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At the Sub-sea Expo in Aberdeen in February 1-3, Mark Richardson, projects group manager with Apache North Sea said that there is actually a single individual we might blame for the industry’s poor performance in the years up to 2014.

[As a reminder - this was before the oil price crash – but a time when costs were rising, production was declining, and some operators were struggling to make money at $100 a barrel].

The person Mr Richardson blamed died in 1915 – Frederick Winslow Taylor, author of a book in 1911 “Principles of Scientific Management”.

These scientific management principles were that employees should be given detailed instruction and close supervision, and work methods should be based on a scientific study, not “rule of thumb” work methods.

The oil and gas industry embraced these ideas, and continues to try to use them, although they are no longer applicable in today’s complex business, he said.

“This is what, I think, is the root cause of why we were in [crisis] in 2014,” he said.

In the UK Continental Shelf, we have seen too much reliance on policy, process and practice; centralised functional control; micro management; lack of trust; aversion to risk and a fear of failure, a defer, delay and do nothing culture and a focus on management rather than leadership, Mr Richardson said.

Mr Richardson advocates a culture of “let people take responsibility and get on with it” – and explained how he does this himself, by running $100m subsea development projects with just four staff members from Apache (a project leader and engineers in various disciplines), and leaves the supplier to manage the project.

Apply this to software

There’s nothing new about good management of course – people have thought deeply about the benefits of giving people maximum autonomy to work towards goals, rather than micromanaging their work, ever since people have been organised.

But it led me to think, how can our software tools better represent good management, rather than process driven management?

The principles of scientific management often seem to be behind much of the enterprise software we have to do our work with, if it is forcing us to follow company processes, checking everything we do, enabling micromanagement, and making it harder for us to make decisions.

Perhaps the ideal software for ‘good management’ would be software which helps us better understand where we are, how we are progressing towards our goals, and what is currently going on, and supports us to make better decisions.

Building this sort of software needs a very different approach – a careful understanding of what individuals actually need to do and what situation awareness they need – and whether the software is getting in their way.

If we had this kind of software, our work could be more enjoyable, we would be more motivated, and we could make better decisions, see the effect of these decisions and continually learn.

We’ll be discussing more about how to build software systems geared around the way that people think in our events this year – planned on reservoir exploitation, production, data quality and machine learning. Maybe we’ll see you at one of our events!
Improving multi-disciplinary workflows with virtual models

SEG is running a joint industry “Life of Field” project to improve integrated 4D workflows using virtual models – and is looking for more companies to join.

The Society of Exploration Geophysicists (SEG) Advanced Modelling Corporation (SEAM), the non-profit research and development arm of SEG, formed in 2007, is running a joint industry project to use virtual models to improve workflows, and along with the SPE, currently has a multi-disciplinary project happening in 4D, the “Life of Field” Project.

To try to explain - one problem with seismic interpretation and reservoir simulation is that it is very hard to know how good your results are.

You can interpret the seismic, and generate nice computer earth models, and use these to build reservoir flow simulations. But since you don’t know exactly what is in the subsurface, it is hard to know how good your seismic interpretation and reservoir models actually are. If they are completely wrong, they are worse than useless.

The idea is that by starting with a piece of ‘virtual’ subsurface that you know everything about – because it has actually been created by computer – you can then do ‘virtual’ seismic to see what seismic data you would gather if you did a seismic survey over it. Then you can put this seismic data through your normal seismic processing and interpretation workflows, and see if you end up with something similar to the virtual subsurface you started with.

“We know what the answer is, because we built the model,” says Mike Mellen, director of business development with SEAM.

Using methods like this, you can improve your algorithms and workflows, to develop the best way of putting together an interpretation of the subsurface which best matches reality.

You can keep tweaking (iterating) your workflows until you come up with a workflow that produces the earth model which is the same as the one you started with.

The project is also useful for education, helping people to better understand the dynamics of the reservoir and the interpretation process.

The seismic modelling includes a full range of high density seismic techniques, including full azimuth, long offset, anisotropic, elastic data in 3D. There can also be a gravity or electromagnetic response. These synthetic datasets can be pared down to simulate less dense, more routine surveys as well.

“We can see if there’s something we don’t understand about subsurface, if the algorithms are robust,” Mr Mellen says. “A magic algorithm that integrates everything does not yet exist.”

Collaboration

The project aims to help develop better multi-disciplinary subsurface workflows, involving geophysicists, geologists, petrophysicists, rock physicists, reservoir engineers, and geomechanical specialists.

“Each of the different disciplines has their traditions, their rules of thumb and their assumptions,” Mr Mellen says.

“As they work more closely in building the model you find they have different assumptions, and sometimes they are inconsistent, these need to be resolved” he says.

Projects so far

SEAM has a history of running major projects to address “industry grand challenges”. These are projects that are at a scale not easily managed by single companies or institutions.

The first project looked at deepwater subsalt imaging, running from 2007 to 2013, with 24 participating companies, and a $5.4m budget. It included simulations of seismic, gravity, controlled source electromagnetic (CSEM), and other methods. The results were benchmark datasets for use in new algorithm development, education and training.
A fourth project was created with funding from RPSEA and the US Department of Energy, a Time Lapse Pilot Project was undertaken in 6 months during 2016. As an extension of the Pore Pressure project, a smaller subsurface model extracted for use as a proof of concept in time lapse imaging. This project has completed and the data will be made available to the public in Q1 2017.

The current project, “Life of Field” which runs from December 2015 to June 2019, includes reservoir simulation and geomechanical modelling in the virtual model, so bringing in a ‘4D’ or time lapse element. Most importantly it brings multi-disciplinary and multi-company collaboration to the forefront in a manner uninhibited by proprietary data. 33 companies have participated in SEAM projects to date, including Anadarko, BGP, BHP Billiton, BP, CGG, Chevron, ConocoPhillips, COSL, Devon, EMGS, ENI, ExxonMobil, Geotrace, Global Geophysical Services, Hess, Ikon Science, ION, Landmark, Maersk Oil, Marathon Oil, Murphy Oil, Nexen, Oxy, PGS, Petrobras, Repsol, RSI, Saudi Aramco, Schlumberger, Sigma 3, Shell, Sinopec, Statoil, Talisman, Total, Tullow and Western-Geco.

It aims to bring together people from oil companies, service companies and academia.

Companies can join the project by paying a membership fee and putting forward their own technical expertise to join the project teams. These member participants make all of the technical decisions and select which geologic and production scenarios will be modelled.

SEAM is currently looking for new members for life of field project. They can be from exploration and production companies, or service companies.

Getting to time lapse

The reservoir simulation study begins with a static virtual model of a complex piece of subsurface, and a complete reservoir description.

The static earth model will be representative of a number of ‘high impact’ reservoir types selected by the membership.

It will include stratigraphic, rock and fluid property variations at and below seismic resolution. Pseudo-wells and all relevant well measurements will also be generated.

Then the reservoir dynamics will be simulated, to see what it might look like at some point in the future, and what the various well and seismic data might look like.

As the reservoir in the virtual model is produced, the rock above and below will change in pressure (stress and strain changes) in different ways, which can be simulated, and which will also make a change in the simulated seismic recording.

Part of the study work will try to work out the optimum time to do repeat seismic surveys, which could be anything from months to years. Repeat seismic surveys are expensive. But the cost is justifiable if it will show how the reservoir is depleting in ways which can help identify a better pathway to maintaining production, for example enhanced oil recovery or drilling a new well.

The project may also model Enhanced Oil Recovery processes and/or CO2 sequestration. The participating members will decide.

The Future

The “Life of Field” project is the latest in the grand challenges attacked by SEAM. In today’s low price / high volatility oil industry, every effort needs to be made to ensure that capital invested in understanding and developing oil and gas fields has a maximum impact on business decisions. 4D Seismic and field development decisions are not cheap, understanding the uncertainty in our methods and improving efficiencies and impact must be a central focus.

SEAM is currently investigating the next project(s) it will propose to the industry. A leading candidate topic is Unconventional Field Development, again incorporating multi-disciplinary integration including seismic, geomechanical modelling, and reservoir flow simulation but extending into microseismic data analysis, fracture simulation and induced seismicity hazards.

For more information on SEAM or current/past projects, please contact Mike Mellen at mmellen98@comcast.net
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Flare – value from unstructured documents

UK consultancy Flare Solutions is developing a range of methods to get value from unstructured documents – including working out when one document is similar to another, and helping people to find and manage the documents they need.

It is better if decisions can be made based on ‘known facts’, something people have collectively, rather than individually, shown to be true, he said.

“We have tried to strike a balance between using standard ‘reference’ values and relationships (known facts) and using information extracted from the target text (new facts that we can learn from),” Mr Camden said.

As human beings, much of our understanding of how the world works is based around spotting patterns, where we have seen something similar to the event which is happening now.

Similarly, in geoscience, it can be helpful to find examples of wells, or rock type, from our past experience, which are similar to the wells we are working on now, he said.

The same approach could be used in reducing downtime on operational equipment. As (non-digital) human beings, we build up expertise and the systems then are learning from that experience, rather than individually, shown to be true, he said.

As far as possible, the system aims to reduce cognitive bias, which can influence human decisions through pre-conceived ideas that are not always based on real facts or knowledge.

But when building up a knowledge base, for example by learning from existing text, you cannot entirely avoid cognitive bias since the text is written by people expressing their ideas and concepts. Choosing peer reviewed articles, looking across texts from multiple authors or choosing very large data sets will minimise the problem.

It is better if decisions can be made based on ‘known facts’, something people have collectively, rather than individually, shown to be true, he said.

“We have tried to strike a balance between using standard ‘reference’ values and relationships (known facts) and using information extracted from the target text (new facts that we can learn from),” Mr Camden said.

Although you can program the computer to classify something as a ‘joke’, it could struggle with identifying similar jokes and would certainly not experience the joke as a human does.

This means that humans with domain expertise, or deep knowledge about a specific domain, will always be extremely important, because they will have to train the computer systems how to understand that domain, he said.

Explicit training or training based on human-written texts are currently a major component on making computers seem smart.

“Heavens are passing knowledge onto systems and the systems then are learning from that and making inferences,” he said.

The human computer challenge

Computers are a long way from being able to understand much in the human world. As an example consider how hard it would be to explain a joke to a computer, he said.

Similarly, things in the real world can be very case specific – you could train a computer to understand when a certain component is about to fail, but the computer may not use that knowledge anywhere else.

This means that humans with domain expertise, or deep knowledge about a specific domain, will always be extremely important, because they will have to train the computer systems how to understand that domain, he said.

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The CDA challenge

Common Data Access, an organisation which helps manage the UK’s national oil and gas data, recently issued a technology challenge for companies to come and try to generate some value from the organisation’s archive of exploration and production data and reports.

Flare participated in the challenge, working through about 25,000 unstructured data reports, mostly well documents for the North Sea.

Flare decided to try to look for ‘analogues’, parts of the North Sea which are very similar, but the similarity was not previously known.
OCR

The first step of working with the 25,000 exploration and production reports was to scan them with Optical Character Recognition (OCR), so the computer could ‘read’ them.

There was a continuous learning process – getting to know alternative spellings, and spotting errors from the optical character recognition, he said.

OCR doesn’t get everything completely correct, but “many mistakes tend to be somewhat predictable, such as confusing zeros with noughts, ones and the letter l,” he said. Spell checkers, or comparing the words with a reference list of words, can pick out many OCR errors. “We’ll build a big knowledge base to enable us to do that.”

OCR failures may add more ‘noise’ to the system, but are unlikely to create false matches, he said.

Another task was to remove so-called ‘stop’ words, like ‘if’ and ‘but’, which are commonly used in English but don’t add anything to the technical understanding.

Formation Analogues

This project was based on characterising geological formations and finding analogues based on the words (terms) that occurred around the formation names in the 25,000 documents.

This particular project did not start with a list of known formations, rather the formation name were extracted from the text (although a previous similar project did use an existing field list).

It set out to characterise each formation by a number of factors – the type of lithology, the age and depositional environment, taking this data automatically from the text.

Text analytics

The next stage was to analyse the text to see which words (terms) occur in proximity to each other (co-occurrence). There were hundreds of thousands of terms in the CDA text set.

“Words that occur together generally share a similar concept,” he said. “The idea is that you can tell a word by the company it keeps. Words that are infrequent probably contain more information than words that are frequent.”

The outcome of this analysis is, for every term, a ‘co-occurrence fingerprint’ of 300 values. By comparing these fingerprints we can measure how similar terms are.

Some of the terms are the formation names we have extracted from the text, others are the lithology values that we ‘know’ from our reference knowledge base that also occur in the text. For each formation, we now compare its co-occurrence fingerprint with those of each of 200+ lithology terms, thereby creating a ‘lithology fingerprint’ of 200+ values for each formation.

To match formation based on lithology, we just look for the most similar ‘lithology fingerprints’ between a user-chosen formation and other formations.

A similar process is carried out for other aspects of formations, like geological age, depositional environment, production, problems.

The system can work in any (human) language, although if it is based on a certain knowledge base (such as oil and gas documents), they are likely to be mainly in one language (English in this case).

Search

This text analysis can then be used as a basis for more sophisticated search tools.

Flare showed a prototype search based on the same similarity methods used in the Formation Analogue system. The used can input one or more terms (for example, ‘turbidite, shale, and tuff’) and the system will respond with a ranked list of formations that best match those terms.

For the future, Flare is currently developing systems around graph databases (which shows which terms are related to which other terms). “That will give us a lot of capabilities in this space to do a lot of this kind of work,” he said.

Information management

Mr Camden’s company, Flare, sees itself as an information management company, but “we’re looking to blur the boundaries between managing information and exploiting it,” he said, “trying to link the information management world with people who consume the information.”

“Analytics is about trying to glean insight from information that’s already out there,” he said.

“As information people, we’ve struggled for years with trying to make the thing relevant as far as the business end user is concerned. We see analytics as one way to achieve this.”

You can watch Mr Camden’s talk on video at www.findingpetroleum.com/event/9cfb.aspx

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Simudyne - using simulation to make predictions

Simudyne is helping oil and gas companies use simulation and network modelling, along with machine learning, to make better predictions and improve decision making.

Together, these three elements provide “incredibly powerful techniques for predictive analytics,” said Justin Lyon, founder and director of Simudyne.

“One of them is really powerful, but when you combine all three, you combine statistical techniques with techniques for understanding organised complexity.”

Decision makers in businesses today are trying to forecast, manage risk and achieve results, all at the same time. “It requires brilliant decision making at pace and at scale,” he said.

To help them to do this, decision makers should have sophisticated models available to them about how the real world works, he says. These models should also run on real data.

Decision makers also need tools to provide them with better answers built very quickly. “If it takes longer than three months, it’s an R+D project, and no-one is going to pay for it except R+D,” he said.

The models need to be sophisticated, because the real world is very complex. In the past, many decision makers, including banks, have made decisions based on standard linear regressions (an understanding of how one parameter will change if another parameter changes).

But these tools do not provide any understanding of the deeper cause and effect relationships, he said. As a result, they do not have a clear idea of what is driving what. “When the crisis hits, they wonder what happened,” he said.

Mr Lyon sees executives in two types, the gut instinct driven and data driven.

“We don’t work with the [gut instinct driven] people,” he said. “We’re interested in people who want to have a fact based data driven approach to making decisions. They [are happy for their] assumptions to be scrutinised and made explicit by computer models.”

One challenge with trying to build interest in these sorts of tools is that no-one wants to talk about their successes, in case other people copy them.

But, “we need to talk about successes so people can know there’s gold in the hills and get the investors to go and dig it out,” he said.

Also, no-one wants to talk about their failures either. “But we need to, because only thorough our failures can we learn to make successes possible,” he said.

For building the simulation models, typically you have a multi-disciplinary team to build the solutions. This can include a number of data scientists, for example one specialising in machine learning, one specialising in computational simulation, one on network modelling.

Sometimes you can re-use some of the work, for example if you build a tool to help make bidding decisions that could be used in other scenarios, the same user interface but different data. “We’re also finding that some of the models are surprisingly also reusable,” he said.

Mr Lyon is a former information and physical security contractor with the Bank of England, developing policies for information and physical security (2011-2015). He has also worked on a simulation for US Health Care (2012), and a project on retail banking technology (2012).

Simulating bidding in Mexico

Simudyne was involved in a project for a (name undislosed) oil and gas company which was bidding for oil and gas rights in Mexico.

The company wanted to use simulations to try to work out the best bid strategy, based on a prediction of the bid strategies other companies might follow.

Simudyne put together a large scale computational simulation. The simulation includes ‘agent based simulation’ (simulating how individual ‘agents’ might behave), as well as traditional data and calculation models.

It basically builds “a virtual world of the whole landscape,” he said.

The simulation took into consideration the business environment and where the hydrocarbons were thought to be.

Simudyne acquired a range of data, and built a range of simulation models, including geotechnical issues, price outlook, returns expectations, capital expenditure.

By using the tool, the project team “predicted the formation of a consortium which they [otherwise] thought was never going to happen,” he said. “In the real world it did happen.”

Simudyne wanted to provide the company decision makers with tools to try out different decisions well in advance of the deadline, he said.

The decision makers can take the simulated results, analyse them and use them to adjust decision making, before they make decisions in the real world, he said.

They could adjust the parameters, and see what might happen as a result of various bids they could make. They could look at the perspective from different companies.
Every time they suggest a bid, the software would run millions of different scenarios around it.

The simulation could be run to look at what might happen on individual blocks or companies. Some of the parameters were preset, and some were adjustable.

Altogether the company could put together a chart of what each company might be likely to bid.

The project needed to be put together within a tight deadline, because the license blocks were going to be awarded in four months time.

Executive communication

The ‘visualisation’ part of the software, building the thin client ‘apps’ which company decision makers would actually work with, should be done separately to developing the actual simulation, he said.

Left to themselves, “the data scientists produce something that’s elegant for data scientists and not understandable for the executives,” he said.

It is very important that the decision makers can play around with the simulation easily, he said.

“We had brilliant mathematicians, but if their insights aren’t communicated in a fashion that executives can get their heads around, the insights are missed and lost.”

“The idea of giving this to a decision maker on a Surface Pro or iPad and letting them explore with parameters and fail safely [is important],” he said. “They can run an infinite number of scenarios themselves.”

The skill of building the visualisation layer is quite similar to traditional website design, he said. You need to have someone who will have conversations with the decision makers who will use the software, about what they want to work with.

The software needs to be able to support multiple users signing in simultaneously, with different teams making decisions about different parts of the system, he said.

If you want to optimise a complex value chain, there will be many different decisions, and a decision in one place will have an impact somewhere else.

Silos

A challenge with developing simulations is that companies often keep their data in different data silos, and a lot of the value is only generated when they can be brought together, he said.

Studies show that 99 per cent of the data generated by offshore oil platforms is never used.

“McKinsey is doing lots of reports saying, as you combine the data, that’s when you generate the real value,” he said. “‘If you don’t bring the data together, you leave so much money on the table.’

Other business applications

One audience member asked whether the software could have predicted the outcome of the US presidential election.

Mr Lyon replied that it might be possible if you could build a large scale model of the entire US population, and gather as much information as you could about them, including from their Facebook profiles (although the privacy issues could be an obstacle).

The software could handle 300m independent agents, he said. You would create a model of how each person is likely to behave.

So technically, it could be done, legally maybe it would not be so easy, he said.

Simudyne is also considering using the software for modelling London house prices, trying to predict when prices will burst and the reasons that might cause it.

Alan Smith: Where we are with data?

Dr Alan Smith, an independent information systems consultant, who has consulted for Shell, BP, PETRONAS and other clients including the Brunei government, gave his perspectives on how the oil and gas industry is evolving in its approach to working with big data sets, at our Kuala Lumpur conference.

Typically, oil and gas companies still do not see their data as part of the core assets of the company. By comparison, the multiclient seismic companies typically say in their annual reports that a quarter of the value of the company is in its data, Dr Smith said.

He was speaking at Digital Energy Journal’s Kuala Lumpur conference in October, “Connecting Subsurface, Drilling Expertise with Digital Technology”.

According to a 1991 study, a geoscientist at that time spent 60% of their time looking for data, 18% in “useful work,” 4% in training, 5% in meetings, 5% on coffee and 8% in vacations.

A 2016 study on “Time Spent on Data Science,” covering data science professionals in all domains and published by O’Reilly Media, found professionals typically spent 8% of time doing data extraction and loading (ETL), 12% working on data finding, 16% doing basic data analytics, 12% on machine learning, 11% creating visuals, 9% presenting, 15% in meetings, 4% on training, 6% on coffee and 7% on vacations.
While working for the exploration and production industry, Teradata found that in one project working with well data, 50% of the time was spent preparing data, and when working on seismic, 80% of the time was spent finding and preparing data, Dr Smith said. Too much time is still being wasted because of inconsistent practices and poor data management.

Data storage over the decades

Data storage and manipulation systems (computers) have of course changed a great deal over the last few decades, but perhaps less than would be expected.

In the 1960s and 1970s, there were only 8 different media types, including punch cards. During the 1960s and 1970s there were only 8 different media types, including punch cards. During the 1960s and 1970s there were only 8 different media types, including punch cards.

In the early 1990s, mobile phones were being introduced, and a PC then had less power than a mobile phone in 2017. Tapes were stored on shelves and racks. There were many discussions in the industry about a “technology solution to data management,” Dr Smith said.

By the mid-1990s, PCs were starting to look more like the workstations of today, but there were still stacks of tapes and cartridges, and lots of paper.

In Europe, National Data Repositories were initiated - CDA in the UK and DISKOS in Norway. The main focus in information and data management was based on people, process and technology, although technology had the biggest emphasis.

In Norway, with the setting up of the national data bank, DISKOS, Statoil found that the benefits of the system far outweighed the costs.

Companies then started concentrating more on processes, believing that if the processes were right, the data management would be right.

Over the past 60 years many new storage systems have become available. In the 1950s, there were only 8 different media types, including punch cards. During the 1960s and 1970s there were more formats of disk and tape and by the 1990s many more types of media had been introduced.

More and more material is now being stored on disk rather than tape. Even so, there is still plenty of paper being used and 9 track tapes are stored on offsite warehouse shelves. Data is slowly being transitioned to online storage but continues to be delivered on CD, tapes and USB drives with some companies using USB disks for long term storage. This may not be such a good idea because the shelf life of these devices is not yet fully understood but getting data off outdated media, can also be very hard.

There will be more online storage, which can be accessed much faster, especially with the price reductions we are seeing in solid state “flash” storage he said. Another change happening today is the increase in satellite data communication bandwidth, which may soon be up to 1 gbps, he said.

In 2016, tape cartridges are still in use for long term storage. They can now hold up to 2 terabytes of data on IBM 3952 in native mode.

The recent oil price crash perhaps demonstrates that oil companies better understand the value of data managers, Dr Smith said. They were not the first to lose their jobs (as was sometimes the case in the past).

Some oil companies made data managers redundant in similar proportions to other disciplines (for example with a company cutting its workforce by 30 per cent of every discipline). Others kept data managers on their payrolls for as long as possible, realising that are the only people who know where the data is stored and how to retrieve it when needed.

“Industry has changed and management’s understanding of the need for careful data management has changed,” he said.

Today, there is much more emphasis on people getting the appropriate skills. There is also more focus on post graduate study in information and data management.

Looking into the future, we can expect to see tapes for a long time, since they are the “only proven reliable static storage technology,” with a known shelf life over 20 years.

PGS case study

Dr Smith gave an example of multiscience seismic company PGS, and how it has recently upgraded its system for delivering multiscientific data to clients, so it is able to handle both pre and post stack data on demand. Dr Smith worked for PGS as a consultant.

In the old way of working at PGS, everything was stored on tape and sent to a processing centre. The tape was subsequently put on a shelf, along with the intermediate products. If the data was to be later re-processed, the company would need to be able to physically find the right tape.

Today, data cannot be spooled onto tape fast enough during marine acquisition surveys. It all goes straight to disk, which can then be loaded directly at the processing centre, although for security purposes it is usually copied to tape as well.

Seismic surveys have become even more data intensive in recent years, with seismic recording typically being done with 24 streamers (long strings of hydrophones towed behind a vessel), compared to 1 or 2 in the past.

The streamers are also much longer, typically 8km long today, so can carry more sensors and generate more data.

There is much more quality control (QC) of seismic data than there used to be.

A few decades ago seismic header data was only really quality controlled at the stage when it was loaded onto a workstation.

Now, at PGS, “there’s increased QC within the company, to ensure that when data is delivered to the storage system it is correct and loads immediately,” Dr Smith said. “Subsequently, when it is sent out to clients it is quality checked prior to dispatch.” Much of the QC is automated to ensure data is delivered in a timely fashion.

Delivering data

When data was stored on tape, subsetting involved manual as well as computerised steps. The process usually took days, weeks and even months to complete. The steps involving manual intervention often resulted in errors creeping into the final product, he said.

Now, when clients request data from certain part of the world, PGS and its contractor Ovation Data, have automated systems to provide exactly what the client requests, in minutes.

Ovation Data can transfer data using Aspera high speed file transfer software, which is also used by Netflix, and is much faster than standard File Transfer Protocol (FTP), he said.

Moving data around the world is getting easier and cheaper, as fibre optic networks expand. The most competitive routes are across the ocean.
the oceans where multiple cables are in place. There are more challenges transferring data across continents where national telecoms companies are involved.

Perhaps companies should be trying harder to reduce the amount of data moving. It might be easier if more of our applications could work on data which is stored remotely.

“We spend a lot of time pumping data from central systems into different application suites, duplicating effort and costs” he said.

“Some countries, including Malaysia and Indonesia, still insist that the data should not leave the country. This can be awkward when data is stored on systems that are running around the world, although sometimes the rule only applies to the original data, rather than copies.”

Video data

Oil companies are working with more and more video data. This started with underwater remotely operated vehicles taking subsea images of pipelines and other facilities.

There is now a big increase in drone data, since drones can film a plant without shutting it down. They can easily inspect high places like chimneys and flare stacks.

Video data was historically recorded on VHS videotape and could be watched with a video recorder, which made it very difficult to search. Now the video is stored on disks, or a stack of disks on shelves and need to be searched through when particular images are needed.

Through its UberPool ‘ride sharing’, Uber tries to match people together, who can then share a ride to work. It looks for potential matches based on people’s shopping habits and Facebook postings.

Uber has proposed to receive a bonus from the government based on any new Singaporean Citizens which are produced from an Uber-created match.

“Uber would get a bonus for performing that service for the country,” he said. “So a completely unexpected outcome.”

The lesson for the oil and gas industry might also be that benefits from analytics can come from directions you do not expect, he said.

Another interesting example is power company GE, which provides power equipment for airlines and many oilfield applications, including compressors and pumps.

A few years ago its aerospace division decided to sell ‘thrust’, rather than the heavy equipment itself – in other words GE takes responsibility for supplying and maintaining the equipment, and it is not actually owned by the operator. This puts the company with the greatest expertise in the equipment in charge of keeping it running.

Perhaps oil and gas service companies could use analytics to package their services in a better way, he said.

Many rail networks are finding ways to use analytics to reduce downtime, something many areas of the oil and gas industry could perhaps learn from.

One German rail operator has built a special railcar for managing data, where all the data about the operations of the train is gathered and processed. This system could be seen as similar to a pigging system for a pipeline, analysing for defects along a long line, he said.

Another user of analytics is parcel delivery service UPS, which tracks fuel usage. The company worked out that in many cases, it would be quicker to make three right turns and drive around a block, than make one left turn which involves waiting for a gap in traffic (this is in the US where vehicles drive on the right).

“The biggest challenge for UPS drivers was getting them to follow something which seemed counter intuitive,” he said. UPS’ solution was to offer drivers a bonus if they could follow their own ideas, rather than the computer, and find it led to less fuel consumption. “The drivers found the computer was right,” he said.

Systems are being developed to index digital videos to a GIS system, so you can understand what part of the subsea you are looking at, or go straight to find video of a certain location. For example you might want to investigate video of the same location filmed over a period of time to determine when damage or scouring round a structure began to occur.

It would be good to have standard ways to integrate other data, such as sonar images, together with the video, Dr Smith said.

Computers can also create 3D images, if they know the location of the camera. You can pull together images from multiple cameras to create a good 3D image.

Jess Kozman – learning from others in analytics

Jess Kozman, Singapore regional representative with the Professional Petroleum Data Management (PPDM) Association, presented some ideas about where the oil and gas industry can learn from other industries

There are many industries which are advanced in their use of analytics, including weather, defence, aeronautics, transport, healthcare, pharmaceuticals, genetics and sport, said Jess Kozman, Singapore regional representative with the Professional Petroleum Data Management (PPDM) Association.

Mr Kozman presented some ideas about where the oil and gas industry might learn from some of these industries, speaking at the Digital Energy Journal conference in KL in October, “Connecting Subsurface, and Drilling Expertise with Digital Technology.”

Car sharing service Uber has developed an interesting business model, with a proposal for making money from contributing to the Singaporean government’s objective to increase fertility rates through demographic analysis, he said.

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A similar principle has been used by companies running service trucks in US shale operations, with decisions about which route to take.

Another user of analytics was a research company which was gathering very detailed data about fatigue damage on metals. The company often had a problem from losing data, since it was being kept on various hard drives and files in different places.

By moving data to the cloud, at a cost of $1100 per terabyte, it found it was massively reducing the amount of data loss, and that saved $500k a year from not having to redo work, he said.

Sometimes analytics can help show areas which are worth paying special attention to. An example is Continental Airlines which discovered that there was quantifiable benefits to giving its ‘Gold’ customers special attention.

The company worked out that by having an employee greet the ‘Gold’ customers on arrival and escort them through the terminal, the person was far more likely to book another flight on Continental and spend money on-board the plane, leading to an additional $500m revenue.

Oil company PETRONAS has been an extensive user of analytics, gathering 50-70 GB a day of real time data, monitoring temperature, pressure and vibration – for its Formula 1 racing cars.

PETRONAS has shared many best practises with real time data operations with its real time operations centre for drilling, Mr Kozman said.

These are all examples of companies finding value from working with real time data in places where it might not be expected, he said.

The oil and gas industry is unique in that it is working with data at many different scales and timescales. “It makes oil and gas data unique and more challenging. But it also means we share a lot of techniques and best practises,” he said.

An oil company might be analysing data for the past 70 years, which is very different from what an e-commerce company might do. And sometimes the most valuable data is the oldest data not the newest, such as handwritten notes by mud loggers, he said.

However, the bulk of the volume of oil and gas data has been gathered over the past few years, he said.

Sometimes a decision might be taken on the basis of only the most easily available data, rather than the best possible data, leading to an inferior decision, he said. “We have a propensity to look at data which reflects the way we’re looking at operations now,” he said. This leads to what data scientists refer to as “mode bias” and can influence the result of analytics.

A key factor in making projects successful is that there should be a subject matter expert involved, who can provide a ‘sanity check’ on any results. You don’t just have statistics experts working on the project, he said.

The oil and gas industry is perhaps too susceptible to claims from some software companies, who say “you just put the data in the system and the data will tell you what to do,” he said.

Watch the talk on video and download slides at www.d-e-j.com/video/1776.aspx
You can look at operations as a pyramid, with expensive shutdowns at the top, and at the bottom, the cause being information which is inconsistent, incomplete or poor quality, says Chris Cran, solution strategy manager with oil and gas engineering software company AVEVA.

He was speaking at the Digital Energy Journal Kuala Lumpur conference in October, “Reaping Operational Benefits Through Digital Technology”.

All process industries have a need to be safe, efficient and compliant.

To achieve this, “engineering information needs to be accessible and we need to be able to trust it,” he said.

Operators are trying to make decisions based on the wrong information. “It shouldn’t be happening,” he said.

People in oil and gas operations could be placed in 2 broad categories, one who understand information quality challenges – usually people who work at the front line, maintaining equipment and keeping operations running.

Then there’s a second group who don’t seem to understand there’s an information problem, or don’t seem to understand the challenges which poor information creates, he said.

There have been studies across many industries, including retail and manufacturing, showing the billion dollar business opportunity if companies could have better information, and how much time and money is spent re-creating and correcting information.

Studies showed that most senior management estimated the price of poor information quality to be under 0.1 per cent of total revenue, whilst it was actually about 10 per cent of revenue, the difference between profitability and loss making for many companies.

As an example, Mr Cran was once involved in one safety incident caused by poor information. His customer had a polyurethane ball stuck in a pipe. The company had a procedure for what to do, but the operations team were unable to find it, and were under pressure to remove the blockage.

Somebody had an idea to feed nitrogen into the pipe to force the ball out. The ball came out of the pipe at high speed. “Luckily no-one was hurt - someone could have been seriously injured,” he said. “If they’d found the procedure, they would have known to use water to clear it safely.

At the time, the near-miss was blamed on “training”, but actually it was because they couldn’t find the information, he said.

Another example was a company which spent $250,000 on an item they didn’t need – but they didn’t know because of a single incorrect attribute. There was also additional storage costs.

“Three minutes or less”

Companies are trying to fix it. One example was an oil company which specified that staff must be able to find information in “three minutes or less.”

This may not be a reasonable expectation. The company did an audit and found that there were 400 different software applications on 3 assets, and 7 different document management systems on one site.

“How can you find information in 3 minutes or less in that kind of environment? I can’t even remember my own logins in 3 mins or less,” he said.

All in one place

The right approach is probably to get all of the information related to the physical asset, including 3D models, data sheets and certifications, all stored in one place, and referenced to the physical equipment.

A search for the equipment tag number will bring up all the documents related to it.

Companies set up their ‘information standard’, commonly called a ‘class library’, which defines what information you need in operations.

AVEVA has a product called Information Standards Manager which can be used to create and manage information standard. It can run as a cloud software service, or on your own servers.

You can focus it on areas on more production critical systems first, or areas where you know there is a problem.

“When you get all the data in place, that’s when you can create a digital asset. “We define a digital asset as your information core for your operating physical asset,” he said.

“That’s non-negotiable – it has to reflect what’s happening in the plant.”

When you share it with the entire organisation it becomes really valuable. It starts enhancing operation and compliance.

Much of the work in building it is making information available from all of the silos in the company, he said.
Operations

All about caring?

Perhaps the most important issue is that there is someone who cares about the data. It doesn’t matter why they care about the data, but important that someone does.

Mr Cran told a story of when he was previously employed at an engineering company, which received seven negative findings on an audit, due to information being inaccurate.

These audit reports were shared between project partners.

“We decided within our department we wanted to clear the audit findings and be the best in our company and be the best company,” he said.

“We did a data capture exercise. A colleague and me went to the site, and spent a week, five days of 12 hour shifts, capturing the information.

“It was a success, we were compliant at the next audit. We felt quite pleased with ourselves and helped the company become top of the league.”

“All we were really doing was capturing information that we had, verifying it and checking the quality, and making sure it was shared with the team,” he said.

The project captured all the data sheets, put together piping and instrumentation diagrams, working with onshore and offshore teams.

After it was done, Mr Cran found that other company departments saw him as a point of contact for finding P+IDs or vendor information.

“I started to realise, we’d become the digital asset, our team had become the reference point for all these other disciplines.

In order to get there, “we need people who buy into the process and want to make it happen, and we need a process to achieve it,” he said.

AVEVA Engage

AVEVA has developed software “AVEVA Engage,” which will “bring a digital asset to people who weren’t previously engaged,” he said.

All of the captured information, including 2D diagrams, laser scans, can be put together in a 3D visualisation “that’s powerful for engineering team.”

This could be a good way to get the sort of people who aren’t aware of the value of good information more interested, he said.

When senior managers see it, they immediately recognise the value of it, he said.

The software can capture changes which happen to the asset. “In my experience it’s close to 100 per cent all the time that some piece of information changes [during construction],” he said.

“Information standards can help there, if you’ve got a standard that defines the information you need, that helps you.”

“You need a process in place. Sometimes it’s as simple as capture a ‘red line mark-up’ on a paper document.”

“Or saying, we’re going to push this out to a team in India and have them re-create these P+IDs.”

Watch the talk on video and download slides at www.d-e-j.com/video/1788.aspx

Publicis.Sapient – three types of AI

There are three different types of artificial intelligence relevant to oil and gas which are all maturing commercially at this point – statistical learning, deep learning and symbolic logic, says Rashed Haq of Publicis.Sapient.

Artificial intelligence (AI) relevant to the oil and gas industry could be divided up into 3 types – statistical learning, deep learning and symbolic logic, says Rashed Haq, vice president, analytics and artificial intelligence with Publicis.Sapient.

Publicis.Sapient is a technology consulting company specialising in “digital business transformation,” owned by French advertising company Publicis, based in Boston, USA. Mr Haq is based in Houston.

Publicis.Sapient serves the healthcare, automotive, retail banking, consumer packaged goods, travel and tourism, financial planning and investment banking sectors, as well as oil and gas.

Statistical learning

Statistical learning is perhaps the sort of analytics we usually think about, for example to work out which factors are most relevant to a certain outcome or whether one factor is driving another.

For example, during drilling there are many streams of data – vibration of the drill bit, thermal gradient (how the temperature is increasing with depth), information about the rocks.

A statistical learning system can analyse past data to show (for example) which parameters usually change before a problem, such as stick-slip (where the drill bit gets stuck and then jolts).

This sort of learning is widely used in consumer industry – as an example, consider an electricity supplier which wants to stop customers from leaving, Mr Haq says.

The electricity supplier may work out, from analysing data, that customers have a high likelihood of leaving the company if they have just...
received a phone bill which is a certain percentage larger than their average bill over the past few years, and this person makes a phone call to the company helpdesk.

The electricity company may find it makes commercial sense to set up a system to phone all customers with electricity bills which are much higher than their average (perhaps to give them a warning and help them work out how to reduce their demand), and by doing so prevent them taking their business elsewhere, Mr Haq says.

**Deep learning**

Deep learning is where a system is built with a number of different mathematical functions (known in the jargon as ‘neurons’) and adjustable ‘weightings’ for each of them.

As an analogy, consider how a human being with expertise in a certain subject is able to place a ‘weighting’ on different pieces of new information and so judge whether news like ‘Kelly is leaving the company’ is something which warrants immediate action, or perhaps no action at all.

As a result of adjusting the weightings, or ‘training’, a deep learning system can be programmed to come up with useful answers within a defined criteria, for example determining whether an image of a cell is a cancer, or (for a well-known example) determining if a photograph is a picture of a cat.

Within the oil and gas industry, such deep learning systems are being used to identify faults within complex 3D subsurface visualisations, he says.

Such a system could also be trained to continually analyse streams of drilling data, and give advice to the driller about whether there is a problem and drilling should be stopped to sort it out.

The same technology is used in self driving cars, he says, where cars gradually improve the way they understand what is in front of them.

**Symbolic logic / causal reasoning**

Symbolic logic / causal reasoning is a form of artificial intelligence, but it is not big data – more likely small and complicated data, he says.

The basic idea is that human experts write some logic which they would like the computer system to follow in certain situations, about how the real world works. Then the computer system can follow the logic, but much faster than the humans can.

For example, an alarm system could be better set up using symbolic logic.

Usually, oil and gas alarms are triggered to sound if operations go outside a certain window. Once the alarms go off, the operators go through a certain series of steps to determine if there really is a cause for alarm.

If this series of steps is structured enough to be written as symbolic logic, it may be possible to program a computer to go through the steps and take the necessary investigations, and do it much faster than a human can, Mr Haq says.

The process of building this system involves sitting down with the human experts and finding out what they do.

**Ship vetting**

Another example involves building a system using a mix of statistical learning and symbolic logic for an oil company, to help it make decisions on whether to accept a certain tanker ship for charter (“tanker clearance”).

Typically, tankers have a human inspection every six months, where experienced tanker professionals visit a ship and go through a questionnaire, designed to help the oil company work out if the ship is being safely managed.

The reports are sent to the oil company vetting department, where a team of professionals read them and determine whether or not their company will accept the ship.

Over the years, the oil company builds up a large database of reports about every ship and management company.

The system can automatically go through the reports and determine which factors usually arise in inspections as reasons why a ship should not be accepted.

On the basis of these reports, the oil company found it was possible to make assessments about whether to accept a ship, which were nearly always the same as the assessment made through a recent manual vetting / inspection process.

Now, to save money, the oil company has cut down on the number of manual inspections by 90 per cent.

This means that the vetting department can approve or reject a certain ship within a few minutes.
Aligning drilling updates with logistics

One big cause for non-productive time in drilling is that the logistics department are not fully synchronised with the constant changes in the drilling plan. It could be improved with better data management systems, says Dr Carlos Damski.

One way to improve expensive Non Productive Time (NPT) during drilling is for better synchronisation and communications between the drilling department and logistics department, to reflect changes in the drilling plan, said Carlos Damski of Genesis Petroleum Technologies.

He was speaking at the Digital Energy Journal forum in Kuala Lumpur, Malaysia in October, “Connecting Subsurface, Drilling Expertise with Digital Technology.”

Logistics is a highly complex and organised activity, but which is often structured on a ‘just in time’ basis for offshore drilling, the same way that factory logistics is, he said.

But offshore drilling (or any drilling) is subject to changes in plan far more often than most factories, he said, in addition to dealing the constraints of incredibly limited holding space on the rigs.

As a result, there is a great deal of non-productive time due to waiting for resources, he said, equipment not being there or the wrong equipment delivered, perhaps just one piece of equipment not delivered.

Drilling non-productive time can reach around 25 per cent, so during a 100 day drilling operation, the drilling rig can be non-productive for 25 days, he said. One of the causes of this non-productive time is waiting on resources.

An alternative approach, Mr Damski suggests, would be to organise a system around the specific aim, of reducing non-productive time in drilling by focusing on common logistical issues.

If you had comprehensive information about previous operations, what went right and what went wrong, together with information about future planned operations, that would be a good basis to assist logistics team adjust their operations accordingly, he said.

Over time you aim to improve the business, not just improve the data, he said. If a business process is repeatable, it should be possible to measure and improve it.

The logistics planning starts after the drillers supply their original operational plan, showing what they expect the next sequence of activities to be, for drilling and completion of the next well.

A report is issued to the logistics staff saying what is planned, and everything needed for that particular well.

As the drilling starts, there can be changes to the plan. But it is too common that there is no detailed follow up sent to the logistics departments, Mr Damski said.

Perhaps, instead of logistics staff making a fixed plan to deliver a certain item by a certain date, they could have a risk based plan, taking into consideration how critical a certain item is, and how likely the date it is needed might change.

Also, some delivery dates are more flexible than others, and this is useful information for drillers to pass onto the logistics department.

A more sophisticated ‘lessons learned’ process would be helpful. For example, if drillers repeatedly find drilling interrupted for the need of a certain spare part, the company can learn to keep this part in stock nearby.

“We can keep notes about what we planned and did not execute, or what we executed and did not plan,” he said. “We compare every single operation exactly against our plan and execution.”

Over time, it should be possible to build up a statistical model, which can then work out the statistical likelihood of failure for each part of the operation.

This data can be fed into a Monte Carlo simulation, which can then calculate the amount of uncertainty which can be plugged into a future project.

Then you can have both a definitive plan, and a plan to revise the plan, based on different eventualities, in order to minimise the overall costs, he said.

This risk based plan can reflect the amount of complexity involved in changing the dates when different items are brought to the wellsite.

Note all drilling sites have the same logistics challenges. Deep offshore wells are serviced by boat and are hard to reach by helicopter. With unconventional oil and gas, there is a large amount of wells, and often poor access roads or no roads and no warehouses.

The plan could be visualised in different ways, perhaps with a chart showing bands of uncertainty and time, he said.

The data management department can contribute more to building a better system, he said. Some tend to focus only on the challenges of data acquisition, storage and quality control, but don’t tend to focus on the business function, which allows one department to have the best possible information to help them make decisions.

In this case, logistics department would greatly benefit from having a frequent update of the drilling activities for the next few weeks, along with the list of all materials to send and return to/from the rig. This allows them to fine tune their complex supply chain and mobilization, to truly deliver “just in time” resources when they are need on the rig.

Watch the talk on video at www.d-e-j.com/video/1777.aspx
Weather forecasts available offshore are getting better

Oil and gas companies can take advantage of three technology developments to better understand weather: lower cost weather radars, high-resolution data and mobile computing, says Jim Menard of The Weather Company, an IBM Business.

Until 2015, weather radars were very expensive, large and heavy, and installing them was a major civil engineering project. But lately they have become much smaller and cheaper, so it becomes viable to consider installing them in remote locations, Mr Menard says.

The cost of the radar has dropped by a fairly substantial amount, he says.

The weather radars are designed to survive in remote locations, such as on top of mountains, so they are very resilient. They are also used by TV stations to help manage remote broadcasts. TV stations sometimes use them to generate real time maps of forest fires, for broadcast on TV.

These satellites are small enough to be carried around on pick-up trucks. “A few years ago - the idea of throwing a weather radar on a bed of a pick-up truck - would have been a really silly thought,” he says.

The Weather Company is currently discussing installing these systems on board remote assets for major oil companies, he said.

The data can be fed into locally running computer models. If the remote asset has enough satellite bandwidth, the data from the radar can be sent on to The Weather Company’s weather center in Boston, where “we can apply more resources to it,” he says.

The Weather Company is very keen to hear from oil and gas companies interested in testing out different ways to use the radars (the company can be contacted at energy@wsi.com).

Resolution

There have been big improvements in the resolution of weather data, in the models developed by weather forecasting organisations, Mr Menard says.

There are a few dimensions to high resolution. You can get a weather prediction for a smaller space on earth, up to 2km x 1km square, for any place on the planet. You can get more precise predictions about when exactly the weather will change. You can also get much better predictions in advance.

All of this can make a big difference to people planning oil and gas operations, particularly for parts of the world which are a long way from mainstream consumer weather services, he says.

As an example, consider an offshore worker

Oil and gas companies can improve their understanding of weather using three different technology developments: reduced cost of weather radar technology, improvements in the resolution of data, and better mobile computing, says Jim Menard, general manager of the enterprise division of The Weather Company, an IBM Business.

The Weather Company provides weather services to a number of industry sectors, including aviation, energy and insurance.

Weather radar

A weather radar is a piece of equipment which can be installed on an offshore installation or vessel, which sends out microwaves into the air, which are reflected back if they encounter water droplets or ice.

The radars can see 80km “fairly reliably”. They can also calculate which way any water droplets are moving, and how fast, using the Doppler Effect.

This way, it is possible for offshore operations staff to get a good prediction of rain which is heading their way, and when it will arrive. They can also get advance warning of tornadoes, if they can see water droplets rotating.
who can see the sky is starting to look menacing, or there is lightning in the distance, and needs to make an expensive decision, for example about whether to reschedule helicopters or maintenance work. Better weather information can make a big help in this decision making.

A company may decide that they are comfortable doing certain work if lightning is over 5km from a platform, but would like to stop immediately if it is under 5km away.

With more sophisticated weather systems, you can get a better idea if the lightning is going to be within 5 km of the platform, rather than wait until it actually is. “You can be a lot more precise,” he says.

When there is a risk of extreme weather events, the information can help a company decide whether or not to shut the rig down and evacuate.

And having better weather information 10 days in advance can be very helpful when planning future operations.

Companies like The Weather Company take data feeds from more than 160 different computer models around the world, many state run, including from the US, UK, EU, Canada and Japan. The European Centre for Medium Range Forecasting, based in the UK, is “arguably one of the best models in the world,” Mr Menard says.

The company continually rates each of the models, by comparing their predictions against what actually happens. “No one model is always right, but with several models, our accuracy and forecasting goes up dramatically,” he says.

### Mobile

A third technology development which helps people to better understand the weather is mobile phone software.

In terms of presenting the data, the company develops a range of mobile apps and websites, and has done an enormous amount of research into the best way to display complex information to people who aren’t meteorologists.

It is possible to set up alerts easily, for example warning people that winds will be gusting to 70 miles an hour or there is a big squall coming.
Intergraph - managing documents on the cloud

Intergraph Process, Power & Marine is working with Shell, ConocoPhillips and ENI, among other leading companies in the oil and gas industry, to build document management systems, sometimes completely on the cloud. Jens Olav Nordanger, sales manager Intergraph PP&M Norway explained how.

Engineering software company Intergraph PP&M is working with leading oil companies including Shell, ConocoPhillips and ENI, to help them manage their upstream engineering documentation - some of which is kept completely in the cloud.

ENI has over 10m tags in its document management system, all stored in the cloud, said Jens Olav Nordanger, Norway sales manager, Intergraph PP&M, speaking at the Finding Petroleum forum in Stavanger on Dec 1, “Transforming Offshore Operations with Digital Technology.”

The Intergraph PP&M software is also used by many small companies, the smallest being a Danish company with 6 employees.

The cloud-based document management system is called Smart Access and no desktop software is required to use it. It can be used on tablet computers as well as PCs and the software has automatic tools for checking the data quality and consistency.

A main driver behind using software like this is maintaining information quality in the company, Mr Nordanger said.

Researchers have calculated that having poor asset information can lead to costs equivalent to 1.5 percent of your annual sales.

If workers don’t trust the corporate documentation, they will go back to information which they keep on their own computer hard drives or paper documents, which is not a desired outcome.

By keeping documents on the cloud, document handover (between an engineering company and an owner, or owner’s project team and owner’s operations team) can be much simpler. It is basically a case of giving someone else access to the relevant online documents, he said.

In the same way, owner operators can easily share documentation with other people involved, and engineering companies can pass their information to owners.

You don’t need to take a ‘big bang’ approach to moving all of your documents to the cloud at once, you can start small, moving documents for one part of the asset, and get people comfortable with the system, and put all of the documents on the system gradually, he said.

One example was a vessel operated by Australian oil company Woodside Energy, where the company gradually set up an online document management system for a ship over 8 months, including doing laser scanning and adding in tag numbers.

Some oil majors insist that all of their suppliers store their documentation on the cloud service, as a condition of doing business with them.

Software

The software can manage any drawings and office documents. You can include 3D models in Smart Access, including 3D models of the landscape and seabed, and laser scan models. When entering data and documents, the software can check that you have all the right attributes entered, and the information is consistent.

It can do automatic analysis of pdf files, looking for tag and document numbers.

You can use the software to search for all of the relevant documents about a certain item such as a heat exchanger. You could automatically bring up a pdf file of electrical information, and get the tag numbers.

You could also access a process drawing, such as P+ID drawn in AutoCAD. There might also be laser scan and 3D data available.

An employee can download a ‘work pack’ with all the documents they need to do a certain job onto their tablet computer, including videos. Once the work is done, any changed documents can be uploaded back to the database, so it is available to the rest of the engineering and operations team.

Intergraph PP&M is continually developing more interfaces with other software systems, including enterprise resource planning software (like SAP), maintenance management software, and asset performance management software (like GE’s Meridium).

This means, for example, that when bringing up information from Smart Access, you can also bring up relevant information from other software, such as maintenance software showing when a certain task was last completed, or purchasing data from SAP.

In future, we might see more use of virtual reality, or screen projections superimposing real life, like ‘heads up’ displays on an airplane, taking the relevant data out of the software, Mr Nordanger said.

There could be ‘computer enhanced vision’, to help people who are reading gauges on the equipment, and provide instructions to help fix any problems.

About Intergraph PP&M

Intergraph is part of Hexagon, an enterprise engineering and geospatial software
Operations

company with around 15,000 employees.

The company specialises in technology to improve the design, construction and operation of plant and facilities.

Intergraph Smart 3D software is used for both building and plant design around the world to keep schematics information and 3D design drawings up to date, including electrical and piping.

Smart 3D Materials Handling software helps companies to ensure correct and accurate procurement processes, saving cost by removing material surpluses.

All of the software is also available in the cloud.

In 2015, Intergraph PP&M acquired a company called EcoSys, which makes a project control software that helps owner operators worldwide plan and optimize project portfolios, control project costs, and improve project performance.

For more information about Intergraph PP&M, please visit ppm.intergraph.com.

You can watch the talk on video at www.findingpetroleum.com/video/1652.aspx

Datum360 – focus on the data

Datum360 of Teesside, UK, offers a framework for creating your ‘engineering data warehouse’ on the cloud

UK company Datum360 offers a cloud hosted data SaaS management framework so you can manage your engineering data.

As a ‘data management framework’, it is simply a way to manage data requirements, and so perhaps much simpler than other data management software, said Lin Whitworth, director of client services with Datum360. “SaaS can be delivered in one day without the need for an IT project” he said.

He was speaking at the Finding Petroleum forum in Stavanger on Dec 1, “Transforming Offshore Operations with Digital Technology."

Datum360’s Engineering Data Warehouse software is called PIM360, and it is available as a cloud based service. The company has a sister product called CLS360, which can be used to manage the class library (which indicates what data you need for each item), and the handover specification (which shows what information must be present when an asset is handed over from project development to operations staff).

The products are supplied as cloud-hosted ‘software as a service’. Datum360 SaaS can run on a public cloud or private cloud.

SaaS product reuse one set of programming code many times, which demands and delivers reliability. Datum360 has a subscription model that allows the customer to pay monthly or commit to longer periods. The monthly subscription includes, implementation, maintenance and availability against and agreed SLA.

CLS360 and PIM360 have been available for over 3 years now, and has been 100% available to all customers during this period.

The expertise of Datum360 staff in engineering data management is embedded into the design of the tool. It was also developed specifically for use as a cloud service, taking advantage of social media type functionality.

Single source of truth

The Engineering Data Warehouse (EDW) should be a ‘single source of truth’ for all of your company’s engineering data, a place for people to find any kind of engineering data, Mr Whitworth said.

For this to work, there needs to be a robust system to manage change, or updates.

For example, if a process engineer has decided that the set point for a process safety valve should be changed to 25 barg, the new set point needs to be updated in the relevant documentation.

As the appliance is modified, approval from the Process Engineer and the creation of a detailed audit trail bring provenance to the new data value.

The Datum360 software has tools to manage the update to the engineering data.

A relevant project manager can see proposed updates to the data and make the necessary approvals, enabling the updated data to enter the master database. The software keeps an audit trail of who agreed to what.

Managing a Class Library

Information managers can spend a lot of time specifying requirements for the data that an organisation needs, and the CLS360 SaaS solution software aims to reduce the amount of time it takes, by providing a strawman specification and functionality for controlled change, he said. The class library can then be carefully managed, adding in an extra class of equipment, unit of measure or register when it is needed.

Software demonstration

Elle Forrest, information consultant with Datum360, did a live demonstration, showing a system with 71,000 tags, with data stored on PIM360 systems, hosted by Amazon Cloud.

A typical task for a customer might be to bring up all the data needed for a specific project, for example an electrical load list or a register of pressure safety valves (PSVs).

Following any modification to the asset, the data can be updated, and updated data can be temporarily stored in a ‘Engineering Information Change bubble’, separate to the live information. It is only added to the live information when an authorised person believes that it should be.

For example the maintenance manager might telephone a company process engineer, and say, “I’ve loaded some new tags into Workpack 49, and you let me know if you’re happy to publish it.”

The process engineer can look at the information, and check (for example) the PSV has been given the right set point.

It is possible for any PIM360 user to see the various updates which have happened over the day, and what the previous values were.

This detailed audit trail of engineering data change helps to build trust in the data.
**Digital asset**

AVEVA’s core philosophy is that companies should create and maintain a digital asset for every physical one. The two need to be kept synchronised and up to date. The digital asset should also be fully integrated, rather than distributed across numerous different systems.

“Consider this,” says Mr Nerseth, “the physical asset is mostly made of steel, whereas the digital asset is made of information. When managing the physical asset you focus on mechanical integrity. But when managing the digital asset your main focus is always on the data integrity in your system”.

**Lundin**

AVEVA is working together with Lundin Petroleum in Norway, using its software on Lundin’s Edvard Grieg platform, a brownfield project.

Lundin is using the AVEVA Engage software, which can visualise a 3D model of the asset and enable staff to work on it directly in a collaborative manner. Powering the visualisation software is the AVEVA’s integrated engineering database, AVEVA Net.

As part of his conference talk, Per Ivar Nerseth shared a video describing AVEVA’s work with Lundin using 3D data, and featuring Geir Sjøsåsen, operation advisor at Lundin Norway. (The video is on YouTube at www.youtube.com/watch?v=Zv636q7S-s8)

In the video, Mr Sjøsåsen emphasises that offshore personnel should only be executing work which has been planned. He explains that the visualised 3D model makes it much easier to plan the work onshore and avoid the risks on-site.

The biggest users of the software at Lundin are mechanical, electrical, instrumentation and processes personnel, working in operations as well as in the technical department. AVEVA’s Asset Visualization software provides substantial help in engineering design and review processes. The users utilise the tool to schedule work and review the detailed engineering information associated with every part and component of the platform.

Also, the teams can see all the information needed – parts, equipment history and future jobs – in order to plan a job on one screen. They don’t need to access multiple disparate systems to find information that they require to make decisions.

“It is also very easy to use,” says Mr Sjøsåsen, “in all it takes about 15 minutes to learn how to use it. Different staff members can see the same visuals and work on the same set of data.”

There is no need for anyone to physically visit the platform and take photographs to plan work. Measurements can be taken directly from the 3D visuals. Also the P&IDs don’t need to be marked up on paper. With the integration of detailed engineering information, everything can be accessed and marked up digitally.

The integration of AVEVA Net’s engineering database ensures that all of the tags, engineering drawings and work history are readily available. This makes it possible to search for objects by tag or object number.

You can bring up highly detailed information and carry out searches in various ways. For example, you can search for an object and bring up relevant associated documentation, and see when you last worked on it. All of this can be done from working on the single 3D model. “That’s elegant,” says Mr Sjøsåsen.

With the intuitive user features and isolation modes, you can choose to view a specific section of the asset. For example, you can select just the living quarters and hide everything else.

You can also use the software as a planning tool as part of a physical meeting, where everyone involved is present. In this way, it is easier to explain how the work should be done using a digital visualisation of the physical asset.
eVision Industry Software is providing software for Statoil to help it manage its permit to work system, taking relevant data automatically from Intergraph document management software

eVision Industry Software, a company based in The Hague, Netherlands, is working together with engineering software company Intergraph on a project with oil major Statoil, to provide software to help manage and control work processes.

The control of work software will pull data directly from Intergraph’s engineering documentation management system.

It should go live in the beginning of February 2017.

Statoil wanted the system to work on mobile computers, including tablets, right from the start, said Kasem Challiou, global alliance manager with eVision.

He was speaking at the Finding Petroleum forum in Stavanger on Dec 1, “Transforming Offshore Operations with Digital Technology.”

Most clients start with the system running on desktop computers and then get it working on mobile computers as a second stage, he said.

eVision already provides permit to work software for Shell globally, on its upstream and downstream assets. BP is also a customer.

The “control of work” software enables a company to have a system of permits managing and controlling the work which is taking place. Having such a system enables the company to ensure that there is no work going on which the relevant people don’t know about, and all work has been assessed as safe before it is done, and any necessary safety precautions, such as shutting of the electricity supply in the area, has been done before the work starts.

You can make sure that the work is in compliance with industry standards or regulatory standards.

Control of work systems were introduced partly as a result of disasters like Piper Alpha, which were caused by equipment being put into operation while maintenance work was being done on it, because the relevant people were not aware of the maintenance work being done.

Improving efficiency

eVision believes that its software can also save companies money, by enabling them to get better utilisation from their assets and workforce, Mr Challiou said.

Studies have shown that offshore oil and gas workers typically only spend about 48 per cent of their working day as “hands on tool time”. Some companies say the number is lower than that, typically 30 per cent of the time out of a 12 hour offshore working shift as “hands on tool time”.

Much of the rest of the time is spent sorting out appropriate permits.

With better ways to manage permit to work, there should be fewer delays waiting for permits, and so the “hands on tool time” can be increased, he said.

The work permitting process can be made more efficient by making it easier for staff to find the data they are looking for, and making it easier for people to work with the system on mobile devices, so they can access and update the system from wherever they are.

If people can work more efficiently, that will mean that more tasks can get done on time, and the maintenance backlog will be shorter.

Studies have shown there is usually a direct correlation between the length of a company’s maintenance backlog and the number unplanned breakdowns they get, Mr Challiou said.

One company, which implemented the new software, decided to revise its procedures at the same time, and in doing so cut all its procedures down to 300 pages. The company also consolidated a number of different permitting systems, including a paper system, into one. Having just
one system means that less time is spent training staff how to use it.

One company analysed the data from its system and found that the majority of permits were only activated until 7-8am, although staff normally started shifts at 6am.

It also found that most of the permits were completed between 3-4 o’clock.

This meant that the workers were only working about 8 hours of the 12 hour shift they were paid for.

The company asked the shift supervisor to start working at 5.30am, 30 minutes earlier, and this led to workers getting their permits activated much earlier, by 6am.

The software can also help permits to work to be revised more quickly. There are often delays during a turnaround, when it becomes clear that a different piece of work needs to be done, and this needs to be communicated to the planning office, to issue a revised permit to do the work. A better permit to work management system can reduce this delay, he said.

A further advantage is that some of eVision’s clients have agreed to make their safety information freely available to all of eVision’s clients within the software, on the basis that they don’t have any competitive advantage over their safety procedures, so they do not have any reason not to share the information.

Software

The software has been designed with what Mr Challiou calls a “Windows XP look and feel”, with large icons.

This has proven popular with the workforce, he said. Once, when eVision suggested changing it, there was “a lot of rejection” from workers.

The software can provide an overview of all of the work happening today. There are tools for the relevant managers to check that all work planned for today complies with any relevant company safety regulations, and do any necessary risk assessments.

With the integration with Intergraph software, the eVision software can show relevant information from the company documentation. For example, if the work requires that a certain section of pipelines need to be isolated, the software can show exactly which valves need to be shut to achieve the isolation.

You can see the work you are about to do on a 3D image of the plant.

In this way, eVision connects work processes with the plant, Mr Challiou said.

The agreement with Intergraph is non-exclusive – eVision is also willing to integrate with other software.

If the oil company is using SAP to manage (for example) purchasing, it can use eVision and SAP together to manage the procurement of the relevant spare parts for an upcoming task.

The software can also integrate with Oracle Primavera, a software tool often used for managing turnarounds (when an offshore asset is completely shut down for a period of scheduled maintenance).

About eVision

eVision sees itself as the market leader in control of work software for the oil and gas industry in Europe, and is ‘very dominant’ in the Middle East and has a ‘very strong pull’ in the US and Asia.

It has received Eur 7m funding from the European Union under the Horizon 2020 project, which supports research and innovation in Europe.

The company is active in a number of other industries, including data centres, where there needs to be a system for managing electrical work, making sure the electricity supply in that part of the data centre is switched off.

Fablabs – helping improve production decision making

Stavanger start-up company Fablabs AS is building a software tool to help improve production decision making, taking advantage of knowledge which production engineers already have.

Company founder, Joe Chesak, worked as a senior engineering analyst with ConocoPhillips from 2011 to 2015, embedded with the company’s production optimisation team. In that role, “I really learned the business, I learned also that any new solution has to fit with how people work,” he said.

The software considers a limited range of parameters – the “gas lift” rate per well, choke settings, and routings on the topside. This reflects most of the options that oil and gas production engineers actually have to improve production rates, Mr Chesak says.

Production engineers face the daily challenge of identifying system bottlenecks and
Operations

then working out the risks and benefits of taking corrective measures. Their production environment is inevitably resource constrained, and that spawns a complex decision environment. It’s what inspired Production Tuner. “The more complex your environment is, the more benefit you’ll see from this tool,” says Mr Chesak.

The pace and uncertainty of life offshore is the other half of the story. Engineers have to be aware that something else might change while they are implementing a change. “Platforms are like ongoing construction sites,” he said. When engineers are under pressure to act quickly, it can be tempting to choose the easiest option, not the one which will lead to the best production, he said. With a deficit of actionable knowledge, that’s a good decision.

Making adjustments to production systems can require a lot of team effort, and often conditions change before those adjustments are complete. So the expected time it takes a team to execute can be the key driver for ranking options. This uncertainty of the environment impedes decision-making, and in fact can be paralyzing. If the flow parameters justify a change in configuration near the end of a shift, then there is that temptation not to do anything and leave the decision (and work) to the next shift, Mr Chesak says.

The software aims to make this decision-making easier by presenting the few best action plans, along with the effort required by each, and what their expected benefit to production will be, Mr Chesak says. Mr Chesak believes that the software will enable companies to increase production by 5 per cent, with little change to how they do their work.

In these lean times for oil and gas, cutting costs is priority one. By making the most of an operator’s given resources, it should allow for a reduction in the amount of exploratory drilling necessary to achieve production targets, he said. It may give operators reason to decide against cementing in older wells, because even a low producing well may fit perfectly in a high production scenario with other wells.

Fablabs is currently looking for a Pilot Project Agreement, and investment funding, to develop and test the technology further. And in conversations with companies he asks for a ‘statement of interest’ to help secure funding through Innovation Norway.

Using the engineer’s knowledge

The theory behind the software is that production engineers, who often work on the same wells for years, already have a unique knowledge about the ‘personalities’ of those wells: how a well responds to changes and different scenarios. The software aims to encapsulate this additional knowledge as ‘rules’ within the software. The key data captured and stored by today’s production systems has been largely unchanged for decades. But the reports based on only that data do not tell the whole story of how engineers make decisions.

The term ‘engineering judgement’, occasionally used to fill in gaps in engineering reports, includes intuition, which encompasses real knowledge, knowledge that does not have a home in the reporting systems, says Mr Chesak.

As part of implementing the software, there needs to be a dialogue with the engineers about their wells and connected infrastructure. As a side effect, an engineer understand her own decision process better and becomes more explicit in describing how she would approach the various scenarios. It is also possible to run an analysis on past decisions, asking an engineer why a certain decision was made.

The decision time itself can be legitimately seen as a barrier to execution. The tool might just help the team achieve the same decision they would have made before, but faster. This can have a big impact if it means that any problems have less time to become expensive problems, and engineers have more time to certify a software-suggested approach rather than start from scratch. They can also have more time to search for missing data, or an alternative to missing data, or fix problems with data communication from various sensors.

Alternative software

Mr Chesak has not seen any other tool on the market which does something similar to Production Tuner, he said.

There are many far more complex and expensive software on the market.

Perhaps the biggest competitor is ‘integrated operations’, where you have decision making offshore and onshore more closely integrated, but of course that’s less a software solution than a management/communications technique, with cross functional teams in war room type office spaces.

“Itegrated Operations has been credited with a five per cent boost in production”, he said, “Production tuner can achieve that again.”

Constraints to maximising production

One common constraint to maximising production is that the topsides are only able to process a certain amount of water cut. There may be wells with high hydrocarbon production and high water cut, and so the overall flow from the well needs to be constrained, thus reducing hydrocarbon production.

There will be a number of wells feeding into the same topside processing system.

Companies typically have many tools to tune an individual well, but not a tool to optimise all wells connected to a single processing system, Mr Chesak says. “Local optimisations sabotage system wide optimisations.”

Mr. Chesak described a scenario of a typical start to the day: the 6am production meeting. A new situation is identified, that requires attention ASAP. In the meeting, the team reviews what happened, makes assessments and a preliminary decision about next steps, and starts planning how to do it. It may take a couple of hours to gather the rest of the data needed to see the whole picture, and then another couple of hours to assess what choices of action can be taken. It would be better if the engineer closest to the problem could have a set of recommendations ready available in-hand, based on an up-to-date model, at 5.59, just before the meeting. It would show what the current state is now, and what the options are.

The software

Production Tuner takes real-time data from sensors on wells, and on off-shore equipment. Together with well-test, well model data, and other well-specific operating information, the software runs analytics on the data, and runs models, to work out the optimum configuration.
The system works on digitised knowledge, maintained by the engineers, that gets structured so that network computations can repeatedly run over it, he said.

The software continually monitors for certain offshore events and activities, and looks for ways the system could be running more efficiently.

Rather than merely trigger alarms, it offers alternative solutions targeting the root problem. The production engineers can then choose the one which best suits them.

It evaluates millions of viable scenarios, without taking up anyone’s time. In selecting the best solution, it honours the unique constraints of each well, working out what the maximum output is for each.

The solutions are listed as a series of steps to follow. For example, it may suggest a series of three steps. First increase gas lift on a certain well by 20 per cent, which will achieve a production increase of 70 bopd. Secondly, to choke back another well by 50 per cent, which would decrease its output, but the computer has worked out that this is a price worth paying. Thirdly, to re-route a third well to a different separator, which will give an increase of 1100 bopd.

The team can review the choices, compare their gains, and decide how to proceed.

Typically an engineer might be responsible for 15 wells, and there are five similar people looking after their own sets of wells. No engineer can know the impact of any change on the overall system. With software like this, you can say “what is the best thing that I can do with my wells to increase total production today,” he said. That’s a lot more valuable to the team than “What can I do to improve this well’s production?”

The computer might suggest a number of configurations which are better than the current state, but with a similar increased output, and then the team can select the configuration which is the team can implement most effectively, given current staffing, availability of materials, etc.

Alternatively the software can be used for running ad-hoc scenarios, over-riding the suggestion engine on parameters to see what the overall result would be. It’s gives every engineer visibility unavailable today.

So which operators would be good candidates? The answer lies in the complexity of the decision process, which points to any production system with two or more separators, with topside constraints such as a maximum amount of water which can be handled, toxic gases, or slugging wells that should not be routed to the same separator.

**Graph databases**

The software is built up using graph databases, a database structure which allows different pieces of data to be directly linked together.

Graph databases have been around for 15 years, but mainly used in Silicon Valley until now, he said.

“You can model exactly how everything is connected to everything else,” he said. “It creates a very elegant computational environment.”

“When you make changes to the system, they are immediate and impact the system.”

You can watch the talk on video and download slides at [www.findingpetroleum.com/video/1656.aspx](http://www.findingpetroleum.com/video/1656.aspx)

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**Operations**

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