpreting seismic, simulating a reservoir or making predictions about maintenance. Some simulation algorithms used in modern reservoir simulators were written in the 1960s, he said.

One head of research for an oil company recently said he thought that all of the algorithms that the oil industry will ever need have probably already been written.

The challenge is more getting all of the algorithms into day to day use, or "operationalising" them, he said.

Also, there is still a big gap between what data scientists are able to do, and what companies have embedded into their organisations as "strategic capability," he said.

Many companies are doing "top down digitalisation," perhaps driven by a chief digitalisation officer. "That's OK, it's a standard organisational box to put the new transformational stuff in," he said. "It is not old IT, it is new stuff, it has to have a C level executive giving leadership to it."

Artificial intelligence and machine learning are buzzwords, but they are "buzzwords for a reason, they have tangible benefit," he said. The challenge is working out how they fit in at a strategic level.

Large oil company

In January, Dr Irving moved to work for a large oil company, helping it define its vision, and create a strategy and roadmap, for digitalisation in the subsurface domain.

"Really, it is the coolest project I've had the privilege of working on," he said. The work involves many in-depth interviews with IT practitioners, and domain experts, such as "explorationists, well planners, reservoir geologists, field managers, production engineers."

The introduction of digitalisation means that people will change their day to day work, perhaps with computers doing the more mundane parts of their jobs and people applying their knowledge in new ways. Many people are nervous about this, especially older people, he said.

"There is a palpable feeling of transformation across the industry."

Cloud

The introduction and ubiquity of cloud is one of the main drivers behind the new possibilities in digitalisation, Dr Irving believes.

Oil companies often start with Microsoft's cloud services, because they are usually using Microsoft Office already, and associated file storage, computational tools, perhaps SharePoint as well. This means that a geophysicist can see SharePoint and their computing tools through the same portal.

So if geophysical technology providers offer their software in the same cloud system as their clients use, whether Microsoft or Amazon, they can also be immediately part of the infrastructure. It is something of a surprise that more geophysical technology companies are not seizing this opportunity, Dr Irving said.

Outside companies could also offer analytical tools and services on oil companies' cloud data.

To work with cloud, you need to get your data onto a cloud system, and if you are processing on one cloud and storing data in another one, then data needs to be moved from one to another.

Duncan Irving, Oil & Gas Practice Partner, Teradata

Legal issues can "really slow things down moving to the cloud," he said. For example, if each oilfield has its own legal framework and team, that means that if you want to move data for 30 oilfields in the cloud, you need to get 30 sets of approvals.

Security concerns have more or less gone away. "A few years ago the cloud was so new and so poorly understood, people asked, 'how could an operator countenance trusting the security?'" he said. "Now, it's 'do you really trust your own IT guys with your security? Of course you put it in the cloud.'"

"That one just flipped with no-one really noticing."

Today, applications should probably be run on the cloud as a first choice. "I don't really see the need for applications on people's PCs in the medium term," he said.

That means that if an oil company has made a decision to move software to the cloud, it changes the way it does business with vendors.

Subsurface digitalisation

Oil companies are exploring many ways to introduce digitalisation to the subsurface world.

Companies want to set up "workflows", where people go from one step to another to get a subsurface understanding from subsurface data such as seismic.

To do this, they need a digitalisation "architecture" around their data, to manage how data is brought in, quality controlled, integrated with other data, and then subjected to some kind of analytics, in a suitable timeframe.

Meanwhile, the business imperative is to do

everything faster, compressing tasks like "deliver a well plan" in 2 months, where it previously might have taken 6 months.

Companies are also looking to automate many of the data housekeeping and management tasks, for example where data needs to be moved between different packages during a process, such as Halliburton's software packages COMPASS for directional well path planning and EDM for managing engineering data.

If companies want to work with real time data, for example to support drilling operations as they happen, or even predict what will happen, they need a stronger digitalisation capability, he said.

The ultimate aim is for individuals to be able to blend the insights they get from computer simulation with personal experience, so they can (for example) see what the production is like in fields similar to the one they are about to drill.

People answer questions like that all the time using their own experience, or perhaps looking up reports of past projects which they recall are similar. But it is very hard to do with digital technology, because it would need some kind of predictive data mining capability, he said.

The current way

The way most oil companies operate today could be compared to an old car, with lots of different components which don't quite fit together, and the need for a human to get it started, understand what is happening and try to diagnose problems.

"We have several applications, poorly integrated. We have to spend a lot of time deciding whether we trust the data from someone else's piece of the workflow before we can perform our own analysis on it."

"We have to decide whether we trust the way the data has been reformatted and restructured to put it into the application we are using. And there's also the time it takes to find the data in the first place."

This means that geoscientists end up getting locked into doing specific tasks, not because they are particularly capable of creating value while doing them, but because they know which buttons to push on the software to make it work effectively. No-one else in the company knows how to do it, so they can't move on to any other job.

"This has come out of interviews I've done with some of the operators last year," he said. "Companies want to find a way out of their bind, and find a way to make the most of the abilities of their geoscientific talent."

How geophysicists can add value

There are many processes in upstream oil and gas where geophysicists could add more value in upstream operations, aside from the traditional technical work (processing wavelets).

They could add strategic value to a company, if they could help drillers understand better what they are about to drill to, using a combination of well logs and the logging while drilling data.

This is actually quite a complex data challenge – it isn't easy to integrate different well log data streams in Excel, for example. But you could do it with geophysicists and data scientists working together.

The aim might be to create a really clean master well log with all of the available data integrated, and any bad data removed. In the process, a geophysicist might be able to identify that a certain piece of data is obviously wrong and remove it. Or a geophysicist could advise a driller which data is more reliable.

Geophysicists might also be able to use their geomechanical understanding to advise on the best way to construct the well. They could also help predict production and what factors would affect it. They could advise drillers on the best targets to go for first.

Once a number of wells have been drilled, geophysicists could advise which ones are most worthy of intervention investment to improve production. If data from all the wells is integrated, it becomes possible to do comparative analytics and work out how to optimise drilling effectiveness.

Geophysicists could contribute to efforts to find remaining oil reserves in mature fields. "Who has a sneaking suspicion that in all the seismic data for the North Sea to date, we might have missed something? Or are you happy we found everything there was to find because it was all imaged well?" he asked.

Geophysicists can act as a bridge between different domains, having both the geological understanding and the numerical skills to talk to engineers and business decision makers.

Quality control

Geophysicists can help quality control data from outside companies, ensuring that any seismic or logs lacking the right master data do not find their way into the corporate archive.

Teradata has put together a "forensic geophysics" team for its oil company client, including data scientists, geophysicists, and a data management specialist.

This team was able to combine its skills to make tools for quality assessment of well mlogs. It used both statistical and geophysics understanding, to see how a well log fits with the well logs around it, and whether it shows the lithofacies (rock layers) you expect.

Some logging while drilling (LWD) data is provided time based, some is provided depth based (this log was recorded at this depth). "It would be nice to flip between the two really seamlessly, we've discovered," he said. Teradata's team built a tool which could do it.

When the diameter of a borehole changes, you expect to see some change in the response of the gamma ray recording. If you don't, it might indicate a problem with the gamma ray, which can then be corrected before you use the gamma ray log for other analysis.

Once the company is satisfied that the well log data is good quality, it can be used for tasks like trying to find bypassed pay, combining the digital tools and data with people's expertise, drawing on drilling logs, well logs, reservoir simulation and the seismic model.

It is not so much "innovative geophysics," but could be considered innovative data management, and a good use of geophysicists, he said.

Silver haired geophysicists

This kind of work might be well suited to so-called silver haired geophysicists, who have many years of experience, and deep understanding of the physics itself, Dr Irving said. "They can provide numerical insight and an understanding of the wider context."

It would mean going to the traditional, earth sciences part of the skillset, and numerical part of the skillset, rather than the ability to work with a certain piece of software or follow a workflow.

"I think geophysics should be the hottest job in the industry. We need to re-invent ourselves as a profession."

How geophysical contractors could do more

Geophysical contractors could increase their contribution to the oil and gas industry if they could help oil companies do what they want to do today, mainly improving recovery from mature and onshore fields, said David Bamford, a former head of geophysics with BP

Geophysical contractors could add value to today's oil and gas industry if they could better help oil and gas companies to do what they want to do at the moment, which is mainly improving recovery from mature and onshore fields, said David Bamford of Petromall and a former head of geophysics with BP.

Some oil majors today are even saying they have no interest in "frontier" exploration, the traditional area of focus for explorers. They are also saying much of the investment in frontier exploration in recent years did not yield very good results, he said.

Meanwhile, some geophysical contractors seem to be betting that the oil price will soon be back to $100 because of Iran and Venezuela's collapse, so they just need to wait and there will soon be employment for the big seismic boats.

That could be a risky strategy, when you consider how much effort companies are putting into demonstrating that they are now 'energy' companies not oil and gas companies, he said.

Broadband

Geophysical contractors might be able to sell broadband seismic surveys over mature fields, to support further development. Some of the seismic surveys of the UK Continental Shelf "are truly awful at the moment," he said. "There's a lot more scope for good acquisition."

In the UK North Sea, oil and gas companies often seem too happy to accept reprocessing of 10 year old 'megamerged' 3D seismic "as the limits of technical progress," he said, "and I don't think that's true. Although it is certainly better to re-process them than rely on processing done on original multiclient data."

For West of Shetland, Northern North Sea and Central North Sea, there are "very large megamerged surveys" with data over 10 years old.

Modern recording technologies, such as broadband, enable much clearer subsurface images. "I personally don't understand why folk who can offer that are not doing so more assertively," he said.

Also, 3D seismic surveys onshore should be as routine as they are offshore. "The perception is still that it remains forbiddingly expensive," he said.

David Bamford, former Head of Geophysics with BP

Seabed

Seabed seismic recording could add a lot of value in today's industry, including areas which have already had one seabed survey, since many earlier seabed surveys had many operational problems, he said.

Seabed surveys can record both P and S waves, generating data which can be used in rock physics calculations. "There are fields in the North Sea where that has happened and the field has been transformed as a result," he said.

Analytics

Geophysical contractors might be interested in subjecting their large data sets to big data analytics. "I have not yet seen anybody who has delivered anything sensible in that arena," he said.

One useful area for the analytics could be improving the velocity model (understanding of the speed of seismic in different parts of the subsurface, essential data for migrating time to depth).

"If you are exploring, exploiting or doing reservoir management in complex structures, you need to get the [time to depth] migration right," he said.

Integrating data

Another business opportunity for geophysical service companies is services to integrate and manage many different types of data.

For example, on a basin like the Permian or Powder River in the US, companies are drilling thousands of wells, and each well has 6 or 7 well logs. Every state has a cuttings and rock samples depository. Fluid samples are kept. It leads to huge databases.

In the North Sea, the UK's Oil and Gas Authority publishes data about several thousand wells, including several hundred exploration wells, with cuttings, cores, fluids, huge historic data. You could add to that new data, such as broadband seismic, seabed seismic, inexpensive 3D Controlled Source EM, full tensor gravimetry.

The industry is not very good at integrating all this data, so it remains in silos. "Between geoscience and reservoir management and production operations, different data kept in different ways."

Geophysicists could shift their focus from just seismic technology to the whole sub science of integrating seismic and well logs to get at rock physics, which leads to an understanding of lithology and predicting fluids, he said.

Ultimately, you have enough data, control, understanding of the stratigraphy, sedimentology, structural history and rock physics, you can be much more specific about where good drilling targets are, rather than using probabilities.

"It opens up a huge opportunity for geophysics contractors to augment and change what they do," he said.

North Sea opportunities

In the North Sea in particular, many of the opportunities can be around improving the recovery factor, which needs a lot of technical work. Many fields have only seen 30-35 per cent recovery so far.

As an example of work to improve recovery, the West of Shetland has been explored for 50-60 years. "I started getting involved with it again about a year ago, I realised the whole petroleum system story was not understood at all. They knew which rock the oil came from, Kimmeridge Clay, but not when [the oil came to the reservoir]. They didn't have the data to tell them when."

"What they did was rely on an academic model of how margins evolve, and it was wrong."

"You have these models that underpin everything you do, and they were wrong, not even close. If you believe the models, most of the oil was generated before the reservoirs were in place, which is a tricky problem to solve."

Land seismic – from brute force to precision

It is technically possible to get much higher fidelity in land seismic surveys, or get the same quality survey as we do now but for lower cost – but the main factor missing is equipment suited to the real physics of land acquisition, said Bob Heath

Too often, the priority nowadays with land seismic surveys is just maximising the number of channels and sources, said Bob Heath, a former vice chairman of SEG's Technical Standards Committee, and whose career included being International Marketing Manager for a number of land seismic equipment manufacturers.

Maximising channels and sources should be considered a "brute force approach". It suits the larger manufacturers because they get to sell more equipment. But there are more sophisticated ways to get a higher fidelity recording at possibly far reduced cost, he said.

Another reason which necessitated the gradual move towards the "brute force" approach over recent decades may be the reduced numbers of people with appropriate scientific expertise, particularly physics, working at oil companies, manufacturers and contractors, Mr Heath said, himself a former physics and astrophysics graduate.

Seismic contractors must of course focus on the signal to noise ratio of the data they wish to record, this is what they are selling. But high quality data could be acquired with less source and receiver effort than is presently used. This requires a better understanding of the physics of sensors, recording systems and sources.

Geophysical contractors, effectively encouraged by oil companies who also may lack the requisite understanding of underlying physics, often just buy the technology with the lowest cost per channel, or whatever their competitor just bought, with little regard whether this allows them to optimise data quality with less equipment. The result has been ever more equipment often doing ever more of the wrong thing.

Instead, companies could offer equipment with better monitoring capability. For example, geophones can sense information about their condition, and whether they have a good 'plant' in the ground while the digitisation process could be more attuned to how seismic energy disperses.

It is also possible to fit sensors to source vehicles (Vibroseis) to calculate and record what exactly is being sent back into the earth, rather than just using a poorly calculated ground force as a proxy.

Quality driven acquisition

Another idea is quality driven acquisition (QDA), where the quality of some essential aspects of the data are monitored in real time, allowing adjustments to be made to the source and receiver effort.

Bob Heath, speaking at Finding Petroleum's April London forum

Just as there is no point in coming back with data so poor it cannot be interpreted, it is also costly to acquire data with more SNR than is really needed. QDA, based around appropriate hardware, allows adjustment of field effort according to recorded quality.

This is not a new idea – AGIP (now ENI) was doing this in the 1990s, he said. "Quality driven acquisition came to a halt simply because [in the 1990s] there wasn't the processing power in the recording truck. That is a problem nobody has any more."

"If you want to radically reduce the cost of land seismic to get it to the absolutely minimum, these are the sorts of things you have to do. There are no other choices. Simply acting as though ever more source and receiver effort is the only answer simply ignores basic physics and economics."

Note: Bob Heath can be contacted on **rgheath@btconnect.com**

IOGP – encouraging standard seismic formats

The surveying subcommittee of IOGP geomatics committee is encouraging seismic interpretation companies to make more use of standard formats for seismic data – to make it easier for oil companies to integrate the data together

The surveying subcommittee of the International Association of Oil and Gas Producers (IOGP) geomatics committee is encouraging the use of standard formats for seismic data, to make it easier for oil companies to integrate data together.

The 'navigation' format ensures that everyone is clear where in the world the source and receiver were – or were the subsurface features are thought to be, said Declan Byrne, chair of the subcommittee, and also lead geoscientist with the geodetics applied geophysics group at Tullow Oil.

Because of the curvature of the world, a number of different geographical grids have been developed over time, and it is important that data all uses the same grid if it is going to be overlayed on other data. Or at least, you know exactly which grid is used.

Use of the standard also makes it much easier to quality control data, Mr Byrne says.

There are different formats developed for ocean seismic, land seismic and ocean bottom recording, and for repeat surveys. Also data for boundaries, exclusion zones (where seismic cannot be recorded), and each seismic "bin" or cell in the subsurface.

In general, seismic recording companies (contractors) are using the new formats, but the seismic processing companies are not, Mr Byrne says. So oil companies like Tullow still receive data in old formats.

"As an oil company, Tullow wants to receive everything in standard formats, but we are still using formats based in the 1970s."

The latest formats have special capabilities built in, which enable an oil company to trace any changes to the co-ordinate system, or the bin grid structure. If there are no changes, it is easier to merge survey data together.

The output is also more machine readable.

Automating chemical injection management in onshore operations

By Dave Milam, senior VP business development and marketing, WellAware

Research based on well site surveys suggests that actual chemical injection rates only hit around 50-75 percent of their target rates. As a result, operators waste chemicals through over-injection, or they miss their production goals due to scale and corrosion, or paraffin issues – all of which requires expensive maintenance procedures and significant downtime.

This same research shows how automating chemical management programs enables operators to reduce operating expense by $3,000-$6,000 per chemical tank (per year), which provides a return on some automation investments in less than 6 months.

Chemical service providers see the flip-side of this equation. They have high labour and transportation expenses due to driving to each site to check on conditions, but also have difficulties keeping pumps injecting at their target rates. Ensuring accurate injection and reducing labour costs is the key to success for these companies in today's market.

Automation technology is enabling improved visibility into production chemical costs and management for both parties. It offers better solutions than manually inspecting each well site on a daily or weekly basis, as this route-based approach is incredibly expensive and also fails to accurately monitor the rates at which chemicals are being injected. Now there are new edge computing technologies that reduce the complexity and cost of remote monitoring, changing the way the entire chemical system is managed.

Not all automation solutions are created equal though. Here are a few points that should be taken into consideration when evaluating remote monitoring and control solutions by both operators and service providers:

- Collect pump rate and tank level data remotely though a reliable data network. For Batch Truck Treatment, native mobile apps can collect treatment data, even when cellular coverage is not available at the location.

- Monitor sites for anomalies and trigger alarms as needed for situations like high or low injection rates, low tank levels or power outages at well sites. These alarms can be delivered by SMS or email notification.

- Analyse data via dashboards and reports: dashboards provide an overview to identify which sites have issues that should be prioritized. Chemical usage, pump rate accuracy, and batch treatment reports help drive decisions, based on historical data. One size will never fit all - operators should look for solutions with customized reports that can be tailored to their specific business processes.

Accurate chemical injection

Many companies seeking to automate their chemical management programs begin with only tank level monitoring systems.

These battery-powered systems unfortunately cannot measure chemical injection rates accurately due to the wide temperature swings in the field, inaccurate pump calibration methods, and changes in product specific gravity.

Pump rate monitoring and control systems, however, measure pump strokes (or tach feedback in the case of variable speed pumps) to precisely determine pump injection rates.

These systems can remotely change pump speed, vary injection rates based on production flow meters or H2S analysers, and they can start injections at particular temperatures to keep wells from freezing up. An operator or service provider can then adjust rates as needed no matter where they are, in a timely manner.

Correlating injection with production

Target injection rates should be updated in a dynamic fashion based on the current production of the well. If unadjusted, injection rates can become too high as well production declines. Injections may be too low if they aren't adjusted after well stimulations.

This issue can be easily solved via software systems. Production levels from an operator's SCADA system can be quickly imported with a .CSV file upload, or an FTP file integration can be used to completely automate the process. With this information, a chemical target rate report can identify which wells should have pump rates adjusted to provide more effective treatment.

Well Aware's device to monitor chemicals remotely

Variable speed pumps

Many pumps in the oilfield are single-speed pumps which utilize a start/stop method of flow rate control. For critical assets and pipeline operations, it is much more effective to use variable-speed pumps.

The value of variable-speed pumps can be increased when deployed in closed-loop control applications, where a chemical flow meter is added to precisely measure the volume of chemical delivered. Operators are experiencing significant increases in production rates by leveraging the precision of variable speed pumps, compared to injection from single-speed pumps.

Operator and service provider

The process of capturing site data, storing it in the cloud, and sharing it via the web, or iOS/Android-based apps keeps all stakeholders on the same page. Role-specific dashboards allow different users and business partners to see how systems are performing at a glance.

Usage reports summarize information for injection treatments over desired date ranges - and they make it easy to identify any changes that need to be made. Alarms can be customized to notify both service providers and operators. When both sides have visibility into chemical data, collaboration and quality-of-service can be greatly improved.

Case study – Tech Management

Tech Management is a chemical service provider servicing thousands of wells on both a continuous injection and batch treatment basis. They needed a digital solution to increase efficiency, improve chemical injection accuracy, and grow their customer base.

Seeing the value in WellAware's Chemical Management solution, they installed the WellAware Integrated Radio and Controller on customer tanks in the Permian Basin. WellAware's solution is able to cover batch treatment applica-

tions through Field Data Capture, as well as continuous injection monitoring for those customers, making it a perfect partnership.

After the installation, Tech Management was able to realize a 50% reduction in site visits, allowing field technicians and managers to prioritize their work and focus on critical field testing instead of inventory evaluations. Dashboards and automated reporting improve efficiency of the technicians on a daily basis. On the customer side, Tech Management has been able to ensure accurate chemical injection and minimize the risk of under-injection.

"Our current project insights have revealed a reduction with fuel expenses and in parallel has increased our value-added service from our field technicians addressing customer needs," said Billy Acosta, Business Integration Director for Tech Management. "Partnering with WellAware's technology has made us a better company that meets our core value in exceeding our customer expectations in this niche business."

Downhole wireless technology for production

Advances in wireless communications downhole make it possible for production engineers to get a better idea about flows and check downhole valves are working

By Brad Baker, CEO and Annabel Green, CTO with Tendeka

Wireless systems on downhole valves can provide a communication mechanism to monitor and control wells effectively, while keeping the completion simple. They also allow a quick and safe installation.

Without instrumentation on downhole hydraulic valves, their operation and feedback can only be inferred through complex surface hydraulic modules.

If the communication is made through control lines (wires), this adds significant cost to the project.

Once the additional hardware, man-power and rig time are included, this can readily add up to over $1million to the well cost.

In addition, the complexity of these installations can potentially increase installation and operational risk as well as often limiting completions throughput and access.

Implementing wireless communications

Wireless devices are standalone units, and require minimal installation time and rig floor presence.

Wireless systems have less complex interfaces with the wellhead. Electromagnetic/Radio frequency or acoustic-based systems require small control modules and interface cards, whereas pressure pulse systems utilise existing wellhead equipment.

Barrier integrity

One of the benefits that wireless systems offer over control line systems is improved barrier integrity, during installation, operation and workover.

This is achieved by removing the need for cables across the blow out preventers (BOPs) and cable feedthroughs in hangers and packers.

This significantly reduces the number of potential leak paths.

Control lines also pose an issue for workovers and well abandonments, with added cost and time to ensure all are recovered and out-with the cemented pressure barrier zone.

Although a wireless completion is as simple as a conventional one in terms of make-up and deployment, wireless systems can offer additional benefits during Run in Hole and landing out of the string by providing active fluid control.

Place anywhere

Without the need for control lines or intervention access to operate, devices can be placed in almost all areas of a completion.

An example is having multiple devices along the lateral in a complex multilateral well.

Having close and detailed control facilitates increased reservoir contact and enhanced recovery.

In addition, its wireless function systems require a degree of in-built intelligence, lending them to operating with more autonomy.

Examples include devices that can detect changes, such as well shut-ins and react as planned, or devices targeting specific downhole conditions rather than flow areas, and syncing with other devices in the system to achieve this.

This autonomy lends wireless the capability to even diagnose trouble spots in a completion and dynamically heal the problem in real-time or divert and shut-off the zone at the source without shutting in the well.

Most wireless equipment can be retrofitted as and when required by using standard intervention techniques.

This highlights the suitability of installing wireless equipment later in the life of a well, whether that is to recover the functionality of failed equipment or add in monitoring and control to wells that had none.

About Tendeka

Earlier this year, with funding support from the Oil & Gas Technology Centre in Aberdeen, the company installed a PulseEight downhole device and a newly developed PulseEight surface system with OMV Group in Austria.

During the installation, various operations were undertaken to test the downhole device and prove the surface decoding system.

The initial two-week trial demonstrated accurate two-way wireless communication in a flowing gas well and proved that the data and results could be shared over the cloud to anyone connected.

A major North Sea operator has now agreed to progress the next phase.

The PulseEight system was launched in May 2017 and uses pressure pulse telemetry to channel wireless communication between a well's downhole monitoring and control system and the wellhead.

The offering has increased to include an autonomous data decoding system which allows the seamless transmission of well data to any location in the world.

PulseEight Surface allows the user to see real-time the data transmitted from the reservoir. The system autonomously measures surface choke changes and confirms that the surface to device pulse sequence is correct.

Beyond Limits – applying NASA AI technology to oil and gas

Beyond Limits of Glendale, California, is an artificial intelligence company applying technology originally developed for NASA to the oil and gas industry. It has $20m strategic investment from BP Ventures

Beyond Limits, an artificial intelligence company based in Glendale, California, is applying technology originally developed for NASA to the oil and gas industry.

The company has a $20m strategic investment from BP Ventures.

The AI process is for the computer system to ingest millions of data points about how an industrial operation is performing now, or has performed in the past.

Plus hundreds of rules about how the system should be managed, for example using procedures from a manual, or from detailed interviews with oil and gas experts about what is commonly done to solve problems.

The AI system weighs each set of rules, as it works out the best path to follow, especially in the event of a conflict.

For example a safety or financial rule pointing to differing directions since many companies have thousands of procedures for safety, financial, regulatory, physical and operational issues. Over time, as more data is ingested, more knowledge is gained, and the system becomes smarter.

This way, the company sees its offering as taking artificial intelligence "beyond" where most AI companies go, since the offering for most conventional AI companies is restricted to data analytics and pattern spotting, says Scott Tomlinson, SVP global sales with Beyond Limits, and a company founder.

The Beyond Limits AI claims its label "cognitive AI" by saying that the software operates in a similar way to humans, in that humans also have experiences and scripts in our minds, including the intuition for working out which path to follow in each situation, and which decision to make in the event of a conflict.

The Beyond Limits system does not require new IT infrastructure, no supercomputer needed, but sits on top of it like a thinking layer to help solve problems for the operator.

NASA proven

Beyond Limits was founded to bring advanced technology originally developed for NASA by Caltech and The Jet Propulsion Lab (JPL).

One example is an AI system written by company CTO, Mark James, that saved the Voyager 2 mission from disintegrating on Neptune. Another system enables a computer to ingest, understand, and follow millions of pages of manuals to help guide autonomous operations by a Rover on Mars.

Beyond Limits has an exclusive licensing agreement to commercialize the Caltech / JPL software, and has a formidable stockpile of its own AI intellectual property.

In the Mars rover example, it would be very difficult for a human to read and learn all the pages of manuals and so quickly know the right procedure to follow in a certain situation. An artificial intelligence system, especially one with human-like cognitive reasoning powers, can do it faster, with no bias.

Oil and gas example

Consider a fairly common problem with offshore installations – a malfunctioning sensor, which nobody knows about.

The inspectors can see the sensor is physically present, they can see lots of data from all of their sensors, but they do not realise that sensor is not detecting what it is supposed to until a problem emerges, for example, too much water in a gas line leading to hydrate formations in cold weather. They could run regular checks to see if there is a data stream from all the sensors, but might not have time, priority, or motivation to do so. This is just one of many things an offshore facility manager needs to keep an eye on.

However a computer system can be programmed to check data streams from all of the sensors continuously, all day and all night long, comparing real-time data vs rules set by human experts.

In the oil and gas industry, Beyond Limits has looked at using its technology in reservoir management, incorporating static and dynamic observations into an integrated model of the probable state of the reservoir. It has developed a deepwater reservoir drilling target selector, and an advisor to prevent sand production.

The company announced $20m in funding from BP Ventures, the investment arm of BP, in June 2017, with Meghan Sharp, managing director BP Ventures - Americas, joining the Beyond Limits board.

In the press release, Ms Sharp was quoted as saying "BP Ventures is excited to help Beyond Limits grow into new verticals, as we bring forward the pioneering work they have developed with the space program to our industry and throughout our businesses."

Helping people reduce risk

As the company sees it, AI systems are like a second set of eyes on a problem. Unbiased eyes that do not have any leaning towards "erring on the side of caution", or doing nothing unless there is a reason to do otherwise, as many people might do.

Sometimes human operators might be working very tired, for example if they start work offshore immediately after a long flight to the worksite. This will impair their judgement, or motivation to make changes.

A key selling point is "explainability," the system's ability to demonstrate how its conclusions were generated, Mr Tomlinson says.

Rather than just pop out an answer to a problem with no explanation, as conventional "black box" AI systems might, the Beyond Limits technology can show the reasoning path that was followed to achieve the desired output, and how risks and rewards were weighted. This allows operators to make final decisions with faster, better information and reduce risk.

Healthcare

The company has also looked at healthcare, finance and logistics industries.

In the healthcare sector, the system can incorporate patient sensor data plus the millions of 'rules' followed by healthcare professionals and developed over decades, to advise on the best course of action based on the situation.

Some of the outputs might take the form of simplified "traffic light" style guidance, showing that a certain course of action is safe, another one has a warning, and another is in between.

Statoil (Equinor) leading the way on digi-tech

Statoil (now Equinor) is perhaps the leader in the oil and gas industry in its use of digital technology. We heard about some of its exciting projects at the Oslo Subsea Valley Conference in March

Statoil is working with technology "seed accelerator" Techstars, to try to find and develop 10 early stage companies developing technology which could be useful for Statoil, and bring them into the corporation.

Companies will get $20,000 in funding. Statoil has also set aside 1000m2 of office space in its corporate building in Oslo for the start-ups. The start-ups will also receive mentorship from Statoil, Kongsberg, McKinsey, and should end up on something of a 'fast track' to do business with these companies.

Applications closed May 13 2018, with programs starting Sept 9 2018, with a demonstration day already scheduled for Dec 5 2018. Subsequently it plans to look for 10 companies a year.

The decision on who to support is made on "team, market, product and traction," says Jens Festervoll, former VP corporate strategy at Statoil, now VP innovation.

An added benefit is that it can help bring entrepreneurial thinking into Statoil. It means that Statoil will see more completed "solutions," rather than linear thinking," Mr Festervoll says.

It also forces Statoil to look at its procurement and legal systems to make sure they make it as easy as possible for Statoil to engage with smaller companies, he said.

Further information is at techstars.statoil.com

Robotic process automation

Statoil is experimenting with 'robotic process automation' (RPA), using software to automate repeatedly done software tasks, so that people no longer have to do them.

Statoil's chief digital officer, Torbjørn F. Folgerø, said that the company has identified 60 work processes which could be automated, including in subsea, maintenance and procurement.

Statoil started in around March 2017, aiming to identify work processes which could be automated in this way. So far most of the value is in back office processes, including supply chain management and logistics, said Stein Petter Aannerud, head of RPA in Statoil.

People in oil and gas companies do a "huge amount of activities manually", he said. For example, when one person copies a certain section of data on a spreadsheet and then e-mails it to someone else every day. Perhaps it is fairly easy to automate that.

The RPA software sits on top of the usual software, perhaps having its own log-in, so it appears to the host software as another person. "This technology is fairly easy to put into any part of your process," Mr Aannerud said.

Every step the software makes needs to be carefully mapped out – the software cannot be expected to do much 'thinking' itself.

The company set up a robotic employee "Rob Robot" as an external consultant in Statoil's identity management system, so it could get access to computer systems in the same way as a human employee would.

There has been some reticence from company employees to support the effort to roll it out, since they have read newspaper articles about "robots taking over your jobs" and think this is what it is, he said. But it is maybe more correctly described as "taking robots out of humans, removing tasks humans are not fit to do," he said.

Statoil is working with RPA software company Blue Prism, and has decided to stick with just one software company to make it easier to manage.

Statoil and Blockchain

Statoil is exploring ways it can use blockchain as part of its operations, although recognising that so far it is "not mature, completely unproven, with no real commercial applications," says Owen Williams from Statoil's corporate innovation department.

"We are looking for people to test more ideas."

The idea is that blockchain might be able to add value in transactions where there is a need for more trust and transparency, where there is no central authority to manage transactions, and a need to be able to prove a transaction happened.

It could also be used for "smart contracts"

Jens Festervoll, former VP corporate strategy at Statoil

made between two computer systems, where a payment is automatically made when something happens. Statoil has looked for transactions which might look like this across its 'value chain', he said.

It sees real potential in trading, including commodity trading, supply bank guarantees, certificates of origin, and post transaction settlement / management. The post trade settlement processes are still very manual, he said.

Statoil and optical gas imaging

Statoil is developing use of optical gas imaging tools, to detect and better understand methane leaks using infrared images.

It has trialled the use of cameras to scan large areas of the plant in a short amount of time, doing measurement from a distance. The cameras have a range of up to 1.6km if they are positioned high up on a flare stack. Alternatively, handheld cameras can usually see tens of metres, a company representative said. Another possibility is attaching cameras to drones.

For the time being, Statoil has one handheld camera in each plant.

The data from one camera can be 'scaled up', so you can see gas leaks for a whole plant. You can analyse the data to see degradation rates over time.

A typical process plant can have 1200km of pipe, much of it under insulation, and tens of thousands of valves, and the tallest parts 70m tall.

Note: Statoil changed its name to Equinor in May 2018

DNV GL and digital technology

Risk and quality management company DNV GL is helping companies to develop a wide range of different technologies for the oil and gas industry. Its services include data quality management, risk assuring 3D printed parts, supporting qualitative risk assessment, qualifying subsea equipment and supporting development of the hydrogen industry

DNV GL has set up a data "platform" called Veracity, providing services to manage data quality on behalf of oil companies and shipping companies, with the data hosted on the Microsoft Azure cloud platform.

The service was launched in November 2017, after a development period with a small number of clients.

The idea is that data owners, such as oil companies, can use the service to make it easier to bring in third party suppliers, such as analytics companies, to have broad access to a range of quality data.

Oil companies could also purchase different online services to run on their data via the cloud.

The customer has full control over access to the data, and can see who has been looking at the data, when and which data.

One example is using the system for managing data about subsea well head fatigue. DNV GL can offer services to gather or manage data about loading on the well head, for example from the blow out preventer during drilling. This data can then be aggregated to make an assessment of the amount of fatigue on the well head, and whether it may be enough to cause damage.

Another service DNV GL can offer is to enable third party algorithms to run on the data, verifying that is it not making any change to the core customer data, and the third party is only able to see the results of the algorithms, not the customer data itself.

3D printing

In the world of 3D printing, DNV GL has services to help companies which use 3D printed products, such as oil nad gas operators, to ensure that the parts they are using are fit for use.

3D printing is gradually making a transition from the hobby world to the professional world. But, like much hobby equipment, it is often hard to verify where the materials have been sourced from, and so verify their quality.

3D printing products do not fit easily in traditional supply chains. says Harsharn Tathgar, principal specialist with DNV GL.

Some problems have already been identified which would not be expected from conventionally manufactured components, such as a 3D printed item having a level of porosity, which would not happen if it was made by pouring liquid material into a mould.

Benefits from 3D printing can include weight savings (particularly relevant for aviation components), an ability to make components much simpler (making a component in one print where it would otherwise take many different components joined together), and less need to keep stocks in inventory, if you can just print when you need something.

There is a joint industry project to look at laser aided manufacturing for large ship structures, Supported by Singapore Economic Development Board. 3D printing could be used to print the complex turbocharger parts of ship engines.

DNV GL is developing a framework for how it can expedite the approval process of 3D printed parts to be used in offshore / oil and gas applications.

There is a project for the oil and gas industry to develop standard requirements for components made by additive manufacturing, so suppliers can provide parts knowing they will be acceptable.

Qualitative risk assessment

One long held dream of oil and gas industry safety managers is to be able to assess risk quantifiably, or simply have a high certainty about whether an operation has a risk or doesn't.

DNV is working on better ways to help customers quantify risk , said Koheila Molazemi, global service area leader for Risk Management Advisory with DNV GL.

It is developing software tools which enable risk managers to understand a safety situation in more depth, for example by being able to model how an explosion could develop on a computer and so assess whether the situation has a high explosion risk.

The computer model could also show what might happen if a certain risk barrier had a level of degradation in it.

In order to have a high certainty on your risk level, you need access to good and current data. But this is rarely the case. Customers often don't understand what the data means, or have too much data to work with, or don't even have access to all of the data, she said. Sometimes the data shows inconsistent readings.

Hydrogen

The oil and gas industry may be taking a renewed interst in hydrogen energy – but perhaps different from the first round of enthuasiam about hydrogen, of say 2000 to 2010, said Frank Børre Pedersen, Programme Director, Group Technology with DNV GL.

Frank Børre Pedersen, Programme Director, Group Technology with DNV GL.

Hydrogen can be used for heating, transport (including buses), storage for renewable energy, power generation.

In particular, the idea of generating hydrogen from natural gas and sequestering CO2 in the ground, to make a truly zero carbon pipeline fuel, "could be a game changer," he says.

Qualifying advanced subsea equipment

DNV is developing services to "qualify" advanced subsea systems, including software and electric equipment. By qualify it means determining that the systems are fit for use.

Oil and gas companies are making more use of electric systems on the subsea, for example to open and close valves. This is normally done by hydraulic fluid under pressure, sent by pipeline from a surface vessel.

"The challenge is to demonstrate it [electrics] is as safe as the traditional way," says Dr Pedersen.

New digital technology from Oslo

At the Subsea Valley Conference we heard exciting news from Arundo Analytics, Optime Subsea, Solution Seeker, and about Norway's Tech21 tech strategy program

Arundo Analytics is 3 years old, with offices in Norway (Oslo) and the US (Houston and Palo Alto), employing 60-70 people.

The offering will combine sensing with performance management, helping clients to both understand what is happening with the equipment and see if there might be ways to run it better.

Normally sensing and performance management are kept separate, the company says. For example, pumps have sensors such as temperature and pressure, and separate systems for analysing how the pump is performing, perhaps calculating energy performance

But it makes sense to put them together, in the same way that the Fitbit personal health system combines sensors (a device worn on the wrist) with software helping you improve your 'performance'.

The software can help support performance improvement by building digital models of how the equipment appears to be operating, based on the sensor data.

The commercial idea is that manufacturers of equipment such as pumps will be able to sell analytics based services alongside their physical equipment, using their expertise of their own equipment together with the analytics.

It might be possible for a manufacturer to warn a customer that something isn't right, such as higher than expected vibration. Or a manufacturer could warn a customer that there is a problem with the operation, such as a pump not carrying enough fluid, which can lead to cavitation and ultimately breakages in the pump mechanism if it continues.

A supplier could also offer performance agreements, for example promising that a maintenance job on a pump, such as a new coating, will lead to a certain saving in power costs per year. If the supplier is able to share more of the risk, it has more likelihood of winning business, or can claim a larger share of profit from it.

There are several stages to offering such a service – providing equipment status data, providing equipment status data together with diagnostics, and then using the diagnostics to give guidance on what to do about any problem.

Oceaneering – turning an ROV into an "operating platform"

Subsea technology company Oceaneering is looking for ways to develop the standard "Remote Operated [subsea] Vehicle" (ROV), which have been in development since 1979, into an"operational platform".

The company envisages a subsea vehicle which stays on the seabed for over 6 months, with a subsea charging station, and no need for a support vessel on surface, no winches needed to lower it into the water, and no cables. The company calls it an "E-ROV".

There can be an onshore 'mission support centre' where various experts and surveyors reside, who can look at the data, and never need to go offshore. Oceaneering has its own such centre in its building in Forus, Stavanger, with a number of ROV pilot stations in 2 rooms.

Separately, Oceaneering is developing subsea 'drones', which can be piloted autonomously or with real time (human) control. They can swim free or tethered to a cable.

It is looking at light intervention vehicles, long range inspection and survey vehicles. The interventional vessel can change its tooling while subsea. They will all recharge their batteries from the same base module.It will start trialling a prototype in around March 2019, with a vehicle 3.3m long.

The concept is that you could have a number of docking stations and vehicles in the same subsea field.

Optime Subsea

Subsea well access technology company Optime Subsea is developing a new pump for hydraulic fluids for subsea equipment, where all of the fluids only circulate on the seabed, rather than being pumped down from surface vessels, as is usually the case currently.

Hydraulic fluids are used for a variety of subsea tasks, including opening valves and powering ROVs.

With this system, the only umbilical needed to the surface is for electrical cables and communications.

Ultimately, it should be possible to do plug and abandonment of wells from the seabed, without any rig or riser, the company says. This will make it much easier and cheaper, and also safer, to do subsea well intervention work.

Solution Seeker – helping optimise production

Solution Seeker, based in Trondheim and Oslo, Norway, has developed software tools to support decision making around production engineering decisions.

The company has been working with Conoco Phillips and Engie since the start, and is also working with Wintershall, Lundin and AkerBP. It builds on technology developed in the cybernetics department of NTNU (Norwegian University of Science and Technology) in Trondheim.

The software ingests production data into its servers, and runs its own pattern recognition algorithms and statistical analysis, to try to work out what factors are affecting production and how.

Ultimately you can build a prediction model of the reservoir, which can be used to work out what future changes will have a desired result.

As a typical example, an oil company might have 150 wells routing production to 2 different separators, all sharing the same source of gas lift, and with some downhole pumping available. Meanwhile the wells are declining 5-10 per cent a year.

The computer system can ingest much more data from the wells than a human being is capable of handling.

The original idea was that the service would be based on reservoir simulator data, but that was found to be "too slow". So instead, the input data comes from the field itself.

The software was originally developed with testing on Kongsberg production simulators, and then moved to work on live ConocoPhillips data.

SolutionSeeker has experts in production optimisation on its staff, and works directly with production engineers who know the assets in production.

Many reservoirs are operated based on "assumption based models", that what worked in the past will work now, says says Bjørn-Erik Dale, corporate development manager with Solution Seeker. But you cannot rely on such models over the entire lifetime of the well because the reservoir changes. The software can help operators to get a much better model of how the reservoir and

well actually work.

The software is also designed to cope with sensor data which can be "messy, unstable and uncertain", he says.

Norway's OG21 tech strategy program

Anna Thorarinsdottir, HSE Regulatory & Governance Lead at AS Norske Shell talked about the OG21.

OG21 forum – a program for Norway's technology strategy for the petroleum sector. The purpose is "tackling industry challenges and preparing oil and gas for the 21st century.

Technology target areas include Energy efficiency and environment (TTA1), Exploration and increased recovery (TTA2), Drilling, completions and intervention (TTA3) and Production, processing and transportation (TTA4), she said.

The group aims to guide publicly funded research and development, and stimulate industry funded research and development.

Norwegian politician Gry Fuglestveit Bløchlinger, with Jan-Fredrik Carlsen CEO of Optime Subsea, in front of Optime Subsea's subsea hydraulic pump system

The strategic objectives are to maximise resource utilization, minimize environmental impact, improve productivity and reduce costs, develop innovative technologies, attract, develop and retain the best talents

The technology needs are seen as improved energy efficiency, zero carbon emissions, protect the external environment, improve subsurface understanding, improve drilling efficiency and P&A, optimise production, improved subsea and unmanned systems, improve EOR, digitalise and develop High North technologies. "There are huge opportunities in all of these areas for new digital technologies," she said.

Up to 2030, the group expects that most production in Norway will come from existing assets, and there will be small development projects and subsea tiebacks.

Because Norway's electricity generation is nearly all hydroelectric, the CO2 emissions from oil and gas production form a large proportion of the country's overall CO2 emissions.

To reduce them, OG21 improving gas turbine efficiency, developing hybrid power supplies, using produced fluids for heat source, using more power from shore, and developing lean / low energy subsea solutions, and using hydrogen or geothermal energy for power.

ABB – a shift to software and 'advanced' solutions

Engineering conglomerate ABB reports that it is making a big shift towards software and "advanced solutions", now making up some 30-40 per cent of its business. It is partly driven by customer willingness to share data and use cloud hosting

Engineering conglomerate ABB, mainly known for automation and electrification products, reports that it is getting some 30-40 per cent of its oil and gas business in software and "advanced solutions" now, partly driven by customers' increased comfort with sharing data and posting it on cloud servers.

When data is hosted or accessible remotely, it becomes possible to get more outside experts involved to help work with the data, says Per-Erik Holsten, managing director, ABB Oil, Gas and Chemicals.

For example, ABB experts can help oil and gas companies to manage and monitor cybersecurity, improve process performance, monitor and calculate hydrocarbon flows, and better manage subsea power.

It means that customers can connect to the "total pool of competence of ABB", says Espen Storkaas, upstream lead of ABB.

ABB's Oslo office has experts in analytics, process performance, asset management, energy management, operations management, wells, cybersecurity, simulation, monitoring electrical and rotational equipment, all of which can help with real time operations.

ABB can both operational support, such as problem solving, or helping companies to diagnose alarms.

Per-Erik Holsten, Managing Director ABB Oil, Gas & Chemicals

It can also help companies to improve their own performance. For example, ABB can help one operator see how its performance compares to others, or work out ways to improve oil production.

ABB's platform for digital offerings is called "ABB Ability". There are over 200 different Ability "solutions" developed so far, and 700 ships connected to ABB Ability, the company says.

The company defines "digital" as developing ways to collect, store and structure data, and enable experts to be connected in a structured way.

Cybersecurity services

With more data available on the cloud, ABB is able to offer much more sophisticated cyber security services. For example, its cybersecurity experts can continually monitor customers' network data, and spot a data communications pattern which might indicate a certain type of malware.

For example, it might determine that there is a software system probing the network looking for a vulnerability, and ABB can tell this is probably because someone has put a USB drive in the system with malware on it. It might identify a system trying to contact a "mother ship" server so it can download its "attack payload".

The monitoring service was originally set up to check through customer's networks every 2 weeks. But customers started asking for real time monitoring.

ABB also provides customers with a cybersecurity dashboard they can use with key metrics about their operation, and analytics tools which can try to determine if something bad is happening.

If a dangerous attack is detected, ABB can alert people onsite about a problem within minutes.

ABB has been offering consulting services around cybersecurity since 2005, mainly about assessing a company's security and identifying gaps and ways to fill them. In 2007 it set up "collaborative operations", with services like security monitoring, malware protection, security process management, network security, back-ups and recovery.

Improving process performance

ABB is also developing services to help oil and gas companies improve the performance of their processes or avoid problems, with remote experts looking into control data and trying to make suggestions.

It has set up 6 different key performance indicators for matters relating to process operability. If any of them are "red", or above a certain level, it means it could be difficult to control the plant. If any of the KPIs start to change, then ABB staff can do analytics as to why, for example it could see that fuel consumption increased as a result of opening a valve.

The software can also be used as part of meetings and collaborations, rather than take screenshots to put in PowerPoint slides. People can get answers to questions during the meeting, rather than say, we'll have to look at that some other time.

Virtual flowmeter

ABB is also building cloud tools for calculating flowrates of individual wells, in a joint project with Oslo analytics company Arundo.
ABB has been refining its flow algorithms for many years, to estimate multiphase production rates from individual wells, based on temperature and production sensors on individual wells, although there is only as flowmeter on the co-mingled flow. This is considered a "virtual flowmeter".

The software was originally written in FORTRAN, but Arundo has now re-written it in Python.

The service is already running on 13-14 oil and gas production sites. The models have been developed over the past 20 years, using a wide range of domain expertise.

Subsea power

A big research area is developing better ways to manage and monitor power (electricity) on subsea installations. ABB is involved in a joint industry project with Statoil, Chevron and Total, and $100m investment, to build a "subsea power station". The project criteria are that the power station must be able to handle 100 MW of power, 600km from land, 3000m depth.

It is testing electronics boards to see if they can work at high pressure. Some components sit inside a pressure cylinder, so the components themselves are at a more normal pressure. Other components sit in a pressurised environment themselves. ABB is keen to use components which are already in manufacture, not develop components especially for this application.

ABB is also developing transfomers which can change the voltage of subsea power actualy on the seabed. Typically 100,000 Volts are supplied from the platform and reduced to 35,000 volts on the subsea transformer.

Components are being tested in higher water temperatures than are actually found at the seabed. because this enables the testing to be speeded up. After 10,000 hours of testing, the components will have an equivalent level of damage to 30,000 hours of operation at a lower temperature.

Subsea components are usually expected to last for 30 years.

Defining digital transformation in Oslo

A discussion session was held at the March Subsea Valley conference in Oslo about better understanding what 'digital transformation' means in the oil and gas industry

Walter Qvam, chairman of PGS, SINTEF and DNV Foundation, chairing the forum, said that the oil and gas industry is "pretty early in our curve for adoption" of digital technology – and the changes happening in industry are creating opportunity for new business.

The oil and gas industry should perhaps be thinking much more deeply about how the digital 'ecosystem' ought to work, and which rules should apply, he said.

Morten Dalsmo, Head of SINTEF Digital, part of the SINTEF research organisation, said he defines digitalisation as "using digital technology to change a business or model".

Statoil's digital roadmap

Torbjørn F. Folgerø, senior vice president and chief digital officer with Statoil, who is setting up Statoil's "digital centre of excellence" and developing its company wide digital "road map", said that the company aims to apply better use of data to a wide range of tasks, including safety, climate, logistics.

The company has ambitious targets to increase production, reduce drilling costs and reduce capex, with technologies such as automated drilling, standardised developments, remote operation and other automation.

Torbjørn F. Folgerø, senior vice president and chief digital officer with Statoil

There are 6 "programs" for the digital centre of excellence. Safety / security / sustainability, subsurface analytics, next generation well delivery (including automated drilling), field of the future, data driven operations, and process digitalisation and insights.

Statoil has already put all data from its onshore production onto cloud systems, including safety and subsurface data. This means that the data can be much more easily found by others, and shared with suppliers in new ways, he said.

Statoil is creating a portfolio of digital training courses, driven by the needs of current employees. "We want to refocus them," he said.
For its US onshore operations, Statoil has built a new operations centre to manage data. It can monitor problems with wells and despatch engineers to fix problems. It can also optimise production and try to predict where maintenance will be needed. It plans to create a similar operations centre for offshore wells in Bergen.

Statoil is looking at where it can do more advanced analytics on its subsurface data, and perhaps build a "subsurface data lake".

Dr. John Markus Lervik, founder and CEO of Oslo technology company Cognite AS,

John Markus Lervik

Dr. John Markus Lervik, founder and CEO of Oslo technology company Cognite AS, noted that very few things have changed in the working world through digitalisation – in comparison to the consumer world, where a great deal has changed.

This could be because industrial systems and assets together make a much more complex environment than most things in the consumer

world, he said. For example, Statoil's Johannes Sverdrup field is much more complex than the system to run Uber.

Also, in industry, there are different players which do not have aligned business models – for example when an operator wants improved production, but a consultant wants to bill for more hours.

Cognite has investment and collaboration with Aker Solutions and AkerBP.

Data sharing

A key thing to solve is to make data more available, said Dr Lervik from AkerBP. "Data must be available for machines as oxygen."

"We have massive amounts of competence, very smart people, investment and revenues," he said. The industry can build sustainable technology to "improve Norway and scale it out globally".

In response, one audience member noted that companies do not want to 'share' their competitive advantage by giving data and models to a competitor.

Statoil's Mr Folgerø noted that the industry does have a record of sharing data without adverse effects to business, for example in the DISKOS database of production data.

There can be new business models based around shared data, for example when suppliers are able to directly access Statoil data, and so deliver new products using it. "That's something we welcome very much," he said.

"Equipment suppliers can work on the data they know the best."

But Statoil understands that "share or not share" is not a black and white question, with complex legal and commercial issues involved, he said.

Duncan Irving from Teradata, in the audience, noted that most industries other than oil and gas perhaps see digitalisation as further stages in their organic growth – such as retail and banking. These organisations have a mature understanding of what knowledge can be comfortably shared and what should be kept private. But in oil and gas, "we need to sort out that business model."

Kongsberg

Christian Møller, CTO of Kongsberg Digital and a former researcher with Microsoft in Redmond, USA, says he sometimes senses desperation from companies, as if they believed if they don't jump on the digital bandwagon their business will evaporate.

Sometimes companies seem to be just becoming "buzzword compliant", talking about IOT and cloud. "I don't think that's digitalisation," he said. "We need new business models, we become a digital service provider."

There is no technical reason why the jump to digitalisation should be happening right now, he said. Perhaps it is just that "stars have aligned" and so this feels like the right time to move.

There is a lot of data "infrastructure, scaffolding and plumbing" required to get there.

Three broad trends are the move to cloud, machine learning and better use of real time data, he said.

The cloud makes it easier to quickly build client side applications – for example a pump manufacturer can use cloud systems to store clients' data about pumps, and then can provide machine learning and condition monitoring services from analysis of the data, which can be sold alongside the pump.

Manufacturing items like pumps can be a very low margin market. Companies are keen to get higher in the value chain, which they can perhaps do by providing data services. For example instead of selling sonars, it could sell maps generated from sonar data, which is what companies ultimately do. Or engine companies can sell guaranteed fuel reductions, he said.

Perhaps in future when historians look back on development of digital technology, they may see the move to cloud as a fundamental part of the transition.

Machine learning "is very high on the hype curve," he said. It has revolutionised image and speech recognition. But as far as broader impacts, "we have to do some expectation management," he said. The usual problem is that companies don't have enough data to do it, or data quality is insufficient.

The biggest potential can be from combining traditional methods of working in the oil and gas industry (e.g. physics/ engineering based) combined with modern tools such as machine learning. "The combination we call hybrid analytics - we think that has a lot of potential," he said.

A third element is finding better ways to work with real time data, perhaps as a 'digital twin', where you have a live updated digital model of the physical thing. "We're building a digital twin for drones, offshore fish farms, oil installations.

Kongsberg is building the world's first fully electric autonomous container ship," he said. The digital twin is an essential part of that."

Mr Møller imagines a future where every job needs the equivalent of a Master's degree. "That could be a good thing. You're using the capability of human brains more efficiently."

Attracting people to work in oil

Arild Nystad, chair of petroleum economics at Norwegian University of Science and Technology

Arild Nystad, former department director of Norwegian Petroleum Directorate and chair of petroleum economics at Norwegian University of Science and Technology (NTNU) noted that Norway has a big need for people with petroleum engineering skills.

It won't help if all the bright technical people want to work in digital technology. Norway has only produced about half of its producible resources, and the next 50 per cent will be much more challenging to recover.

Companies perhaps should start talking about "oil and gas" more, rather than just "energy", he said.

The number of master's students applying for petroleum engineering studies at NTNU is much reduced this year, he said. The lack of competence will be a bottleneck for Norway in future.

Mr Nystad is working on a training program at NTNU, where there are just announced 40 Phd positions in digital and automation in oil and gas, and it is building up a program in cybernetics, computer sciences and petroleum engineering.

"The first element in charming the young is to employ them," he said. They have learned in the last 3 years not to get any employment."

In response, Cognite's Dr Lervik said that many top IT people are tiring of working with Sili-

con Valley consumer technologies, and want to move into more exciting things," he said. "What is more exciting than having digital technologies representing and modelling and optimising the physical world?"

When Cognite was founded, the company found that 4 of 10 people in discussions about joining the company said they didn't join "because it was oil and gas".

"But after that we have been much better at explaining," he said. The industry has "very exciting computer science and machine learning problems. Plus it is also about improving the industry and how we operate as a nation."

As a former IT person, "I see we can solve a lot of interesting problems," he said.

Statoil's Mr Folgerø said that he thought the scarcest competencies in the next 3-4 years will be what he calls "translators", or people who understand petroleum technology and geoscience, but also understand enough about machine learning and can connect with the right people.

These people will come from both current employees and new recruits.

Universities like NTNU can help bring important skills together, and bring in new perspectives, people who are interested in data science, who work together with domain experts, he said.

Platforms battle?

One audience member asked whether there might be a battle between the various digital platforms in the next few years, with only room for one winner.

Dr Lervik answered that there are currently "no platforms in the industry space yet", if you define a platform as something very broadly used, like Facebook or Amazon. "Since the industry is more fragmented, complex and verticalised, if there will be platforms, there will be many more of them," he said.

There could be industrial platforms solving specific industrial problems, such as in seismic data or rotating equipment, but that has not yet been seen.

GE Predix is "probably the first one," but it is more a framework than a real platform, "both from technology perspective and a market perspective."

Kongsberg's Mr Møller noted that there could be different "ecosystems" of industry data with a number of companies involved. Some oil companies might see themselves as running a central digital 'hub' from which they connect with partners.

Interoperability

Morten Dalsmo of SINTEF

Morten Dalsmo from SINTEF said that one issue is making sure the various digital 'platforms' can talk together – interoperability is often "quite poor in this context".

Statoil's Mr Folgerø said that the company's ambition is to have one framework, with many services from many suppliers solving the different solutions. Although the company would prefer to buy rather than build, "there is no kind of solution in the market that will help us create a whole architecture."

We are starting to see much more companies making their systems accessible to others. "Even the biggest players realise they need to open up their systems," said Cognite's Dr Lervik.

"If I as a technology provider, or Statoil as an operator, are not able to provide APIs that are effective, then you will be not moving as fast as you should," he said.

Just because companies are in competition does not mean that they cannot integrate their systems. One example of two fierce competitors which have systems which can integrate are Siemens and ABB, he said.

Cognite's Dr Lervik said that it is good that Statoil has built a platform. "They've cleaned up their loft, they are exposing what they have to us," he said. "We don't have to fiddle around with their system."

There's a very simple transaction between us and them."

Dr Lervik noted that in the automotive sector, the digital business models have been enforced by car manufacturers, and the same could work in oil.

It is operators which need to drive for and enforce better data systems. "It is the only way," he said. "There's so many players along the value chain who have different incentives."

New development methods

Companies are developing digital technology in new ways. For example, Statoil is is moving to more of a "minimum viable product" approach, with people working in "sprints" of 2-3 weeks and trying to develop a solution at the end of it said Statoil's Mr Folgerø. In the past, Statoil might have spent 9 months making design documents for a system, then giving it to the IT department to build, and then keeping it in place for years.

Statoil is also changing to allow more flexibility and fluidity, with people having access to more data than before, which should lead to people being able to do new things. The management just set the direction rather than specifying how everything should be done, he said.

Cognite's Dr Lervik emphasised that it is very important for the industry leaders to set the vision. "Digitalisation will never happen bottom up," he said. "It will happen because you set ambitious goals and follow up on those with bottom up. It is as simple as that and as hard as that."

Domain expertise and digital

To write algorithms, children need skills in mathematics and physics, which is then brought to the digital perspective. They also need domain skills – and Norway is strong in oil and gas, maritime and fisheries, said SINTEF's Morten Dalsmo

"Combine strong digital skills with domain expertise, that is the key to be a leader," he said.

If you are developing an algorithm for a piece of machinery, it is important to involve the discipline leader for that machinery in Statoil, because that person understands how that machinery impacts the installation around it.

This person could be the best person to work with data about that machinery, and build up a digital understanding, and then perhaps connect to data scientists. ""That's where we believe the magic will happen," said Statoil's Mr Folgerø.

But if you give engineers a digital "black box" and tell them they have to trust it, they won't. "The best training is to expose them to these digital projects we are working on," he said.