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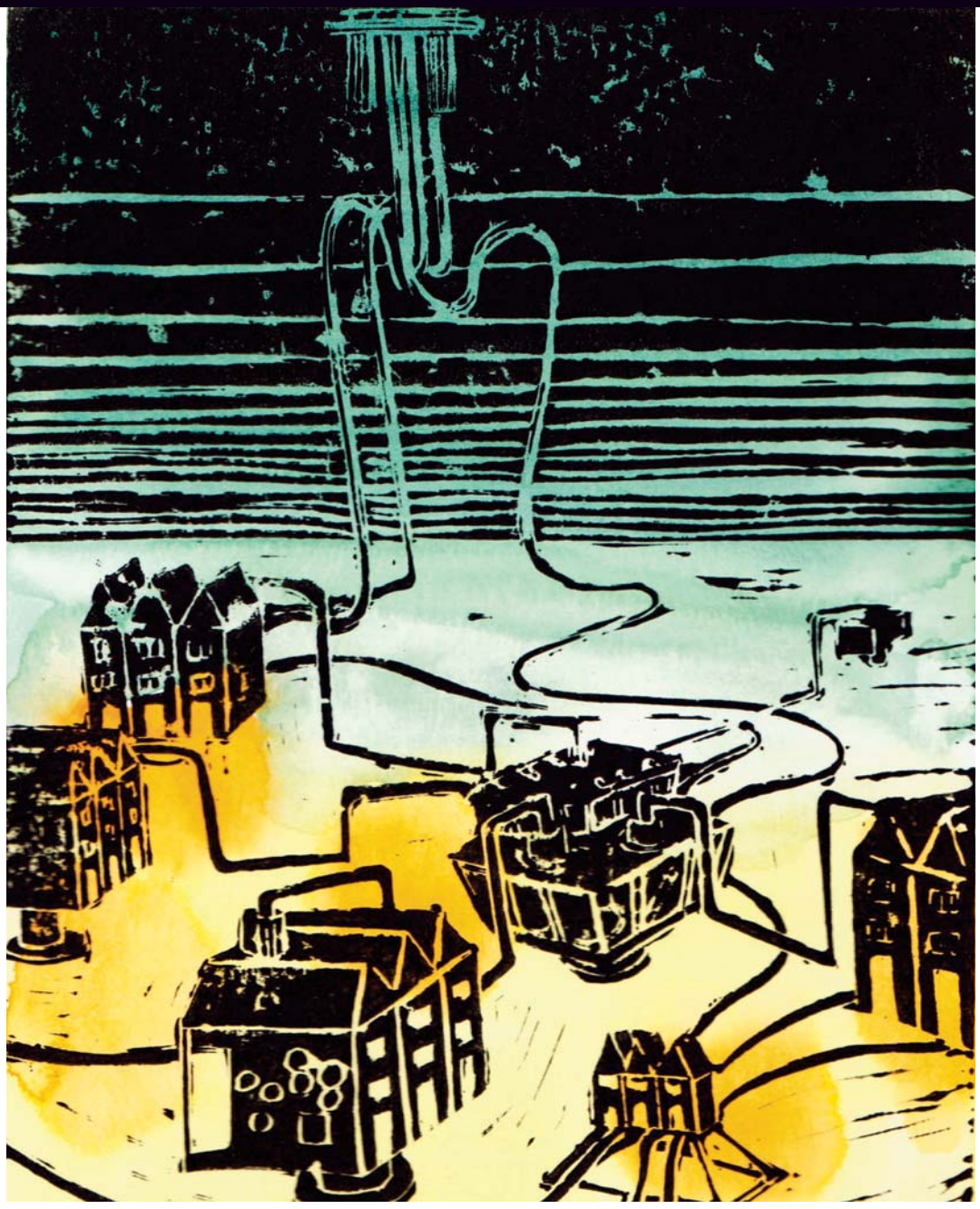

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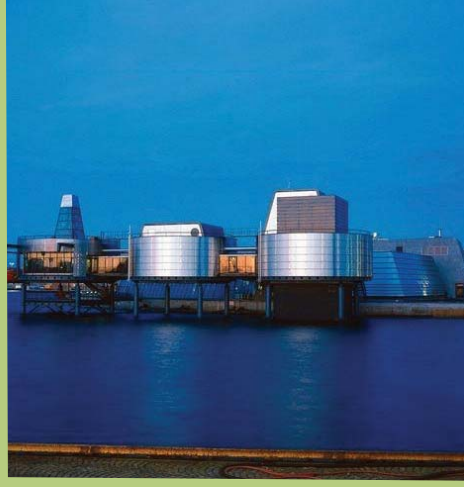

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We should be focussing on integration

by Karl Jeffery

It is quite possible to see the first phase of our movement, the 'Intelligent Energy' / 'Integrated Operations' / 'Smart Fields' / 'GIOP' coming to an end - and we should replace it simply with a quest for more integration - perhaps under the name 'integrated oil'.

Some technologies and working methods developed under 'Intelligent Energy' banners are now used everywhere, like international conference calls and multidisciplinary teams. For other Intelligent Energy technologies, the industry may have gone as far as it ever will with them.

Take remote support of offshore work. The industry does a great deal to support offshore work with remote experts, but there does not seem to be much interest in reducing further the number of people working offshore.

For 'smart fields' - if this means instrumenting wells and working with the data - we can simply say that some wells are heavily instrumented, some aren't, and the industry seems happy enough aboutt that. Some oil companies don't even know how many wells they have. Some oil companies have shut-in wells which they don't know exist, which entered their portfolio as part of an acquisition of a field which has already changed hands a few times and records have been lost - and that's not much of a problem to them either.

Integrated Operations is starting to look wrong. The industry seems to have been quietly reorganising over the past 10 years to the point where most people are working on 'projects' and use the word 'operations' for everything which isn't a project. If project work includes finding reservoirs, doing a field development plan, drilling wells, building offshore infrastructure, doing interventions, retrofits and decommissioning, that doesn't actually leave much left to come under the label of 'operations'.

The name 'Intelligent Energy' is a bit irritating to the many intelligent people who work in other parts of the oil and gas industry, who might actually be quite intelligent themselves.

Meanwhile there are many wonderful ways the oil and gas industry could improve under the banner of 'integrated oil'.

We could get a better understanding of the over 1 million things which have a 1 in a million things chance of happening, which can cause accidents. These are generally an integration of unlikely events - which can cause accidents.

We could develop standards for subsea infrastructure and FPSOs - providing a pathway to lower cost and increased recovery from deepwater developments.

We could try to make the industry simpler, an extremely complex task. Maybe this would mean parcelling up expertise, so the difficult stuff can be held in individuals' heads but the interdisciplinary communication is at a simpler level.

We could get universities and industry far better integrated - industry gets much more involved in universities and inspiring people to take petroleum engineering courses, and universities produce graduates with the right mix of personal and technical skills to add the most value to industry.

All of these ideas, and many more, were suggested during the excellent "Integrated Operations" conference in Trondheim in October, which we report on in this issue.

As a moonshot plan, the industry could integrate together to bury carbon dioxide. Instead of waiting for a high carbon price, the industry could agree globally to sequester one carbon atom (in carbon dioxide) for every carbon atom it produces. This would be a great way to inspire students to join the industry - and might actually be the only way to solve the carbon problem.

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Helge Lund on Integrated Operations

At the Trondheim Integrated Operations conference (Sept 30-Oct 1), Statoil CEO Helge Lund shared his perspectives on how integration and technology can help the oil and gas industry to improve

Focussed on communities, climate and competitiveness - Helge Lund, CEO of Statoil (shortly to become CEO of BG)

The industry is going through a "rather challenging geopolitical environment" with events in Iraq, Syria, Russia and Ukraine, instability in North Africa, Venezuela and Nigeria, and "last week we almost got a new country in Europe," Helge Lund said in his keynote speech at the Trondheim (Norway) Integrated Operations conference on September 30th, organised by the Integrated Operations Centre.

Oil major CEOs even have to convince students to work in the industry these days. "Last week I was in Trondheim to visit more than 500 students at NTNU. My job was to convince them that by joining this industry they could be part of solving the most pressing issues of society," he said.

"There was a very high engagement in the room, the topics of our industry really engaged the students."

"On top of this rather challenging geopolitical environment there are three issues that I believe the industry needs to work effectively with as we move forward. Communities, climate and competitiveness," he said.

Communities

"This industry depends on access to resources, we also need acceptance."

"Our industry is entering now new and more sensitive areas. We are conducting our business closer to where people actually live, like in the onshore business in the US."

"Therefore communities will focus more on how we are operating. They expect much more than only us not to create harm, they also expect to share all of the benefits that this industry is creating, and that goes much beyond royalty and taxes."

"A few weeks back I was in Tanzania where we have made some significant gas discoveries and we are planning the first big oil and gas projects there.

"You can sense the expectation from the local society to what this industry can deliver. Also very high expectations as to deliveries on the short term. Perhaps a bit imbalanced in their expectations and insight. But still an important framework condition for the industry."

Climate

"My second C is about climate and carbon efficiency.

"Last week I attended a UN summit on climate in New York together with many people from this industry."

"I could feel a personal pressure to be part of solving this issue as a representative of this industry."

Mr Lund said he believes that oil and gas will still play an important role in society in 30 to 50 years in the future, even if we manage to limit temperature increase to 2 degrees.

"But we need to provide these resources with less CO2 emissions," he said. "This will require more innovation, new policies to stimulate innovation, and a lot of actions by this industry."

"I think the most forceful action societies can take these days is to put forward a sufficiently high price on CO2 to stimulate all institutions, companies and individuals to work towards more effective solutions to address the climate issue."

"For many years this has been very high on Statoil's agenda. Carbon intensity is an integrated part of how we plan our business moving forward. We assume tighter energy and climate regulations, and we factor in increased CO2 prices from 2020."

"Last week we also launched, together with some industry colleagues, an industry initiative to deal with short lived climate pollutants with particular emphasis on methane emissions.

CO2 planning

Until recently, Statoil planned its projects around the price it thought the world would need to deliver to deal with CO2 and keep temperatures within two degrees.

"We have gradually adopted a more analytical approach [looking at] what will the political communities be able to deliver regionally or on a global basis."

As an indication, he said that Statoil uses the price of around "$50 per ton in our analytical tools and models from 2020 onwards."

"Personally I think that is a little bit on the low side in terms of what the world needs. You have to have a price where gas is replacing coal."

CO2 in Norway

"For those of you familiar with Norwegian politics, the price is $75 / ton.

"To my knowledge this is the highest CO2 price anywhere. I think it has led to an industry in Norway which is delivering world class CO2 efficiency."

"However there is a limit to how far Norway should go in my opinion in being in front. You are impairing the competitiveness of Norwegian industry and not improving the climate because CO2 will be emitted elsewhere."

"I think [a higher CO2 price] is necessary for us to keep the license to operate, to ensure continued support for oil and gas, to make gas more competitive against coal. So this is the way we have approached it."

Carbon competitiveness

There are a lot of synergies between being carbon efficient and being an efficient company, he said.

"If we have that price ($75/ton) I think the best and most CO2 efficient company will prevail and win. I think there is a huge link between the competitiveness agenda Statoil

is running now, to lower our cost, and the climate issue.
The lower your costs, the more robust you are against changes in the environment."

"If you believe, as I do that the CO2 price will go up, then you have a benefit if you run your operations at low cost."

"It will be a competitive advantage [to run a] carbon efficient oil and gas company." Technology will be important in reducing CO2 emissions, he said.

For example, in its Bakken (North America shale) oil operations, it has been working together with GE to develop a way to use associated gas, to run the rigs, instead of diesel. The gas needs to be compressed. Previously the gas had been flared, creating more CO2 emissions.

In the Brazil's Peregrino field, the company had many challenges, with heavy oil, low reservoir pressure and high water production. This meant that approximately 65 per cent of the energy was being spent on processing, heating and pumping.

Statoil implemented a small inflow control valve in the wells, which would reduce the amount of water produced relative to oil. It also found a way to transport the oil with 40 per cent less water. "This contributes to roughly between 5 and 9 per cent reduction in the energy consumption for this field," he said.

Competitiveness

Aside from the climate issue, improving business competitiveness is a high priority for Statoil now, he said.

New technologies are allowing Statoil to access more complex resources, but that means complex projects, which means high cost.

This is illustrated by the fact that return on capital by oil majors has decreased by 30 per cent over the past decade, although the oil price has increased from $40 to $100 per barrel.

More than half of Statoil's assets have a return on capital employed which is at or below 10 per cent, "even though we are running some of the most profitable fields, the legacy fields," he said.

The problem is best solved by improving productivity and removing complexity, rather than simply trying to cut costs, he said.

The industry has no choice. "If we cannot do that, we will fail to attract capital, and this perhaps one of the most capital intensive industries in the world." he said. "We will fail to attract talent because they will go elsewhere. And therefore we cannot fulfil our mandate to provide energy to the growing population of the world."

As another illustration, Statoil compared data from two similar fields, one which opened in 2004 (Kvitebjørn) and one which opened in 2014. These are relatively similar fields.

It found that the number of metres of cable involved in the different projects increased by 30 per cent of engineering hours increased 70 per cent, and the number of man hours for life cycle information increased by 300 per cent.

"This is a trend that we must not only stop, we have to reverse it," he said. "In Statoil we are running the most comprehensive change and improvement program we have ever done in the history of our company."

"Our short term target is to improve cash flow with $1.3bn in 2016," he said. "This is not about cost cutting, this is to look at productivity and take out complexity in every part of the business system."

"I picked out some of my strongest leaders to lead a central effort in Statoil to address this. It is on everybody's scorecard to make sure we can address this."

Fast track

One Statoil initiative to reduce costs is what it calls "fast track projects".

"That's a pool of projects, mid-sized or small discoveries near to existing infrastructure where we have standardised equipment so we can do it much quicker and at lower cost," he said.

"We have launched eight of these projects that are producing around 80,000 barrels per day, with very good profitability. So standardisation did not hamper profitability."

"I think we already have some pretty good examples - that standardisation and industrialisation (ie simplification) is working."

Subsea standardisation

Mr Lund is particularly keen on standardising subsea. The cost of subsea installations have increased by a factor of 2.5 over the last 10-12 years, he said.

"One of the problems is that each operator, each asset, has individual solutions," he said.

"Statoil aims at establishing an agreed standard on subsea interfaces.

"I'm quite inspired by Lego," he said. "Based on standardisation, you can build everything from castles, trains to Star Wars."

"What if we could pout Lego bricks on the bottom of the ocean? Develop industrial standards across operators and suppliers."

"This is not something Statoil can do alone. It requires a collaborative approach. We are trying to take lead to dip into this huge potential for simplification."

"This will allow suppliers to compete within modules - but standardise on open interfaces to achieve plug and play functionality."

"We depend on cost efficient subsea developments. 77 percent of new discoveries on NCS will most likely be subsea development."

"One enabler for subsea development is to develop a subsea compressor. Probably a pioneer today, but a standard of the future, enabling increased recovery and new business opportunities."

Integrated operation

"Integrated operation, as I see it, is an enabler to get the most out of technology, and it can address some of the root causes to the competitive challenge," he said.

"10 years back - IO was to a large extent about building the infrastructure. I think my company Statoil took a visionary approach at that time, and was one of the driving forces of the fibre optic network on NCS."

"This network is quite unique in the world. It enables a multidisciplinary collaboration both offshore and onshore. The high speed fibre optic cables are linking platforms, and people, together in a new seamless way of working. Experts can be anywhere offshore, onshore or even in another country."

"The second phase was that the infrastructure enabled us to develop a new way of working. It enabled us to establish a new operating model for all our installations on NCS."

The top table at the Integrated Operations conference. From left to right: Tord Lien, Norwegian Minister of Petroleum and Energy; Cristina Pinho, E&P Executive Manager, PETROBRAS; Unni Steinsmo, President - CEO, SINTEF; Helge Lund, CEO, Statoil; Chon Fui Chai, General Manager Smart Fields, Shell; Frans van den Berg, Program manager for Collaborative Work Environments, Shell; Arild N. Nystad, Innovation & Industry Liason, IO Centrer/NTNU

"We have established a broad set of centralised expert centres - production support centre, subsurface support centre. This saves cost but more importantly it improves the quality and speed of decision making, such as more accurate well placement in drilling, more safe and efficient operations, and a much better utilization of the core experts in the Statoil organisation."

"Now the key components of integrated operation is how we can improve efficiency further. It is about using our model to work smarter and leaner."

"Technology has enabled us with overwhelming volumes of data. We have to make sure we capture the right data, right routing of data, efficient data utilisation for efficient operations."

The company has managed to improve production by 4.6 per cent on some fields through more integrated operations.

Operations and projects

Statoil is very interested in 'lean concepts' for new field developments, looking for projects which can deliver high production at low cost.

"If you read Norwegian newspapers you would think we have put most projects on hold. This is not the case - we have never had a larger project portfolio on the Norwegian Continental Shelf," he said.

Statoil initially planned to operate its fields at 30 per cent recovery. "Now it's around 50 - we have set a new target for 60 on average on our fields," he said.

At its new Johannes Sverdrup field outside Stavanger, "We think it's realistic to have 70 per cent [recovery]" he said.

The recovery is "partly based on technology and the way we approach these things."

Statoil operates over 40 different installations. "The real backbone of Statoil is to operate these installations in the best possible way," he said. "There's a huge focus on operations."

It has established expert centres to make the most out of the company's expertise. "Drill wells efficiently, solve problems efficiently, make sure rotating equipment failures are addressed with the best competence possible."

"We have never performed better in terms of operational quality than we do now," he said.

The expert centres have "helped us address bottlenecks in expertise in a much more efficient way," he said.

"Previously these guys had to travel offshore, work with a difficult well. Now they can sit in Forus in Stavanger - they can help 3, 4, 5 different wells simultaneously."

But the Integrated Operations philosophy also needs to be applied to projects. "I think we need to build in the philosophy of integrated operations to all new projects," he said.

"We have so many new projects in the pipeline - it is a very important of future efficiency."

Governance

Mr Lund was asked about the company's governance structure and how integrated operations fits with this.

The company gives its 'DPs' (heads of development and production) three mandates, covering safety, production efficiency, and developing the maximum potential of assets, he said.

The wells are delivered by technology and projects teams, which cut across the company, and work with integrated operations.

Complexity

Mr Lund was asked how he thought operational and process simplicity could be achieved.

Integrated Operations allows more people to be involved in a decision, but this does not necessarily processes any simpler, a delegate pointed out.

"Integrated oil and gas companies will never be simple organisations," Mr Lund replied.

"I think at least in Statoil and generally in the industry, the technical requirements and some of the processes that we have developed in oil and gas companies have grown too complex."

"We are living in a compliance society and compliance is important, but I think we need to make sure that more people are actually doing the job and doing it with the right quality in the first place, instead of too many people controlling what other people are doing," he said.

"I think there is a job to remove duplicationary roles. I think we can simplify some of our processes."

Cuts

In response to criticism about reported Statoil cutbacks, Mr Lund said it was important to look at current levels in relation to the past. The activity level on the Norwegian Continental Shelf is "more than double now what it was in 2004," he said.

"The same people that criticized our companies for running too high on activity level [in the past] now criticise me for pushing back a bit."

"I know the recipe is not just to add on more CAPEX."

On October 15th, BG Group announced that Helge Lund had left Statoil to become its CEO.
You can view videos and presentations from the Integrated Operations conference at www.ioconf.no

Standardisation is the new innovation

Lars Høier, Director of Research, Development and Innovation, Statoil, believes that "standardisation is the new innovation" – and explained how his company intends to drive it

Standardisation is "a pathway to reducing costs and complexity" - Lars Høier, Director of Research, Development and Innovation, Statoil

Lars Høier, Director of Research, Development and Innovation, Statoil, said he believes that "standardisation is the new innovation", speaking at the Integrated Operations conference in Trondheim on Sept 30.

Mr Høier sees standardisation as a pathway to reducing costs and complexity.

Mr Høier manages a 2.8bn (US$ 430m) annual budget and 760 employees in Norway, USA, Canada, Brazil and China. He has a PhD in in Improved Oil Recovery (IOR) and was formerly senior vice president for mature area developments and IOR at Statoil.

The company is aiming to improve standardisation in several areas.

It has a "Fast Track" field development scheme, which aims to get fields into production 40 per cent faster, by developing standardised solutions.

In its US onshore operations, the company is finding ways to reduce drilling costs by 25 to 50 per cent, "just by working hard on repeating what we are doing again and again," he said.

It is developing standard rigs in special categories, known as 'cat rigs', which "I think will be important moving forward attacking different fields and drilling challenges," he said. "We think we can increase operational efficiency 20% by doing that."

It believes it can achieve $60m savings with standardised floating storage units.

By developing standardised equipment and modules in general, it believes it can achieve $150 to 300m savings, and with standard platform concepts, it believes it can save 8-10 per cent on facility capital expenditure. We want "standardised platform concepts we can apply in many different places. We can do minor adjustments [to standard designs] instead of doing [it all] tailor made."
It is developing standardised vertical Christmas Trees and standard well designs.

With a concept called 'subsea on slim legs', essentially topsides equipment which are much slimmed down and designed for unmanned operation, like subsea equipment, it believes it can save 20-30 per cent on capital cost.

Subsea factories

In the subsea arena, Statoil has defined six different subsea applications it wants to develop standard solutions for, which the company calls 'subsea factories'.

The first is the 'tie-in' or 'brownfield factory', where you already have infrastructure and a platform, and you want to drill a subsea well nearby which connects to it. This will usually include simplified boosting (pumping), simplified compression, water separation, power distribution, all on the seabed, and ability to do well interventions.

The second 'subsea factory' is the same as the first but with more of the core infrastructure subsea, including sea water injection and gas treatment.

The third subsea factory is long distance tie backs, for example for in the Barents Sea, where you need to be able to pump oil for long distances, and need high capacity boosting (pumping).

The fourth is deepwater, producing in up to 3000m water depth. The company needs to develop its artificial lift technology in the wells which can work at such water depths, and also special seabed separation units, and better ways to do inspection, maintenance and repair. It also wants to find ways to reduce deepwater drilling costs.

The fifth subsea factory is heavy oil. Statoil has the world's largest offshore heavy oil portfolio, he said, including the Peregrino Field offshore Brazil, the Mariner and Bressay fields in the North Sea. This will need a way to pump (boost) high viscosity oil.

The sixth subsea factory is for the Arctic, you will need a way to treat, store and offload oil in the Arctic.

Achieving standardisation

A practical first step is encouraging subsea equipment manufacturers to develop standard interfaces to connect equipment together. At the moment we have "subsea systems with interfaces with a lot of different requirements where you need adaptors to put things together," he said.

Statoil would prefer if subsea equipment would fit together like Lego.

Statoil has already started working with 3 suppliers, FMC, Kongsberg and Saipem, "to have their input on this challenge," he said. "We have started a 3 month study now."

But it needs "all the industry, all the suppliers and vendors to put input into this. "I know there are many others that think about this and have clear ideas how we can attack it. We are seeking advice in a broad sense here. We need as operators to go together on this."

"We want to make a joint industry collaboration, with the main operators, and we want to start it early next year."

Statoil also wants to get more industry support for the idea of standardisation.

Standardisation might not be in a subsea equipment company's short term interests, if it means less billable engineering hours, and making it easier for competitors to join the market.

But it is in their long term interests, if it means that it will help the subsea industry to grow, Mr Høier said.

Trondheim NTNU Integrated Operations Conference

Drilling

For drilling, Statoil is keen to apply some of its learning from the US onshore drilling industry to offshore operations, in particular in simplifying the well specifications.

"Can we challenge ourselves doing simpler wells and more wells instead of more fancy wells?" he asked.

It is pleased with the steerable drilling liner, developed together with Baker Hughes, which reduces drilling time. "We can do even better with the next generation of it."

In terms of drilling automation, the most important drilling automation might be in the subsurface, rather than the topsides, keeping the drill bit automatically in the reservoir. "We can run these things more on autopilot, with a drilling steering control system," he said.

Technology successes

Mr Høier presented what he saw as Statoil's biggest technology successes in recent years.

He is proud of the permanent 'seismic on demand' installations the company is doing on some off its fields, including Snorre, Grane and the new Johan Sverdrup field in Norway, and Peregrino in Brazil, with plans to introduce it on a further 8 fields.

"[The question is] how do you fully utilise this data into efficient model updates of the subsurface," he said.

Another technology success is automatic inflow control devices, which control flow of fluids into wells, first used in 2008. Statoil now has 2400 valves on 8 wells on the Troll field, with an ambition to install them on all 100 wells at Troll.

In exploration, Statoil is developing ways to combine different electromagnetic survey methods with seismic, which has proven "imperative" for some of its Barents Sea discoveries.

Statoil has achieved overall recovery rates of 62-63 per cent on its Nona field, very impressive when many operators are seeing recovery from subsea wells at half what they see from traditional wells.

On the Nona field, "we have excellent 4D data, we do a lot of infill drilling, microbial EOR, we do a lot of stuff," he said.

Less separation?

Mr Høier was very pleased with a suggestion from Andrew Gibson, a specialist in oil and gas field development, operation and maintenance at MARINTEK, that maybe the oil and gas industry should stop worrying so much about separating oil, gas and solids immediately after production – it might be easier to pump the fluids in three phases to a separation unit further downstream.

"I think in our industry we've been so heavily focussed on separation since 1930," Mr Gibson said. But several rotating machinery manufacturers now are producting multiphase compressors which seem to work. There are pumps with good tolerance for liquids and solids. The time is perhaps very right to think radically about how we design production facilities. That might simplify the challenge quite a bit, and radical thinking is perhaps well overdue."

"Heading up R+D, I'm keen for more solutions," Mr Høier replied. "I'm asking for help to attack the systems that we have. That would be really interesting technology for efficiency."

Other industries

When asked which other industries he was looking at for inspiration, Mr Høier mentioned the aviation industry, where it is working with GE to find better ways to run turbines. It is also very interested in the automotive industry, and its success with 'industrialising' and taking down cost. It also works together with NASA, looking at better ways to work with large data, supercomputing, sensor technology (particularly at high temperature and pressure), and transfer data over large distances.

Views on standardisation

In subsequent conference sessions, several speakers provided their views on Statoil's standardisation ideas.

Frans van den Berg, programme manager for collaborative work environments at Shell, said that the biggest value of standardisation is when you build something the same way as you built the last one.

But sometimes you can go to far trying to standardise, an example being a roof in an oil company building in Brunei which has been built to withstand one meter of snow, because that is the oil company's global building standard, he said. "You can take it too far and end up with specifications that take care of every possible risk and uncertainty and make things too expensive. You have to think through what needs standardisation."

Arne Holhjem, Director for Technology and Environment, Norwegian Petroleum Directorate, warned that there could be problems with too many different standards. "If we can have one standard for everybody that would be great. [but] The IOCs now want their own worldwide standard. The countries want to have standard, the service industry is also making their own standard. To try to sort out these standards is one of the first things we should work with."

Mr Holhjem also said that manufacturers of subsea equipment are starting to feel the stress of being asked to build to different standards. "if you ask some manufacturers of subsea equipment, [and] we've talked to them, they are tearing their hair out, every company comes with a different standard," he said. This could all be adding to the price rather than reducing it.

Torstein Sanness, managing director of Lundin Norway, agreed that "standardisation is the only thing that can have a major cost drive down."

As an example, Lundin Norway is building a hotel (staff accommodation) on its Grieg platform. The [hotel] vendor was trying to standardise its products as much as possible. "There was no need for us to interfere or place 20 people in the yard to make sure the vendor is doing what we need," he said. "We don't need to tailor make everything."

"What we have seen so far [is that] most development is a specialised thing with the appropriate high cost," he said.

Pieter Kapteijn, director of FossilFuture, said that the correct question to ask is what amount of diversity adds value. Some parts of the industry, like shale gas, have been heavily standardised, whilst "in many developments I've been part of, a degree of customisation was required to get the value."

You can view videos and presentations from the Integrated Operations conference at
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Lundin's Integrated Operations on exploration

'Integrated Operations' can be about exploration too, said Torstein Sanness, managing director of Lundin Norway

Marking a major exploration discovery every third year - Torstein Sanness, managing director, Lundin Norway

"You can do Integrated Operations on exploration," Mr Sanness says. "We've been doing that for many years."

The company has managed to make a major exploration discovery "every third year", he said.

In 2013 Lundin Norway drilled 18 wells on the Norwegian continental shelf, compared to Statoil drilling 26, he said. It plans to produce 30 to 35,000 bopd in 2014, and 75,000 by 2017.

"There is no challenge for finding the resource, we know how to do that," he said, a comment it is hard to imagine coming from an operator on the UK Continental Shelf.

The company has narrow criteria as to what reservoirs it is interested in. It is not interested in high pressure and high temperature, it is not looking for gas, and is only interested in working in certain water depths.

Lundin has been working on offshore blocks which other companies have worked on before, but with better seismic data.

It was the first company to use Broadseis, a seismic recording technology from CGG, which uses a wider range of seismic frequencies, which can give you a better picture "to see where the sands are deposited," he said. "We used $100m, just for that fancy seismic. You need money."

Lundin Norway also has a small, tightly knit team, with 320 employees and a further 150 consultants, and all employees work in the same office, in Lysaker, just outside Oslo. "We decided to stay together in one office," he said. "We're outsourcing as little as possible, the core team is our own employees."

"We have such a flat organisation, we can make decisions quite quick[ly]."

The company recently advertised 100 positions and received 4,000 applicants. "There are more people searching for a company with an operational centre in Oslo," he said. "We feel that we're off to a good start."

There is an emphasis on openness and trust, and a sense that employees need to resolve problems themselves, he said.

"I meet all employees for one hour every week, to talk about what went wrong last week, what we're going to do next week. There are no minutes."

"I always get challenged, 'when is the shop going to be sold', every Monday for 10 years. The answer is the same. As long as we can demonstrate to the Lundin family that we create and grow value with the company faster than if they invested in gold tomorrow, then we're totally safe."

"So it's all up to ourselves. It's simple. We have to work smarter."

"This company hates back office. We didn't have an HR person until two years ago," he said.

This means that the "line management have to live with who they get in through the door and push them out of the door themselves."

"Now we have two people in human resources dealing with whom we're going to have offshore."

Many of the employees were previously with Saga Petroleum, a company which was acquired by Norsk Hydro in 1999 (a company itself consequently merged with Statoil). This meant that Lundin had a working culture it could build on.

"Very few large companies succeed in harvesting ideas and running with them" - Pieter Kapteijn, director of consultancy Fossil Future, and also chief technology officer of Mexican oil company Sierra oil and gas

Pieter Kapteijn

Pieter Kapteijn, director of consultancy Fossil Future, and also chief technology officer of Mexican oil company Sierra oil and Gas, said that oil and gas leaders are still more talk than action when it comes to technology.

Leaders of international oil companies often understand the core of 'smart fields' type technology, and say they believe in it. "But it is disappointing how much progress is being made," he said.

"The missing belief is that technical capability is key."

"Lots of companies say they believe in it, but I don't think the industry is serious about what they say."

Mr Kapteijn is a former director of technology and innovation at Maersk, and was previously at Shell for 28 years.

"Very few large companies succeed in harvesting ideas and running with them," he said. But "large companies do well at doing things at scale."

Oil company CEOs spend most of their time worrying about higher costs, lower margins, and lack of access to new oil, as well as new competitors such as National Oil Companies operating around the world.

There are also more service companies acting like small oil and gas companies. "They are operating fields and becoming direct competitors.

There's a risk that the IOC will be cut out of the deal."

But all of this should lead to more emphasis on technology, he said.

In the past, oil companies have responded to financial constraints by deferring projects, laying off staff and selling assets, but hopefully the response this time will be to improve the way the company operates. "
At what point do you make structural changes or think and redesign your business?" he asked. "Do you create new partnerships?"

Mr Kapteijn said that in 2009, oil and gas companies thought that there would be a full integrated design environment for the oil and gas industry by 2014, with a continually updated computer model of the entire asset.

This model would be very useful for integrated operations because you could see what impact your suggested changes would have on other people.

"You can say, I'm a production technologist, I'm responsible for the well, I'm looking at the lifecycle of the field development plan. I can change things in the well and see what affect it has on engineering, the power consumption."

"That is the ultimate test of a situation. You understand how it will impact not only the design, but the life of the design.

"Other industries have already got that," he said. "My sense was always that the industry would move to that very quickly. But we're still a long way off. It surprises me."

Mr Kapteijn said he didn't believe there would ever be a fully remotely controlled oilfield, built and then left to run forever, like a satellite sent into space. "It's probably much cheaper and more resilient to have people in there," he said.

Global warming will be one of the defining debates of the oil and gas industry over the next 20-30 years, he said, with some activists already saying that oil company valuations should be downgraded on the basis that they will never be allowed to produce their reserves.

And if the oil and gas industry ends up doing large amounts of enhanced oil recovery with carbon dioxide, that will be an enormous integrated operations challenge, he said.

The oil and gas industry should look at developing a better 'ecology' for developing capability. For example it could look at the way INTEL did it, he said.

Petrobras

Cristina Pinho, E&P Executive Manager, PETROBRAS said that the company is responding to high cost by working with suppliers from outside Brazil.

"Petrobras in recent years flooded our market with a lot of needs for products, materials and service," he said. "We were very ambitious on the local content issue. Now the Brazilian industry is not able to answer the right level to Petrobras needs for next years. So we are working with suppliers in the industry."

A number of international suppliers, including FMC, One Subsea and Aker, have set up manufacturing facilities in Brazil.

What is the most exciting innovation you have seen in IO this year?

Frans van den Berg, Program manager for Collaborative Work Environments, Shell

"The possibility of acoustic fibre optics, we can see things in wells that we couldn't see before. From vertical seismic profiles (VSPs) to leaking valves. It is going to help us understand much better what is happening in water floods and EOR, and help us maximise the resources that we have. [you can] see what's going on around pipelines and leaks. "In Sakhalin in Russia, they have little earthquakes, we can see these too. The first time we knew was when the fibre optics showed it to us."

"They also saw something moving North to South along the pipeline, at 50km a month. It turned out another part of the company was digging a trench to lay a cable."

"The other exciting [technology] is the flying machines, we call it ROAVs [remote operated autonomous vehicles] for inspecting stacks of flares and so on. You normally had to shut down an operation for hours in order for someone to get close to it. Now, we can fly around it with this thing in 20 minutes, the experts can see it live on their screen. It takes a lot of integration between the technology to work, the people to analyse it, the people to do the right things with it, there's a whole process that goes with it."

Pieter Kapteijn, CTO, Sierra Oil and Gas (Mexico) and formerly Director Corporate Technology and Innovation at Maersk Oil and Gas

"The use of fibre optics to do acoustic sensing. You can use one strand of fibre optic to do all these different types of sensing. I wasn't aware that we had progressed that far."

Tony Edwards, CEO StepChange Global (formerly head of BG's digital oilfield program)

"This idea of natural language generation is really interesting. It is not so much automated report writing, it is the knowledge capture, how you can take the knowledge of your experts, codify that, and automate generation of reports."

"For me one of the problems with analytics and big data is that you can analyse it but you've still got to have someone to do a recommendation, so we move the bottleneck somewhere else. With natural language generation, it can capture the knowledge of your experts, work with your data and generate reports which would take your engineers hours."

Trond Lilleng, senior advisor Integrated Operations, Statoil

"The logistics and emergency centres that we are developing now with all these solutions that are integrated there. It is a type of setting Statoil has never had before.

"We have some integrated drilling service contracts now with formats and type of services which we never had before, which makes huge steps in the development of IO in Norway."

Kaare Finbak, vice president, Kongsberg Oil & Gas Technologies

"I've been following a project where the analysis is done in a planning phase, [so you] use the results of the previous phase more effectively in the next phase, to be aware of risk."

Technology at the Integrated Operations conference

Technology presented at the Trondheim Integrated Operations Conference included BP's Well Advisor, VISAVI's big screen offshore collaboration tool, telemedicine at ConocoPhillips, unmanned aviation for search and rescue, and the use of onshore control rooms

BP's Well Advisor

Helping BP reduce drilling NPT: Colin Mason, drilling optimization advisor, BP

Colin Mason, drilling optimization advisor with BP, talked about BP's "Well Advisor" tool to help improve efficiency, safety of drilling, and well integrity. "It is a business solution, not software," he said.

BP spends $6bn a year on well construction and intervention, with 25-30 non-productive time (NPT). 60 per cent of the NPT is associated with downhole problems, he said.

To try to improve this, BP developed a system to gather and analyse data from downhole (including during drilling) aggregate it, check data quality, visualise it and make decisions with it.

The well advisor has a number of different modules, or 'consoles'.

The 'casing running' console provides early warning signs of differential sticking between the casing and the wellbore. "We had a lot of stuck casing events," he said.

Other consoles include cementing, pressure testing, BOP monitoring, rig site fluid management, 'no drilling surprises', rate of penetration, drilling operations, tripping, completions and remote BOP pressure testing.

A full description of these is provided on page 7 of Mr Mason's presentation, which can be downloaded at www.ioconf.no.

The system has been used to date for planning, but is now gradually being introduced for use in real time operations, he said.

The company has already deployed consoles for casing running and cementing. In 2014 it will deploy the consoles for pressure testing, BOP monitoring, rig-site fluid management and 'no drilling surprises'.

Consoles still in development are 'rate of penetration', 'drilling operations' and 'tripping'.

The casing running console compares the planned casing running speed with the actual casing running. "Before, we'd trust the driller to do what we told him," he said.

"We haven't had any stuck tubulars since deploying the technology."

Like many similar projects, the company has found that "deploying the software is harder than developing it," he said.

In terms of value, prior to deploying the technology, the company often had 'casing events' which led to days of non-productive time. Four such events cost $200m, he said.

VISAVI Technology

VISAVI Technology (see www.visavi.technology) is a spin-off company from Norway's IFE (Institute for Energy Technology) and the Integrated Operations Centre, to provide all of the information involved in operating an offshore platform on one very large (84 inch) touch screen.

The screen can be placed in open areas both offshore and onshore, so everyone involved in the operation can see it. It is large enough for a group of people to use at once.
The system is already used onboard the GDF Suez 'Gjøa' platform in the North Sea.

You can see all the maintenance jobs which need to be done and tap on them to see further information. The maintenance system uses different colours for corrective and proactive work.

You can also move blocks of 'jobs' around with your finger, to change the plan, with a tool called 'scenario composer'.

You can see all the helicopter flights to and from the rig and who will be arriving or leaving on them.

You can see when supply boats are forecast to arrive, and what the weather conditions will be.

The display will help you see what your biggest risks are, according to your current plan.

At the moment all of this information is freely available on a rig, but either on paper or on many different computer systems.

It has been designed to be very easy to use, with training limited to a 1 minute training video.

The software currently integrates with GDF's Siemens 'COMOS' software – VISAVI is keen to integrate the software with other maintenance planning packages such as SAP and Maximo, and is looking for more pilot projects.

VISAVI - see all of your rig operations on an 84 inch screen

"One goal is to reduce the need for planning meetings," says Gisle Andresen, co-owner and one of the inventors of VISAVI.

ConocoPhillips telemedicine

ConocoPhillips has been using telemedicine equipment for nearly four years, to provide onshore medical support to offshore staff, sending sensor data and video.

There were some complaints in the beginning, but otherwise feedback has been "unconditionally positive," said Tatjana B. Bergsland, regional medical director Europe, ConocoPhillips.

"We were sure diagnostics would be improved if all parties can see each other," she said. "It is easier to be correctly diagnosed. We also have more effective decision making processes. In emergency cases, every minute can save lives."

There are financial benefits too. "In 2013 we had 70 consultations and [as a result] avoided 10 medical evacuations."

The equipment has been used for training purposes.

To develop the service, ConocoPhillips worked together with St Olaf's Hospital (Trondheim), IBM and the Integrated Operations Centre.

"We can send high quality information to the virtual examination room, images, sound and other data," she said. "It communicates with all medical equipment."

ConocoPhillips ran a pilot project to gather medical ultrasound data from offshore, with 600 offshore volunteers. The data is gathered offshore using a small device slightly larger than a cellphone, she said. "It could get images so a cardiologist in hospital could get important information."

The same technology could also be used to provide medical assistance in remote parts of Norway. It can help improve patient treatment time, if specialists do not have to spend so much time travelling.

Unmanned aviation

Bent-Ove Jamtli, director of the North Norway Joint Rescue Coordination Center (JRCC), talked about how unmanned aviation, or "unmanned aerial vehicles" (UAVs), might be able to help with offshore rescue.

There are 5,000 people working off the North Coast of Norway at any time, he said. The North Norwegian Sea area, including its share of the Arctic, covers a massive 2.5m km2.

It is easy to see why doing rescues in the North Norwegian Sea would be hard – a lack of daylight, extreme weather, ice, lack of search and rescue equipment, lack of spares infrastructure, long distances, poor satellite communications and lack of broadband communications, and waves of up to 5m, he said.

The 'remotely piloted air systems' (RPAs) can follow pre-set search patterns, and drop supplies with high accuracy. They can easily enter hazardous areas. They can reduce safety exposure for humans and reduce the strain on the manned SAR rescuers, he said.

Vegard Evjen Hovstein, CEO of Maritime Robotics AS of Norway, said that the legal framework for unmanned aircraft systems is still complex.

It is usually legal to fly UAVs so long as they are within a visual line of sight of the operator, are below 500 feet, and the operator has a license.

But flying them 'beyond line of sight' (known as 'BLOS') is usually only allowed in 'segregated airspace', operated by a specially licensed operator, he said.

If the systems are going to be autonomous (ie given instructions to go somewhere and come back), then they will probably need to go out of the operator's line of sight.

There are three different types of unmanned aircraft, fixed wing (like an aeroplane), rotary wing and a balloon.

Unmanned fixed wing aircraft can be much simpler than standard (manned) fixed wing aircraft. "You don't need a toilet, kitchen, coffee, food," he said. "They can be in standby for years. One operator can control three at once. You can have 24 hour flying time."

The rotary wing aircraft can typically operate for about 20 minutes, and are vulnerable to wind, but can hover at a single point.

A moored balloon can carry sensors, moored to a ship. It can have a very low operating cost (just requiring 3 or 4 gas bottles), and has a low risk to operators.

All of the aircraft carry cameras, for daylight, infrared or synthetic aperture radar (SAR), he said.

Eldor – onshore control rooms

Oil and gas companies are continuing to think carefully about how much of their offshore operations they would like to bring onshore, said Ove Heitmann Hansen, managing director of Eldor AS, an engineering company which builds onshore control rooms.

BP's Valhall Field, which is over 30 years old, has three unmanned satellite platforms. So "it has been doing unmanned operations since day one," he said.

The field's previous operator, Amoco, said in the early 1990s, that by 2004, the platform would be controlled offshore.

BP, which acquired Amoco in 1998, defined three levels of remote operations – level 1, with control in the field and remote monitoring and support, and level 2, with shared control from a remote location.

BP has a level 3 of full remote control, but has not got there yet, he said.

"Shared control" might mean that the onshore control room manages the wells and the offshore managers the process facility," he said.

In contrast, oil major Total expects to have full remote operations on its Martin Linge project, with production expected to start in 2016, with full remote operations. "They have a building in Stavanger to do operations," he said.

The most critical control function is actually monitoring offshore cooling. "It takes 8 minutes for something to go down if the temperature rises," he said.

There have been lively debates in oil companies about the term 'Central Control Room' (CCR), he said.

BP chose not to use the term at all, instead using the terms offshore and onshore control room, he said.

Total does use the term 'CCR', to mean onshore control, he said.

All talks and presentations from the Integrated Operations conference can be viewed on line at **www.ioconf.no**

Harnessing big data with analytics

In the oil and gas industry, 'Big data' is basically about moving from a deterministic to a probabilistic approach, says Keith Holdaway, upstream domain expert for the SAS Global Oil and Gas business unit.

'Big data' is basically about moving from a deterministic to a probabilistic approach, said Keith Holdaway, upstream domain expert for the SAS Global Oil and Gas business unit, and author of a recent book "Harness Oil and Gas Big Data with Analytics", speaking at the Digital Energy Journal Sept 23rd conference in Aberdeen, 'Using Analytics to Improve Production."

For people trained in physics and mathematics, where numbers have absolute values not probability ranges, moving into probability "takes people out of their comfort zone", he said.

More specifically, the aim is to use both deterministic and probabilistic approaches together.

Keith Holdaway previously worked in Shell as a geophysicist. SAS Institute is a company based in North Carolina, specialising in analytics software, in many different industries. It aims to develop analytical workflows and methodologies.

SEMMA

A tried and tested method to get value from large data sets is the 'SEMMA' process, which stands for Sample, Explore, Modify, Model and Assess, he said.

You take a sample of data, and try to work out which variables are important in a multivariate and complex system, and explore it to surface hidden patterns. You might want to fit the data together with other data ('modify'), doing projects like cluster analysis. Ultimately you work out which model is the best to work with your data, and finally you answer your business question with a probabilistic range of decisions.

You aim to build a useful model with a small sample of your data, rather than all of it by reducing the dimensionality of the input space but retaining the variance and distribution. You want to try to understand the trends and patterns in the data, and develop a hypothesis which is worth testing.

Examples of business questions the oil and gas industry would like to answer are where is the best placement of wells, what is the best way to optimise production and recovery, and what is the best way to do hydraulic fracturing.

Ultimately if you can come up with a model which works, you can 'operationalise' your work – developed a structured and repeatable way of getting useful data.

Data mining can be 'direct' and 'indirect'. With 'direct' data mining, you have a specific objective function or target variable mapped to a business issue you are trying to answer, and you look for variables which will help you answer it. With 'indirect' data mining, you are trying to find the relationship and correlations between independent variables so as to classify the input space that may throw light on a business question.

If the work doesn't lead to a model which you can use to make decisions, "you're not really doing anything other than academic exercise," he said.

Ultimately "It is OK finding the facts - the truth behind the data - but we have to find the truth that enables us to have business value," he said.

US case study

In one example, with a US unconventional oil operator wanted to know what the best hydraulic fracture strategy would be. They had many wells going into a reservoir but didn't know which stages were most productive.

The first step was to gather together all of the available data relevant to the objective, and then use techniques like cluster analytics and neural networks to see what patterns it could find.

The data showed that a lot of the production was coming from certain pockets of the field, and ultimately work out which parameters had most impact on the production. The company identified good wells and bad wells. Finally they could make the best decision about where to place the next well.

Middle East

SAS did a project with a National Oil Company in the Middle East, which wanted a better understanding of which wells would benefit from a workover, and better predictions of what the outcome of a workover would be.

The system provides an answer which is more probabilistic than deterministic.

The work included analysis on the water level in the reservoir. The company's expert on free water level saw the data SAS had produced and first said the data didn't make sense, but then realised it might be his understanding of how water behaves in reservoirs that was wrong, Mr Holdaway said.

Good and bad wells

Another company wanted to do analysis on thousands of wells, and find ways to improve production.

The analytics work identified 'good' wells and 'bad' wells, and their characteristics in terms of how they responded to different inputs.

SAS used the SEMMA process as defined above, to try to put together a model that would work, and understand what the important variables were.

It would aim to get the data to a point where a geoscientist could easily gain insights from it.

Ultimately you can identify if wells are under-producing (ie producing less than you would expect, given the data of their part of the reservoir), and so which wells should respond most to an intervention.

Techniques

There are many different statistical and visualisation techniques to work through multiple sets of data. The neural network is "one of the more popular ones," for working on multiple variables, he said.

There are processes to look at trends of different variables and see how they are related statistically to a target variable,

One audience member asked if there was

ways to integrate time series data (such as pressure readings at points in time) with spatial data (such as understanding a reservoir). "Many people are doing analytics on time series quite well. But in our world we deal with geospatial not necessarily time series," the audience member said.

Mr Holdaway said you can do it with seismic attribute analysis and a neural network approach, to work out reservoir properties between the wells. "So there's well established techniques for marrying the spatial world with the time based world."

Keith Holdaway wrote "Harness Oil and Gas Big Data with Analytics" published by Wiley in May 2014. You can watch a video of his talk and download slides at **http://www.digitalenergyjournal.com/video/1457.aspx**

Data for more effective drilling

Offshore oil and gas operators could improve production by learning from how the North American shale industry manages its drilling and associated data, said Fred Kunzinger of Noah Consulting

The US shale industry is seeing a tremendous land-rush with European oil and gas companies taking non-operated and sometimes operated positions, so they can learn how it works, said Fred Kunzinger, Upstream Practice Lead at Noah Consulting, speaking at the Sept 24th Aberdeen conference "using analytics to improve production".

North American shale is a launching point for the world.

One example of this is China National Offshore Oil Corporation (CNOOC)'s purchase of NEXEN in Canada, he said.

A lot of this expertise could also be useful in the offshore oil and gas industry, he said. "What works in conventional offshore [operations] doesn't translate very well to onshore, where it is a factory model. But what works onshore does translate very nicely back to offshore," he said. "Efficiencies are efficiencies."

Speed

Making shale oil and gas work is about the speed of the business and the advanced analytics you use, he said.

To illustrate the speed of the business, consider that in the Bakken Formation (North Central US and South Central Canada), production is now 1 million barrels a day, compared to zero production nine years ago. The field is producing oil (not gas) so does not require expensive pipelines to get to market. The business growth was helped by the recent high oil price.

Process improvement

Upstream oil companies are starting to look at process improvement techniques such as Six Sigma, which were previously only used by their downstream colleagues (operating refineries and petrol stations).

For years upstream people have been saying to downstream people, "we're different, we're special, and we're a knowledge based business. Your business model is closer to McDonalds than it is to us," Mr Kunzinger said.

But when shale gas came along, the upstream had to get into the same techniques too.

"Operating in shale plays is like manufacturing. Integrating everything, just in time, working with different data sources."

The overall return on investment for shale wells is actually very low, he said. "40 per cent of all shale wells in N America never made a cent. It became a land rush, people were poking holes everywhere."

Now companies are making much more effort to make sure they 'poke the holes' in the right place, he said, looking for sweet spots and the best way to fracture.

"How we're going to drill in one shale is not the same as how we're going to drill in another shale," he said.

Cost per barrel

Working on the cost per barrel is a better metric than just focussing on the costs, which get harder and harder to decrease, he said.

Noah did an analysis of 6 onshore oil and gas companies and found that their margins varied by $24 a barrel, although they were working in the same basins. The companies making the biggest profit margin were not the companies with the highest production of oil as a percentage of total production, contrary to what you might expect.

Data

The solution comes to better use of data, he said.

To start with geological data, data analytics can help steer the drill bit better into the formation. The Bakken is often just 75 feet wide. "It's not all pancake geology where it looks like stacks of plywood at a DIY store," he said.

You have to manage data about well locations. "People do actually drill into another well bore," he said.

You can use analytics to improve your logistics, similar to the way that FedEx uses analytics to work out the optimum routing of its trucks, to the point of choosing (in the US) three right turns rather than one left turn, because it works out faster.

You can analyse how often your wells are 'choked down' (closed) because no truck has arrived on time to carry the oil away.

"Analytics is not a tool, it's about an organisational capability, a way of looking at the data," he said.

You need good data quality. "You really can't talk about analytics until you have quality data to perform your analytics on," he said.

Bakken oil wells can each cost $7m to $8m, so a saving of $500,000 per well through better use of data is worth $500m a year.

Shale plays involve very complex data management.

On the ownership side, it is common for one 10,000 foot well to have 97 owners, because of someone leaving land to his children several generations ago, who all left land to their

children. “There's a lot of farmers in North Dakota who spend more time reading statements from oil companies than running their combine harvesters,” he said. “Entire legal sections of oil companies do nothing but deal with royalty owners.”

There are also enormous logistical challenges for companies which drill 1000 wells a year, including moving rigs, delivering pipe and tubing to well sites, and managing waste water.

You also need to work in different ways. If a company drills 10-15 deepwater wells a year, the drillers and geologists can sit down together in meetings and work out what they are going to do. But if they are doing 3 wells a day it gets impractical, he said. So you have to develop new ways of working and integrating data.

Not just technology

A common error is for people to believe they can make data better just by buying computers, feeding your data into it and “out pop all these relationships”, he said. But if the input data is poor, you computer will work out many relationships but they won’t be any use.

One client recently contacted Noah to say they had bought Hadoop (a software framework for large scale processing of data sets) and “now we want you to tell us how to use it, because everybody is doing this stuff, and if we don't we’ll be left behind.” There needs to be a business reason for using the technology. If you’re not looking for ways to solve known business problems, you probably shouldn’t be acquiring the technologies.

How many wells

One multinational oil company, which had built up an onshore position through multiple acquisitions, wanted to know how many wells it actually had.

In its annual report, it was quoting data for ‘gross wells’ (meaning physical wells), and ‘net wells’ (where if it had a 25% interest in 4 wells, that counts as 1 net well).

In the meeting there were big differences between the number of wells which the subsurface and production people thought they had. “All of a sudden people got very nervous about what they were reporting,” he said.

“Part of the problem was definition. Are they counting production entities, wellbores, anything they've ever produced, or what they're working on right now.”

Companies typically receive the daily drilling report by fax, and then have to cross reference the information with other systems. There is a lot of interest in GIS systems so you can see it all on a map.
Sometimes companies frack wells a second time – and they need to know the best way to do it.

Companies want to have better prediction about stuck pipe.

Client case study

One Noah client wanted a detailed analysis of non-productive time, and whether it was caused by the drilling contractor, geology, the supply chain, or the weather – or the non-productive time when drilling certain sections of well (vertical, curved part, horizontal).

They recognised that some workovers were more productive than others, and tried to work out why. “They weren't wasting time on a workover that would only increase production a little.”

About Noah

Noah Consulting has been building a framework to get the right data to the right people.

Noah works with both the company IT departments and business departments, such as a senior vice president of onshore production, or a technology group.

You can watch a video of Fred’s talk and download the presentation at **http://www.digitalenergyjournal.com/video/1476.aspx**

Understanding reservoirs from measured data

You might be able to get a better understanding of reservoirs if you only analyse the ‘measured data’, such as pressure and temperature, use basic physical principles using the conservation laws, and forget about reservoir simulation, said Henk Poulisse

Time to forget about reservoir simulation? Henk Poulisse, mathematical consultant, Communicative Algebra

When geologists and reservoir engineers forget that they do not know upfront how the production system works, and what it looks like, it is common to see desperately low ultimate recoveries and low success rates in exploration, said Henk Poulisse, mathematical consultant with Communicative Algebra, and a former Principal Research Mathematician with Shell.

Henk Poulisse is credited with inventing a method for production metering of oilwells, to calculate the flow from individual wells when the fluid streams from different wells are co-mingled upstream of the first flowmeter.

An alternative starting point is to start by understanding that the only information you know for sure is the measured data, and the only knowledge you have for sure about the production system are the governing physical principles, such as the conversation laws (energy in = energy out).

You can argue that for any running physical system, there are relations among the measured variables which hold over the measured data, in other words when substituting the values of these variables in those relations the result will be zero, and such relations are called vanishing relations, he said.

“These vanishing relations will in general be non-linear in the measured variables, and

may be algebraic - or differential equations."
"In order to cope with this type of relations, the measured data is interpreted as the evaluations of mathematical objects living in environments in which non-linearity and 'derivation' are natural elements, notably a differential polynomial ring."

"The algebraic algorithm extracts vanishing relations hidden in the data."

"The vanishing relations that are extracted from the data depend on the perspective, on the geometry in which the production system is observed."

Mr Poulisse illustrated this with a case study of a tight gas well.

If you call the cumulative production X, then the production rate is a time derivative of X. "This means observing it in the symplectic geometry," he said.

"The extracted vanishing relations may be interpreted as representing equilibrium situations."

For further analysis, the principle of D'Alembert is applicable in that the vanishing relations can be decomposed into two non-vanishing relations, in this way moving from equilibrium to dynamics.

"The graphical representation of the pairs of non-vanishing relations reveals the dynamical symmetry portrait of the production system, that is symmetry that exists by virtue of the dynamics in the production system," he said.
"The dynamical symmetry portrait generates a wealth of information about the production system. It gives an expression for the kinetic energy, related to the flow of gas through the reservoir. It gives an expression for the energy push from the reservoir."

"It gives information about work done by forces not derived from a potential, which is crucial information in relation with hydraulic fracking.

"It gives an equation of motion, a second order, non-linear differential equation in X - describing the flow of gas through the reservoir.

"This can be used to compute numerical predictions (of the cumulative production and the production rate) and structural predictions (changes in the flow state of the production system)."

"The critical point of the equation of motion gives an estimate of the volume-in-place."

"An abundance of new ideas is obtained by this radical change of view in addressing production problems, and the same holds true for exploration problems," he said.

For companies and research institutes in the UK there is a good opportunity to explore these ideas further by joining the SAMBa (Statistical and Applied Mathematics at Bath) initiative, he said. This is a project supported by the British government, for the University of Bath to collaborate with industrial partners.

You can watch a video of Henk's talk and download presentations at **http://www.digitalenergyjournal.com/video/1455.aspx**

Unstructured data in asset integrity

Oil and gas companies have been working with structured data for asset integrity analysis for many years – but often ignore the unstructured data, such as written notes. Pierre Marchand of Teradata thinks it is time to change

The oil and gas industry does not get as much value as it could do from unstructured documents, said Pierre Marchand, industry consultant for oil and gas at Teradata, speaking at the Digital Energy Journal Aberdeen event on Sept 24th, "Using Analytics to Improve Asset Integrity".

Many engineers are frustrated that nobody reads and actions the inspection reports that took so long to write and which contain nuggets of insights. Clearly they are not used to their fullest extent.

Oil and gas companies have been doing data analysis to make predictive maintenance plans for many years, but nearly all the time, they have only focussed on structured data held in databases.

This data is entered as a result of engineers typing numbers into forms and ticking boxes. "It's all very well organised but a bit limited. "

Computer technology to automatically understand text has improved a great deal in recent years, he said.

Not so long ago, a computer system would be confused by a sentence such as "Compressor A, which was installed to replace compressor B, is performing well," he said.

The computer systems would look for the verb and subject and just understand "compressor B is performing well." Now computer systems can understand the sentence properly.

Some industries are getting very advanced in working with unstructured data. For example, many call centres have computer tools which gauge the caller's mood and advise the operator accordingly based on words used and tone of voice.

It is not hard to imagine a computer system working in a similar way, gauging how concerned an engineer is about a problem from their choice of language in a written report. "That's not in SAP," he said.

Computer systems are rarely comprehensive enough to capture all the information an engineer might want to provide as structured data. And it is a lot easier for an engineer to type in a comment such as 'this room feels too warm to sustain gas turbine XYZ' in a free text box, rather than ask the IT department to create a text box in the software saying 'tick this box if the room is too warm for gaz turbine XYZ'.

Using ISO 55000 for Enterprise Asset Management

The asset integrity standard ISO 55000 might sound like a dry subject, but gets exciting if it makes it easier for companies to work together, share infrastructure and reduce costs, says CGI's Bob Baxter

Many people believe that oil companies should collaborate more, including sharing assets, particularly on mature fields – it was a key recommendation of the Wood Report as a way of maximising oil and gas recovery from the North Sea.

An important tool for getting there is a standard for asset integrity, so one operator can be comfortable that the operator it is working with is operating assets to a certain standard, said Bob Baxter, oil and gas upstream account manager with CGI, speaking at Digital Energy Journal's Sept 24th Aberdeen conference, Using Analytics to Improve Asset Integrity.

For example, imagine if the costs of an offshore project would be much lower if an operator was able to share another operator's sour gas plant, rather than build one of their own. Sour gas plants can be very dangerous, so the first operator might feel more comfortable building their own one, but could be persuaded if they knew that the plant was being operated to a specific high standard.

ISO 55000 was developed by the Institute of Asset Management together with the British Standards Institution, and builds on the PAS55 specification for optimised management of physical assets, which was developed in 2002-2004. CGI played an active role in helping develop the PAS55 which in turned formed the new ISO 55000 certification.

"ISO 55000 gives you 60 per cent of the processes you need to be able to start using your assets properly," Mr Baxter said.

The other 40 per cent of processes you need are the ones geared towards your specific operation, which you probably need to work out for yourself.

The processes guide you to make a method to get a continuous detailed view of your asset, what condition it is in, and what if anything needs work.

It helps you work out your asset management objectives and policy, build an asset management plan on both a "strategic" and specific level. Ultimately you can work out if your asset is working effectively and efficiently, or if there is cause for concern.

You can spot important themes or topics which you should manage, and work out a program to work with the near real time data about the asset. You can develop a system for your operations team about what data they need to capture.

It lays out a 'structure and vocabulary' for how you manage the asset.

Once you have a system in place, you can get it accredited by an outside company to certify that it meets the standard. Additional benefits can be perceived from such certification such as accurate asset values when it comes to divestments or even driving the insurance premium down on some of your assets.

The expanding adoption of PAS55/ISO 55000 and other regulation changes are creating new requirements for improving quality, consistency, and management of asset information that will require new investments in processes and infrastructure.

Benefits

The biggest benefit is a better understanding of how your asset is. "There's no point in having a billion dollar asset if you don't know what it can and can't do for you," he said.

It will also help you keep information in the company for when people leave, and might make the asset easier to sell.

You can develop your own data about mean time between failure, rather than rely on manufacturers' data.

CGI and OpenText

CGI provides services to help clients manage their asset condition data, and usually recommends working with the OpenText software to manage the data itself.

"What we're offering, in conjunction with OpenText, is a 360 degree view of the asset and a single-source-of-truth for asset operations and maintenance for the full life-cycle of the asset. By securely managing all of the structured and unstructured information about your assets and related processes, owner-operators are assured that the information and procedures about their assets is complete, up-to-date, and accessible, anywhere and anytime," he said.

CGI was involved in developing the ISO55000 standard, through its membership of the Institute of Asset Management.

digital energy journal

You can watch a video of Bob's talk and download presentations at **http://www.digitalenergyjournal.com/video/1377.aspx**

Text summaries lead to better decisions

Research in the medical sector has shown that people can make better decisions when information is presented to them in text, rather than in graphs. Could this mean that if we present asset integrity information as text, people can make much better decisions with it? Professor Ehud Reiter, chief scientist with Arria NLG, believes it could.

Professor Robert Logie, a specialist in human memory at the University of Edinburgh, recently undertook a study in a neonatal unit to find out how doctors accessed information about a baby's health.

Doctors were asked what information they used when making a decision about the baby, including talking to colleagues, examining the patient, and using information visualisations from the computer system.

Then they were observed to see what information they actually used.

The research showed that although junior doctors claimed that they used the computer system, in reality they hardly ever used it.

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Asset integrity analytics conference report

The senior doctors, however, did actually use the data from the computer system.

A likely explanation is that it takes a great deal of experience to understand computer visualisations and to use them to make inferences about a baby's health, said Ehud Reiter, chief scientist with Arria NLG and also professor of Computing Science at the University of Aberdeen's School of Natural and Computing Sciences, speaking at the Digital Energy Journal Sept 24 event in Aberdeen, "Using Analytics to Improve Asset Integrity".

"A guy with 20 years' experience can understand what's going on - yes. The guy with 2 years' experience can't. People without much experience struggle to understand graphs."

In a follow-up experiment, doctors and nurses with all levels of experience were asked to make a decision about what was wrong with a patient after being provided both with graphical data, and a textural summary.

"Almost across the board, these doctors and nurses made better decisions from the text summaries than from the visualisations," Professor Reiter said.

Oil and gas

Arria is applying this observation to the oil and gas industry by developing computer tools that communicate with people using language, in the belief that it can lead to faster and better decision-making.

When oil and gas engineers try to solve a problem, they are typically sitting in front of large banks of screens displaying graphs, to try to work out what is going on, Prof Reiter said.

"They might spend half a day just looking through the data trying to find the really important nuggets. Once they find those bits they've got to decide what to do about them."

But if the engineer is working with a colleague to solve a problem, they will probably be talking about it and discussing what the graphs are showing them.

Arria NLG's vision is that the computer will act more like the engineer's colleague and help him or her make faster and better decisions by explaining what it (the computer) thinks is going on using everyday language. The software aims to make the more routine work easier. Some engineers might get 100 asset integrity reports a day and have to distil them into an incident report, a task which can take two weeks. "What we're saying is - we already have the data, and we'll get it out in a minute," Prof Reiter said.

One delegate pointed out that perhaps graphs could provide much more precision than language - different people can interpret a word like 'concern' in different ways. "There are some words [which can be interpreted in many ways] that we avoid, selecting only those where there is no ambiguity in their meaning," Prof Reiter said.

Is medical research relevant?

One audience member suggested that perhaps oil and gas engineers are much more comfortable working with numbers and graphs than medical professions are - particularly younger oil and gas professionals who have grown up with computer games that include many visualisations.

Professor Reiter responded that he thought hospital doctors were in fact very comfortable with numbers, and live in a similar world to engineers. "Yes, the doctor has to talk to the patient, but most of the time they are living in a world of numbers. So I don't think there's a difference in culture from that point of view," he replied.

"In terms of today's youngsters, you'd think they would be more comfortable in terms of visualisations, but that's not what my colleague Bob [Professor Robert Logie] found. If you put people in front of complex graphics, even young people struggle with them.

"I think there is a big difference between a computer game and the kind of set-up where the engineers and doctors are surrounded by complex screens full of data."

Examples

Arria's aim is to extract the key facts which someone needs to know, taken directly from the data, and present them as though written by a human.

Alternatively, the information could initially be presented as a simple graph, with 'key-fact annotations' (similar to those included in graphs of political polls describing key events). People can then click on the annotations to see more detailed summaries.

Here is an example of a statement which Arria's system can generate based on oil and gas data:

"There was an Acceleration alert on FGC Gearbox Casing at June 23 2014 15:22. The alert has been intermittently active since June 22 2014 07:34. An analyst previously examined this alert during the intermittent period and did not turn it into a service. Casing Drive End Vibration was unstable from June 23 2014 15:11 to 15:23 with a mean value of 1.0 g. CGC was on during this period."

"There was 1 closed service that had examined this alert. Service 1102 was closed on May 22 2014 20:06. An action was taken: 'Gearbox vibration noise is consistent to what is seen currently. Going to close this for now'. Over the previous 90 days, the alert was marked as No Action 130 times and was turned into a service 3 times"

Arria NLG

Helping oil and gas companies communicate information with text summaries - Professor Ehud Reiter, chief scientist Arria NLG

The company's founders have strong credentials. Chief scientist Ehud Reiter is also professor of computing science at the University of Aberdeen's School of Natural and Computing Sciences, and founder of the University's natural language generation (NLG) research group. He also wrote the book 'Building Natural Language Generation Systems' together with Dr Robert Dale, published in 2000 by Cambridge University Press. He has a PhD from Harvard.

Dr Robert Dale is chief strategy scientist and chief technology officer at Arria NLG. He joined Arria after 17 years at Macquarie University in Sydney, where he was professor in the Department of Computing in the Faculty of Science, director of the Centre for Language Technology and former director of the University's Microsoft Research Institute. Dr Yaji Sripada, chief development scientist with Arria NLG, is senior lecturer in Computing Science at the University of Aberdeen.

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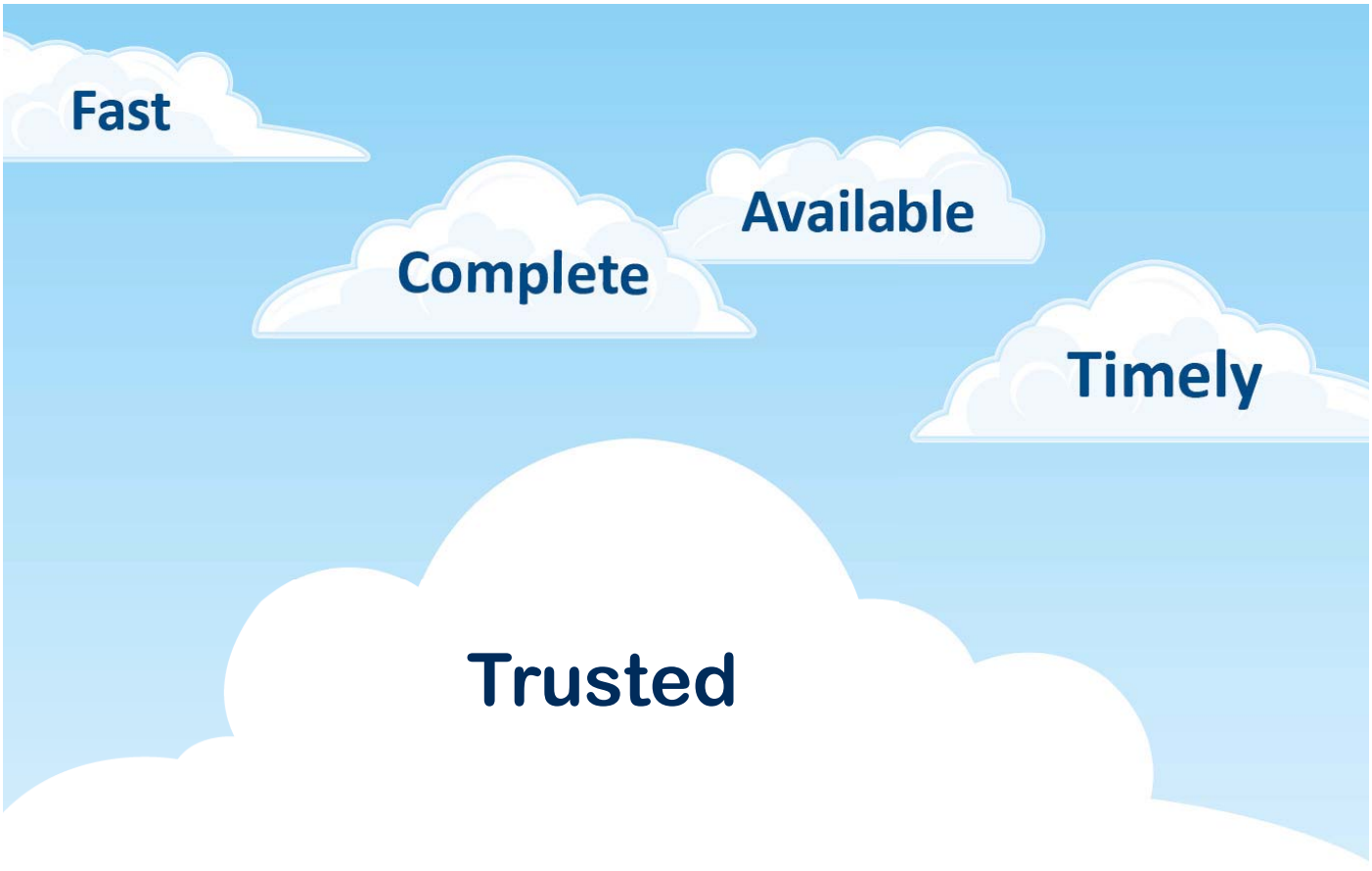

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Offshore satcom on demand

For years, satcom on a rig has been 'fit and forget' – you pay a fixed monthly fee for between 256 kbps and 1.5 kbps, and then everyone in the company has to share it up. That could be all about to change.

Satellites have been getting much more powerful over the past decade, which means they can carry a lot more data – and at the same time, oil companies have been coming up with new ways to use it.

But most oil companies still manage their satcoms the way they used to, with a fixed monthly budget for a fixed throughput, of between 256 kbps and 1.5 mbps.

This might all be about to change. Oil and gas communications company Harris CapRock Communications is now offering satcoms on demand, up to 15 mbps, where a company can make a request for higher bandwidth speeds for a certain period of time, and pay for it by the hour.

The technical name for the Advanced Very Small Aperture Terminal (VSAT) solution is "dynamic bandwidth management (dSCPC) network architecture". So far seven companies in the Gulf of Mexico are using it.

The service is currently available across North America, the North Sea, Africa, Brazil and the Asia Pacific.

So far most oil and gas customers have not asked for more than 10 mbps but Harris CapRock has been providing 15 mbps for customers in other sectors, such as cruise shipping.

Having a fixed cost for satcom is of course re-assuring and easy to manage, but so is the opportunity to send larger amounts of data when you need to.

You might want to switch on a faster satcom bandwidth because you want to send a high definition video stream to onshore experts, perhaps during a complex phase of a drilling program. You might want more data if someone has an accident and onshore doctors need to make a diagnosis. Or you could use it for a short term, intense inspection program, or perhaps for sending seismic data.

The additional bandwidth can be parcelled up, so a service company working on your rig could have 512 kbps for their exclusive use and pay for it directly with Harris CapRock, rather than queue up their data with everything else the rig needs to send, or accept the IT department's judgement of which data has priority.

If they have their own satcom contract they don't need to talk to the oil company's IT department at all.

"Today, the service company is forced to take with them their own communications package, which is expense on their part, they're not using it most of the time," says Andrew Lucas, chief technology officer of Harris CapRock. "They have to transport it, commission it, and take a field technician to help out."

It is not uncommon for oil and gas companies to send urgent data back to shore by helicopter, because it is the easiest way to do it, Mr Lucas says.

The oil and gas company typically pays for the extra bandwidth on an hourly basis. The cost of bandwidth is higher when you buy by the hour than by the year (as when buying your standard bandwidth).

"But the price is reasonable," Mr Lucas says. "If you do something short term, you know you're going to pay more for it than if you have it over many years. People will be quite comfortable with the value it represents."

Harris CapRock is considering tools to allow bandwidth to be increased with an online tool, he says.

When companies want more bandwidth, they inevitably want it now, not in a week's time, so fast decision making and activation is critical, Mr Lucas says.

In larger oil and gas companies, it is still typically the CIO who makes a decision about how much to spend on satcom bandwidth, Mr Lucas says.

In smaller companies, the decision might be made by rig operations personnel. Sometimes the decision about how much to spend on satcom is made by people in charge of offshore operations, who then ask the IT department to send the formal instruction to the satcom provider.

A Harris CapRock technician prepares a stabilized antenna system for advanced VSAT

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Founded in 2000, **OFS Portal** is an organization which consists of diverse supplier members who are committed to promoting eCommerce and reducing cost. We have a non-profit objective to ensure we promote the best approaches for the industry. In addition to advocating strong protection for the security and confidentiality of electronic data, **OFS Portal** has gained the trust and confidence of the entire upstream oil and gas industry. We do this through our proactive advocacy approach toward best practices to reduce costs and complexity while increasing the speed of adoption.

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A well equipment reliability database

Wood Group Intetech has put together a database of the reliability of different well barrier components.

By Ged Lunt, Technology Manager at Wood Group Intetech

Wood Group Intetech has launched a global database of well component performance data.

Known as 'iQRA', this online quantitative reliability analysis tool provides operators with access to global well and oilfield component performance information.

Subscribers can identify the highest performing well components, benchmark reliability figures, and extract statistical and mean-time-to failure (MTTF) data to support cost-saving decisions.

Choosing well components

Making the correct selection of well equipment is far from simple.

Different equipment models may be more suited to certain operating conditions.

When conditions are very challenging, well designs may need to be adjusted to allow for lower achievable reliability of particular equipment.

A lot of considerations lie behind the selection of well designs and the selection of replacement components during well workovers.

The performance of installed well components must be totally predictable.
Should a problem arise at any given point in time, operators must be confident that they know how their well barrier components will respond.

For example, if they shut a subsurface safety valve (SSSV), then they know with certainty that it's going to close and contain the well fluids in the specified time.

Getting accurate reliability figures for well barrier components requires access to a statistically significant database. Whilst the industry recognises this need, a key challenge has been the reticence of operators to make data such as component reliability and failure rates available externally.

In addition to concerns over data confidentiality, efforts to build such a database have tended to be limited to single regions such as the North Sea, or focussed strongly on specific components such as the SSSV. Previous systems have also been badly structured and suffered from poor quality of data or difficulty of use or access.

Most operators accept that certain well barrier component failures are inevitable and operational constraints may mean that they cannot be repaired immediately. It can be necessary for wells with individual components not in full working order to continue to operate, provided risk assessment indicates the risk level is acceptable.

Of course, some types of failure call for the well to be shut-in and repaired immediately, but for the majority of non-critical failures, repairs are scheduled to take place within a designated timeframe, or when the opportunity arises.

Testing can actually reduce the lifetime of the equipment – especially an active component that is opened and shut, each cycle causing some amount of wear and fatigue.

Given that it is necessary to close valves in order to test the leak rate across them, using risk-based analysis to determine that testing can be safely performed less frequently, should extend the lifetime of valves, as well as reducing operating costs.

Access to this kind of reliability information makes it possible for operators to identify where they have low reliability equipment or potentially a faulty component installed. They can pre-empt potential failures on other wells by taking the opportunity to replace a questionable piece of equipment if another well intervention is taking place.

The quality and volume of data upon which iQRA is based means that operators can make independent and impartial assessments of reliability performance.

For example, decisions on well components for new well designs or replacement during workovers can be made based on the highest performing and most reliable equipment.

Selecting high reliability components is a must to reduce well entries, establish optimum maintenance levels, and justify plugging and abandonment decisions.

The development of iQRA was driven by operators.

Following the ISO-14224 standard, iQRA's functionality also includes failure data analysis such as critical failures versus degraded failures. These features have been designed to accelerate the industry shift to risk-based assessment and performance-led decision-making for maintenance scheduling.

These capabilities are already enshrined in UK health, safety and environmental practices, and in Norway, where the Petroleum Safety Authority stipulates that each well workover case be assessed per well and based on reliability data.

The iQRA reliability information service allows an independent and impartial assessment of well component reliability performance. The scope of data incorporated includes all well environments: onshore; platform; and subsea.

iQRA can be accessed from anywhere via a standard web browser.

Users can build data queries based on Individual Xmas tree, wellhead valve and seal components as well as SSSV; Global regions and well location (land, platform, subsea); Equipment manufacturers; Operating environment characteristics; Time period of data to interrogate

Results reported include statistical evaluation of the failure data and the mean-time-to-failure (MTTF) report, while a "saved searches" option allows users to quickly run further reports according to their specific requirements, as new data becomes available.

Digital Energy Journal will be running our second conference in Aberdeen in February 2015 about doing more with well integrity data.

Keeping your production data accurate

Chittimalla Malliah explains the best techniques to getting accurate flowmetering.

By Chittimalla Malliah, manager process engineering, Gujarat State Petroleum Corporation Limited

Getting accurate production data is quite complicated, writes Chittimallah Malliah, manager process engineering with Gujarat State Petroleum Corporation Ltd

Accurate and timely production data is very important in E&P business for production loss management, reservoir analysis and regulatory reporting.

An efficient metering management system is required to maintain the accuracy of production data that flows from wells to plant to corporate offices. This will allow operational staff and business managers to be more efficient and control the value of production from upstream operations.

Production fluids are measured at different measurement points and at different time intervals. Some type of data is required in real time, others intermittently.

The key is to determine what needs to be measured, location of measurement points, frequency of measurement and the degree of accuracy.

In E&P industry there are many end users for production data.

Reservoir managers need production data for reservoir simulations, Commercial / Finance team need to for generating invoices, Production team, Operations team for various analysis like actual vs. target / forecast, loss management, locked in potential and for production planning.

Metering Management System

There are many types of meters in E&P industry – fiscal, custody transfer, operational and allocation meters.

These are used to measure the quantity and quality of the produced fluids such as gas, condensate, oil and produced water. Suitable management procedures required to ensure the maximum reliability and required data accuracy.

The meter management life cycle must start at the 'define/conceptual' stage and continues to 'execute' stage to 'operate' phase.

'Define/conceptual' stage

Various commercial agreements usually document the requirements for fiscal and custody transfer meters. These agreements must refer to latest applicable and updated standards (for example AGA standards)

An instrument specification document to be developed to mention the purpose (i.e. operational or fiscal), required accuracy, range

Project execution stage

This is the next phase of the project, the conceptual team hands over the requirements to project team. Project team shall review the requirements and ensures that the metering system is designed, fabricated and installed to meet appropriate standards, commercial requirements.

The following provides key guidelines for the factory acceptance test (FAT).

A detailed acceptance criteria to be developed and all stake holders including government representatives must be invited for FAT; complete the integrations with 3rd party solutions; all meter calibration must be witnessed by concerned; all flow computer calculations must be verified;

All configurations with respect to flow computer, online analyzers, gas chromatographs, pressure and temperature transmitters must be verified against design; pressure and temperature transmitter's calibration validity & recalibration schedules; recalibration schedules for online GC, ultrasonic flow meters; verify the data sheets for all transmitters and RTDs

Project 'Operate' stage

Once the formal handover and take over format is signed by Projects and Operations, Operate phase of the metering system commences.

OMIR – operations, maintenance, inspection and repair of metering system is of utmost importance.

At this stage metering management must ensure the following:

All metering system calibration reports and other certificates are maintained in a proper document management system and accessible easily when required

Standard meter operating procedures and maintenance procedures are prepared and up to date

All operational spares and spare calibration gas cylinders are procured and maintained in warehouse

Regular audits of the metering system shall be undertaken to ensure that metering systems are compliant with the required regulations, standards and commercial agreements.

Production Monitoring

The production monitoring business function enables consistent monitoring and analysis of asset's production data and facilitate decision making. Define performance indicators for well, facility performance, losses emissions etc; collect the data and calculate the performance KPIs.

Typical data examples are down hole pressure, temperature, well head flow meters, facility custody meters, online gas analysis all provide necessary information for well performance KPI.

Once KPIs have been defined, determine the measurement and reporting frequency. Categorize KPIs into facility performance, plant performance and production critical. The date must be stored in a secured database for access from any location.

Presentation of production data is required for analysis; identify the daily, weekly and monthly reporting requirements. Typically, well and production facility performance data is required daily, loss data weekly and locked in potential monthly.

Visualization tools must be engaged to generate real-time and automated production reports and graphical representations of the production data.

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