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Cover image: the Sercel 508XT land seismic acquisition system. Sercel announced in February 2023 that it will deliver an additional system to Sinopec for a 3D survey to be conducted in China this winter. This brings Sinopec's 508XT inventory to 130,000 channels.

How Equinor implemented the 'data mesh' concept

The 'data mesh' concept is about 'packaging' a company's data management, so the output of every company department becomes a 'product' for any department which uses it. Equinor is trying out the idea

Equinor was seeing a great deal of "challenges and friction" when trying to use its data across different company departments, said Nina Reiersgaard, Advisor Enterprise Data Management, Equinor, speaking at the Society for Professional Data Managers conference in November.

The company was interested in ideas for how organisational data could be better organised.

Company staff liked the corporate data management philosophy described in a Harvard Business Review article "Democratising Transformation", which has Microsoft's CEO Satya Nadella as a co-writer. It describes the practise of different divisions of the company making data 'platforms' with associated governance and documentation.

The company was also 'inspired' by a Harvard Business Review article, "A better way to put your data to work" by McKinsey consultants Veeral Desai, Tim Fountaine and Kayvaun Rowshankish. This has the idea that data is seen as a 'product', as it is made available to other parts of the company, like products on a supermarket shelf.

This then makes it easier for other employees to discover and use data which might help them. The data can also be made available to machines, for use in machine learning projects.

In this model, the company should have some centralised governance about how data is managed, just as any company has some level of centralised governance. This ensures that each department provides high quality data.

The aim is to fix the biggest challenges employees have with data, according to employee surveys. Employees regularly say that they don't know what data the company has and they can't find it easily; they don't have the skills to work with data; and they don't know which data is trustworthy.

The initiative can address all three of these challenges, Ms Reiersgaard said, by making it easier to find and access data, which is already prepared to be easy to work with, and trustable.

The initiative should also help the company better allocate its training budget, so that it is perhaps less orientated around specific software packages. Equinor has done some analysis of its spending on digital competency, and found that sometimes only 20 per cent of staff are using a certain tool, a year after they have completed a training course on it.

The data mesh approach can help remove many [work] bottlenecks. Rather than one team being responsible for too much, work is more distributed, she said. "That makes a lot of things go faster compared to how it was."

For data to be considered a 'product', it needs to have an 'owner' who is responsible for it, and a clear understanding about the data quality and the rights to use it, she said. It should also have context around the data, so people know what it is.

"We are implementing and publishing data products with the relevant context in our data catalogues," she said.

Equinor is starting its 'data product' re-organisation by starting with the data which has the highest value, or which is most used in the company, she said. There is a particular focus on 'master' or 'reference' data, which is widely used and relied upon.

The work is taking place in 'sprints'. There are 7 teams, who all join a review meeting every second week, to show what they have done. The work is happening iteratively, "not everything will be solved at once," she said.

Altogether there are 60-70 people involved in these 'enabling activities', working together with domain specialists," she said.

The OSDU data framework, which Equinor had a big role in setting up, will need to fit into this mesh system. The company is still working out how to do that, she said.

Federated governance

The company's 'federated' data governance model means that certain aspects of data governance are decided for the company as a whole. This includes decisions about which data standards will be used in the company.

It has set up a 'data governance council' providing central co-ordination and ensuring that the governance systems are "relevant across all business areas."

The company has many data teams distributed

around the company. The common governance ensures they follow the same standards, she said.

The company is divided up into both business 'areas' (such as for a certain part of the world or a certain asset), and 'functional domains' such as reservoir. Some functional domains have responsibilities for multiple business areas, such as a reservoir team being responsible for reservoirs in different parts of the world.

In the past, each business area has had its own IT department. The IT departments are being more joined up, so that there can be a closer connection between data product owners, data stewards and technical data delivery teams, she said.

Reducing data engineering

The company is keen to find ways to reduce the amount of data engineering / integration work.

At the moment, data engineering is needed for every data task, and maybe several iterations of it, she said. Perhaps some of this data engineering effort could be re-used.

For example, a typical data engineering task might be connecting together data from safety or maintenance management, sometimes by developing mapping tables. It is a similar picture integrating data about pieces of equipment, wells and subsurface. It may be possible to re-use these mapping tables, for every time these data sources are used together.

Nina Reiersgaard, Advisor Enterprise Data Management, Equinor

Equinor's data governance roles

Equinor is developing a standardised way to approach data management across the company

Traditionally, oil and gas data management has had "quite a distributed approach," done differently in different parts of the company, said Liv Stordahl Borud, Leading Advisor Data Management, Equinor.

Ms Stordahl Borud has a role to develop the data 'network' and community in the company. She was speaking at the Society of Professional Data Managers conference in November.

In the past, responsibility for data management ultimately came down to the line managers, people responsible for overall management of different areas of the company. "That made it hard to have a common and co-ordinated way of implementing any governance," she said.

Now, Equinor is developing a "data governance model," which includes a description of roles, responsibilities and requirements for managing data in the company.

Each business department carries responsibility for managing its data and information. The 'enterprise governance' ensures that data can be moved between different parts of the company.

All of this is part of what Equinor calls a 'federated governance model' – a model defined to be used for the entire company, while different departments additionally have specialist needs to work out themselves.

Liv Stordahl Borud, Leading Advisor Data Management, Equinor

The federated governance model "provides flexibility and makes it easier to adapt to changing business conditions," she says.

Where previously it was managed in a decentralised way, with every division going about it in its own way, now it is a combination of decentralised and centralised, she said.

Data leads

Equinor now has an appointed 'data lead' in all the main divisions of the company, such as subsurface, 'drilling and well', project development, 'operation, production and facilities', marketing and supply, supply chain, 'safety, security and sustainability,' 'technology development, digital and innovation,' 'finance and control', 'people and organisation'.

Larger divisions, such as 'operation, production and facility' have several data leads, such as a data lead for renewables and a data lead for oil and gas assets. There are 12 'data leads' at Equinor in total.

The responsibilities of a data lead are described in detailed documentation.

They have ultimate responsibility for data and are the key contact person for questions about data. They also need a good understanding of the data in their own domain.

Data steward

Another role is the 'data steward'. This is a working role, and there are many more data stewards than data leads in the company. They need to understand the framework for how data is used in the enterprise architecture.

They are responsible for implementing enterprise data governance and defining local governance if that is needed. They need to ensure data complies with any rules and manage the risks of having incorrect data.

They monitor and aim to continually improve data quality and manage data related competence and training in their department. They also co-ordinate data management, although would normally have data management staff who do the data management work.

This person also manages a portfolio of 'data products', which are then made available to other parts of the company.

A data steward can be a key contact point with business people and may be a subject matter expert. This person can have a role in translating the business needs to data requirements.

"This is a lot of tasks and a big responsibility. It will be impossible to do this alone. You need to work together with data professionals in different roles," she said.

Other job roles

Other job roles within the 'data profession' include data lead, data manager, data steward, information manager, data architect, data engineer, data analyst, data scientist, she said.

A data manager can take responsibility for certain types of data, or responsibility for 'master' or reference data, or ensuring data is in compliance with regulations.

The information manager's role is managing documents and records, and the software solutions for that.

A data architect defines the structure of how to store data and needs really good knowledge of the data the company needs to use.

Competency development

The company may also need a framework for competency development, defining what all employees working with data should be able to do, and what 'expert' knowledge looks like. This can be different for different roles, For example the 'expert' level for a data steward is different to the expert level for an information manager.

People may pursue multiple development paths at the same time, for example building competence in multiple disciplines. There is no single path forward.

Can we avoid big data downloading?

One ideal for data management is that data is never downloaded. If it is going to be analysed, the analysis algorithms run on the data while stored in its original place. Can this work?

It would make life a lot easier for data managers, and others, if large data files never needed to be moved. Whatever analysis needs to be done on them, can be done on the files wherever they are.

To illustrate how this might work, imagine if you wanted to train an algorithm to spot cancers on images, using thousands of labelled images for training. The images are owned by hospitals around the world, and there are privacy implications, so they do not want the data to be moved. So instead, perhaps your algorithm could run on the images where they currently are.

This way of working means less data downloading, no worries about data storage, and no concerns about security of storing any second version of private data.

A team of data managers discussed the plausibility of this during the Society for Professional Data Managers conference in November.

A discussion panel of oil and gas data managers. Top row: Daniel Brown, Head of Data & Digital, Offshore Energies UK; Jesse Lord, lead for product strategy, Kadme. Bottom row: Jane Hodson, senior licensing manager, North Sea Transition Authority; Ying Guo, business developer and senior advisor at NORCE (screenshot from webinar)

Ying Guo, NORCE

Ying Guo, business developer and senior advisor at NORCE, the second largest research institute in Norway, said that she had explored many of these issues working with Norway's National Data Repository DISKOS, where she started her career.

One challenge is the large number of new data formats being developed all the time.

Data generated by new technologies are often not managed under the industry's 'data management environment'. "They are more complicated and more specific," she said.

"There are lot of new solutions, which will again require new input data," she said.

For example, some companies are putting different data sets together in new ways to give it context.

The industry has evolved from using tape and disk to today's Petabytes of data often stored on cloud servers. "It's very different and very complicated," she said.

"Multiple data sources have popped up. That poses a lot of challenge for data management and data access."

With the DISKOS system, users can select data and download it to their desktop, and perhaps store it in their own project database. This may be considered by some to be an old way of working, she said.

20 years ago, "we thought it was fantastic, it was awarded 'most innovative project' at the time."

But now we see that the average data set has been stored 10-20 times in different places. Best practise today says that there should be a distinction between an 'authority' data set, with a single version made available, and 'processed data' which is in company data stores, themselves often also on cloud data, she said.

Ying Guo's project team is experimenting with DISKOS data, to see if it can make the 'don't download' approach work. After that, it will try the same approach with proprietary data from companies.

"Our mission is to avoid copying data," she said. "The first rule is, 'don't download'. We want to make tools that go to data, digest the data and we get the knowledge back."

For the cancer images example, it would need the right technology, data access contracts, and standards for the quality of images, in order to work, she said.

There is no long term requirement for the company training its algorithm to store the data. "What you need is the trained model for your cancer treatment. You don't need raw data," she said.

Daniel Brown, Head of Data & Digital, Offshore Energies UK, noted that one reason companies might want to download is to make sure they will always have it in future, rather than be reliant on the data provider to continue providing it, via the same API.

"As you build up a digital environment with more and more of these APIs, the likelihood something breaks somewhere seems to increase, the fragility of the system goes up," he said.

Another point is that cloud providers often charge per the amount of data downloaded, so if a company wants to use the same data repeatedly, it might find it cheaper to have a local version.

Jesse Lord, lead for product strategy with oil and gas data management company Kadme noted that in some cases data is required to be available by law.

That means it must actually be available. If it is not possible to download the data, then the company hosting the data must make it possible for people to do what they need while the data is stored on their servers, he said.

Easier data integration

For such a system to run, there would need to be integration between the software running the algorithm, and the server hosting the data. Such integrations have been very hard in the past, and this was a big obstacle. But integration is getting easier.

20 years ago, the fashion was to use "SOAP" (Simple Object Access Protocol) web services for integration. "They were phenomenally complicated and hard to use," said Mr Brown.

"Today everything is much more straightforward, more standard, more consistent."

Mr Lord noted that there has been a big shift

from monolithic software to microservices over the past few years, which has also made integrations easier.

A great deal of standards development has been done to make that work, he said. "In order to pull off a 'planet scale' microservices architecture, it requires standards."

Mr Lord mentioned the travel website booking.com as an example of how different services can come together. You can login to your account with Google, Facebook or Apple IDs. You can see travel options on Google Maps, and it uses different payment services. There are also integrations with other travel services.

"That technology really is only possible if everybody agrees on a standard for sharing data, such as an API," he said.

A lot of work has gone into developing these standards, but companies have supported the work because they see it as an essential part of survival, he said.

Today, it is common to use REST (Representational state transfer) APIs, where the communication is between a 'representation' of a system, not the system itself directly. This makes the API easier to manage, because the system can change but leave its 'representation' intact. REST APIs do not need any continuous integration, or any direct response to any request.

Mr Lord explains REST APIs with the analogy of a restaurant front and back of house. The order is taken from the front of the house to the back, and the food is cooked. There does not need to be any continuous integration between the two, it is a call-and-respond type model.

Another example is website delivery systems, where you order something using a digital device, and the order is sent to a company which delivers it to your home. You do not need any continuous connection to the delivery company.

The various systems can be updated every time a record changes, or specific 'events' happen.

There is a lower digital communication overhead, which makes it easier for people to see actual real time data. "That [is] real progress," he said.

We need patience with OSDU – Simon Kendall

It takes a long time to develop oil and gas digital standards, observes Simon Kendall, CEO of Interica. We need patience with OSDU – and recognise that other standards will continue to be used until it reaches maturity

Simon Kendall, Interica (screenshot from webinar)

We need to recognise that it takes decades for petroleum standards to mature. "We should not expect OSDU to become mature over too short a period of time," said Simon Kendall, CEO of data management company Interica. Meanwhile, "PPDM and Energistics have an ongoing role."

He was speaking at the Society for Professional Data Managers November conference.

OSDU has a goal of making it easier to separate data from applications. That has been a goal for many in the industry for decades, it is a continuation of this work, he said.

The work to develop oil and gas data standards goes back to a project to develop a system for unique well identifiers, in 1929 in West Virginia, USA, he said. These unique well identifiers are still used in North America today.

We can also trace back the PPDM Association a long way, back to 1984, when Gulf Oil was bought by Chevron and there was frustration that Chevron could not read all of Gulf Oil's data in its existing software.

So, a group of companies started a project to make a standard data model which the industry would own, rather than data models being owned by individual software companies.

Energistics, another standards organisation, was 'effectively started' in October 1990 by oil companies BP, Chevron, Elf, Mobil, and Texaco, as the Petrotechnical Open Software Corporation (POSC). Its initial role was to try to connect the islands of software and data, he said. Its standards evolved over decades, and during this time they became more mature and more widely used.

Another long-established standard is LAS, originally started in 1992 by the Canadian Well Logging Society as a digital format for well logs.

Today, the attention is on OSDU, developing a 'reference architecture' for oil and gas data, mainly subsurface. We can expect OSDU to also take a long time to evolve, he said.

If you were to plot these standards on a technology 'hype curve,' Mr Kendall would place Energistics and PPDM standards as at the "plateau of productivity", with PPDM a little more mature than Energistics. whereas OSDU is just coming out of the "trough of disillusionment", he said.

OSDU

The core purpose of OSDU is to make it easier to separate data and applications, so that data can be kept apart, in a single place, well managed and trusted, and nobody controls it. Discussions leading to OSDU go back to 2018, with a genesis within Shell, he said.

Companies are contributing to the development of OSDU and joining the community, but we are not yet at the point where they are using it to make real life workflows.

One person has joked that there are more 'pilots' being conducted on with OSDU than a large airline has to fly its planes. It is time to move it into production, he said.

After a sort of grace period to allow the OSDU community and standards to develop, there is now more of a drive to implement "real life operational workflows based on OSDU and cloud working within companies," he said.

"The maturity of OSDU needs to increase in order to create those modern workflows in the cloud," he said.

The scope of OSDU is currently limited to geophysics, geology and wells, he said. But that PPDM data model has a much wider scope, additionally covering land rights and financial, facilities and HSE, production data, and geological samples, he said. "We're going to rely on PPDM to manage data for a period of time, maybe 3-5 years, probably a decade."

Do people know?

Mr Kendall was very surprised to read a question posted on LinkedIn by a manager of a national data repository, saying that they would like companies to report their core analysis data in a standardised format, and asking if anybody knew of a suitable widely adopted standard.

There was a response from a consultant, suggesting PPDM and OSDU standards, but also sharing a personal view that they were not 'vendor agnostic'.

This consultant was mistaken, Mr Kendall said. The Energistics and now OSDU RESQML standard can be used for core analysis data, is widely adopted, and vendor agnostic.

But the comment indicates a broader problem, that there is not enough awareness about the standards in the geoscience community, he said.

How far with OSDU

Another question is how much data companies should put into OSDU. Although it was originally planned as a repository for all subsurface data, "I have yet to talk to any company that is talking about a bulk migration into OSDU," he said.

"Nearly everyone I talk to is talking about subsets of data moving into OSDU, maybe starting with individual assets and workflows."

For example, it might move all the data for a certain field into OSDU. Or use OSDU for a certain task in the company, such as core analysis, developing its use for specific workflows and disciplines. But meanwhile, we will continue to see legacy standards being used, until new standards have been created and certified.

When companies look to migrate data to OSDU, there can be 5 phases, said. Discovery (of what data you have); analysis of it; working out how to integrate the systems to OSDU such as by loading it into a software tool with an open API such as Power BI; the actual migration; and archiving of data that isn't migrated.

Trusted vs quality

People commonly mix-up the terms 'trusted' and 'quality' when it comes to data, Mr Kendall said. They are not the same thing. One is perception, the other is a fact.

To illustrate the difference, consider that Norway's National Data Repository, DISKOS, once said that any log data included in the database would be deemed to be of high quality, whether or not it actually was.

There are times when people wrongly trust low quality data – or do not trust high quality data, he said.

Energistics and OSDU

Mr Kendall also raised questions of how well the development of formerly Energistics standards will be handled now they are within OSDU.

For example, Energistics' WITSML drilling data standard version 2.1 was published in May 2022. It is "the only standard that is designed around rig to shore transfer," he said.

But now Energistics is part of OSDU (since Jan 2022), there is no system in place for certifying it.

"How do we undertake this work in our new community-based world and who certifies these things?" he asked. "That is something which is going to be a challenge for our industry."

"Things like the true real time streaming of data will become more and more important."

There is also a risk the work gone into developing Energistics standards gets eroded, if OSDU is not able to "move quickly enough to pick up these standards and move things forward," he said.

Best ways to build organisational digital competence

The UK oil and gas regulator NSTA is working to help companies develop their digital skills. Patrick Rickles, Head of Digital Skills and Innovation at NSTA, explained what is happening.

UK oil and gas regulator the North Sea Transition Authority (NSTA) is developing tools to help oil and gas companies assess their digital 'maturity' and find ways to assess it.

A "digital roadmap" has been put together showing various things organizations could be doing in order to advance their digitalisation in the organisation., explained Patrick Rickles, Head of Digital Skills and Innovation at NSTA, speaking at the Society of Professional Data Managers conference.

Mr Rickles' role is to support the NSTA's own understanding of new tools and technologies, and then see how to better support people who want to use them. He has been with the organisation since 2020.

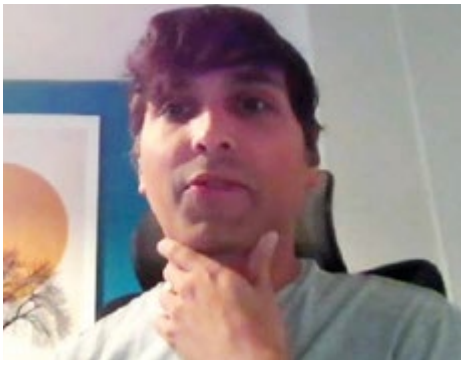
The work follows a digital capabilities assessment of UK Continental Shelf (UKCS) companies, done with researchers from RGU. Simon Burnett, Professor of Information Management at Robert Gordon University, Aberdeen, and Fionnuala Cousins, course leader for the Petroleum Data Management Graduate Certificate at RGU.

Organisations were classified as emerging, developing or enhancing in different categories.

Roughly speaking 'emerging' meant they were aware of the issues, 'developing' meant they were assigning digitalisation roles, and 'enhancing' meant they were making digitalisation KPIs to measure and help improve progress in various categories.

The tools development followed extensive research into the digital needs of oil and gas companies, and people's current skills and capabilities. This research was conducted during the COVID lockdown.

This work followed the UK Continental Shelf "Data Digital Maturity Survey", conducted by a group of industry associations and published in June 2020.



Patrick Rickles, Head of Digital Skills and Innovation at NSTA (screenshot from webinar)

NSTA's own scores

The NSTA allowed itself to be put through the same assessment of its digital maturity by RGU researchers, as was being made of oil and gas companies, he said.

It showed that NSTA was 'fairly mature' in its awareness of digital issues. This is illustrated by the fact that it has internal 'digital champions' and digital skill development projects.

NSTA has been running 30 minute "digital awareness" sessions on specific themes, including business process mapping and agile, he said. "Pretty much everybody in the company has attended a 'digital awareness' session."

Although It does not yet have any centralised 'digital academy', to centralise training on a number of new technologies such as Power BI, ArcGIS and 'agile', another recommendation made in the 'Roadmap'.

It is not yet doing KPIs of its digital implementations, to work out which of its implemented systems are actually being used. This would enable it to address the platforms which are not being used so much. Either to give people better support to help them use it, or to determine that they are clearly not helping people do their work and closing them down.

After its own technology maturity assessment, NSTA decided to try to find people in all of its work disciplines willing to take a role as a 'digital ambassador', helping embed digital technology in their team, sharing information, helping solve problems within their team, and connecting people with help elsewhere.

Ways to progress

The research work suggests that companies can build a foundation of 'enabling activities' to support digitalisation, including appointing technology enthusiasts as 'digital champions', and having skill development projects.

The report mapped out 'data' jobs, such as data scientist, pure data manager, data users, data engineers, data analysts. There are some jobs which are emerging, such as the data governance expert, and data lifecycle engineer.

NSTA looked into more depth at how companies were progressing in specific areas of people and culture, IT and technology, strategy, processes and organisational culture.

Under 'people and culture', some issues which emerged were the need to better communicate digital changes, and to simplify terms or explain language. "A big message given to us is that people just want someone to talk to," he said.

If someone in the company is struggling with digital technology, it is not a suitable response to send them a link to where they can find information about how to do what they are trying to do, as technology people will typically do, and not check whether or not it solved the problem. The person struggling is more likely to want to engage directly with someone who can help them.

Under 'IT and technology', we can observe that COVID-enforced home working made many people understand the need for better digitalisation, he said. But people could have been given better and more personal introductions to the tools and technologies being introduced, including an explanation of why they are helpful. "Make sure you've got a good comms plan," he said.

Under 'strategy', a digital strategy can be defined as aligning digital efforts with the priorities and strategy of the organisation.

Sometimes companies go too far with documentation requirements. "Many times, we want to document everything. It gives us excellent metadata. But if it takes a week to fill out a form for a small internal project, that can dissuade people from trying something."

Digital strategy should also include standardisation and consistency in data management. "Make sure [all data] is going in one place. Or you never know where people are storing the data," he said.

Under 'processes', it is important to get organisational support for what you are trying to do. It is useful if there is transparency about why the various decisions have been made, and if there is a means to change direction, if the people who use the digital technology feel that something isn't working.

Some personal recommendations

Mr Rickles had a range of personal recommendations for companies based on what he has seen.

There should be ways to ask for access to digital tools and training. Mr Rickles suggests you should be careful about steering staff to participate in Massive Open Online Courses (MOOCs) type training, because they may not be as useful as expected.

A MOOC may not do much to show staff why

the software is relevant to their specific industry, since it is designed for people from all industries, not just oil and gas. There may be a lecturer present who can for example answer questions in a chat, but unlikely to be able to engage one on one with people, including to understand their specific concerns.

If you have a smaller training group, even if it is not specifically for that industry, the trainer will have more time to explain to people what the data is about.

Companies may be better off writing their own training materials and delivering the training themselves, rather than going to an outside service provider, he said. Although not every company has the capacity and knowledge to do this and keep training materials up to date.

Mr Rickles recommends that you make a careful judgement about what course is most suitable for someone, taking into account their role and current level of technical understanding. For example, whether they need "Basic Power BI Training" or "Advanced Power BI Training."

Sometimes people have the biggest difficulties with technologies they use infrequently. It can be useful to provide one page 'aide memoires' showing the most important information about how to use them.

Making 'cheat sheets' to help people use digital tools quickly, such as showing keyboard shortcuts on Microsoft Word, can be helpful.

When promoting new technologies, you should emphasise what problem they solve, not just that they are better. If people are happy with what they have, they may not want to go through the effort of learning something better. "Even if you think that you're making a resounding case with this new tool [because] it is clearly better than the old tool, technologies carry emotions with them, people have been using things for some time," he said.

You should think hard about the digitalisation pathway, including what should be implemented right away, what needs more broad discussion in the company before implementing it, how you define 'good', what targets you set, and if your target is overly ambitious, he said.

Think about what people in the organisation really want to see, and what will provide the most benefit and impact.

If you are looking to appoint 'digital ambassadors', bear in mind that these people don't necessarily need to be good at digital technology, "it is more about being enthusiastic about digital tools, making sure we can effectively use them," he said.

Being a digital ambassador may take up a large chunk of someone's working time, so it is important to have their line manager's approval.

Engagement

An underlying idea here is to try to get people to want digital technology, rather than seeing them as something done to them.

"You need to engage with people on the tools and technologies they are meant to use," he says.

"If you foist it upon them, they might use it in anger [reluctantly]," he said. "But they are using it in anger."

"It's more sustainable to encourage people, to get them to want to use it. This will involve training, personal engagement. We in digital, data and IT need to do better."

Mr Rickles does not use the word 'users' to refer to colleagues who are using the digital technology in their world. "'Users' seems a bit detached and cold," he says. "We need to work better at being personal and kinder towards our colleagues."

Equinor's progress with OSDU

Equinor was one of the founding participants in oil and gas data 'reference architecture' project OSDU. Einar Landre shared the developments from Equinor's perspective

Equinor was one of the founding participants in OSDU, a project formerly known as 'Open Subsurface Data Universe', to develop a standard 'reference architecture' for data.

OSDU builds on Equinor's first data platform it established in 2016, calling it Omnia, hosted on Microsoft Azure. It started building a subsurface data lake environment, and found it involved a lot of custom work.

OSDU came into being in 2017 after Shell asked whether the companies could collaborate, since the work is extremely difficult and there is no competitive advantage in doing it by themselves.

Einar Landre, Lead analyst IT, Equinor (screenshot from webinar)

Equinor had its first operational version ready in 2021. "I think that, given COVID, was a major feat," said Einar Landre, Lead analyst IT at Equinor, speaking at the Society of Professional Data Managers conference in November 2022.

As of November 2022, OSDU has reached "some level of technical maturity," he said. But "there is a lot of stuff that needs hardening."

OSDU is not so much a new standard, but a way of making existing standards operational, he said. As a result, it aims to 'industrialise' data management, and also reduce the time needed for new software to get to market, he said.

There are now 220 members in the OSDU Forum, including energy operators, software and tech companies, service companies, research organisations and academia. OSDU Forum is managed by the Open Group.

In its approach to developing standards, OSDU aims to "implement as we walk, taking advantage of what's already in place."

So, a different approach to the conventional way of making standards, where people sit down, agree on what should be standardised, and then define it, he said.

Mr Landre sees the approach to selection of standards like farming, where you "plant many seeds, nurture the strongest, remove the less healthy ones."

It puts in place a "data platform philosophy," which says that business interoperability can be achieved through "standardised fit for purpose data."

"We think that 'fit for purpose' and 'standards' work in two dimensions," he said. There's the 'data pipe dimension', what data is needed to define an item such as a well bore, and what metadata should come with it. Then there is the 'artefact delivery' dimension, how you put that into production.

There are many drivers behind OSDU, but two Mr Landre thinks are particularly important. One is the need to get better information about how data came to be where it is (the 'broken lineage' problem). The other is the need to know where data came from (the 'lack of prov-

enance' problem). "Those are intertangled," he said.

OSDU does not get involved in defining software to work with the data on its platform. It defines an 'application' as something which you get when you have both data and software together.

Supporting oil and gas processes

The overall aim is to support oil and gas industry processes. Any oil and gas operating company has to deliver new wells onstream, to replenish its production.

"Today that process is filled with siloed applications. Each speaks its own language," he said. "We experience what we call 'broken lineage'".

"This comes with a lot of problems with error prone handovers, manual interventions, a lot of work done twice or more. There is no thread through the delivery process. OSDU provides the mechanics to deal with this."

We know the work processes, such as 'create the well plan', 'design the well', 'assess geological risk', 'revise and commit', 'execute and revise plan'.

The data footprint

If processes are conducted using the OSDU platform, you can easily see the different versions of plans or other data, and what has changed. "You have a data footprint with a history."

To illustrate the idea of a data footprint, consider all the data you could provide to give a 'footprint' to a typical holiday photograph, he said. Which holiday the photograph was taken on, is it an original or an edited image.

If you transform the data, such as to add in some synthetic data, you can still easily retrieve the original, because its location is part of the data footprint.

OSDU availability

OSDU is available as an open-source product, which can be downloaded and installed on your own servers.

It is also available ready installed on a cloud server, including from IBM, Google, AWS and Microsoft.

If you develop your own version of the platform, you can 'repack it' and deploy it somewhere else.

OSDU is exploring how it could be used in CCUS and wind, and other industries with scientific or real-world data sets.

Today's implementation

At Equinor, OSDU has been in 'soft' production mode on its Omnia cloud hosting system since the third quarter of 2022. "We use the word 'soft' because there's a lot of routines not fully operational," he said. "we need to keep backups elsewhere."

Its first 'production' project was for analytics of well log data on the Norwegian Continental Shelf. In one example, it did analytics from 32m well logs, and 1 million raw files. "To do the work manually would have taken hundreds of years."

It invited Halliburton, Schlumberger and Microsoft to show if it is possible to have interoperable seismic interpretation tools, using the platform. "We kicked off an interoperability sandbox, where we focus on end users' workflows and application support," he said. It will run from November 2022 to Feb 2023.

The interoperability test is run on Equinor's "Volve" data set (data from the Volve field), which is made publicly available. It has a separate version or 'instance' of Volve, so applications can change the data, but leaving the original unchanged.

There is a 'seismic track', with OSDU taking data from external data banks. It links IBM's "Seismic DDMS" suite for accessing seismic data, with Halliburton's OpenVDS seismic data format.

A number of new pilots are being planned for reservoir data. It is also testing out how OSDU can 'consume' geospatial data.

There are well and drilling-centric work groups. "This year we have done proof of concepts and pilots, a lot of use cases," he said.

"When we have something ready to go, we will put it into production as quickly as possible."

Automatic detection of information in an NDR

The Geological Survey of the Netherlands is developing AI tools to automatically classify information in the country's National Data Repository

If a technical research organisation wants to automatically classify its data, its researchers may prefer trying to develop their own algorithms, rather than purchase them.

This is what happened at the Netherlands Organisation for Applied Scientific Resea rch (TNO), which also runs the Dutch National Data Repository, acting as the Geological Survey of the Netherlands.

Since TNO is itself a research company, "there was already a big push to develop stuff like this ourselves," said Jurrien Dijk, Data Manager, Geological Survey of the Netherlands, speaking at the Society of Professional Data Managers conference in November.

Much of the data in the system is large unstructured data sets, with old, scanned documents, which normally need manual processing, he explained.

One of the goals behind the project is to be able to use old data in new ways. For example, there is some data about aquifers in these documents which could be used to plan CO2 storage projects, if people knew where the data was.

TNO developed a text and image classification system with machine learning. It will now use it as part of a data processing 'pipeline'.

In tests, it was found to work with 91 per cent precision, and it is optimising it further.

There were "extremely reliable" results for well detection (98 per cent precision) and "reliable" results in document type classification (89 per cent), both using optical character recognition (OCR).

The results from OCR were then analysed using natural language processing (NLP) and

Jurrien Dijk, Data Manager, Geological Survey of the Netherlands (screenshot from webinar)

stored in an elastic search database. Ultimately the data is made available via various web applications, and quality control is done.

The big questions are – what is an acceptable level of accuracy and precision in the results, which data points are most relevant, and where should human controls be included in the process.

Background

The background to the project was TNO receiving a large unstructured data set in 2012, from a Netherlands operator, Mr Dijk said.

It contained 5,000 folders and 500,000 documents. Many of the folders just had numbers, no title. The documents were pdf files, but some were handwritten, old, typed and in varying quality. In the past, the data would have been searched manually.

There were three options – TNO to go through the data set manually; TNO to find an external company to search through it manually or automatically; or TNO to develop its own machine learning 'tooling'.

TNO was keen on this last option, also thinking that perhaps this machine learning tooling could then be made available to other departments at TNO.

The systems

TNO experimented with building an Optical Character Recognition system using open-source software Python-tesseract (PyTesseract), a wrapper for Google's Tesseract-OCR Engine, but it turned out to be complex to manage and maintain.

Peter Faasse, data scientist, TNO (screenshot from webinar)

Instead, it decided to use Microsoft Azure's Computer Vision. "We found Azure had relatively good results and a low cost per page," said Peter Faasse, data scientist with TNO.

Document classification is very critical, he said. Some documents should be kept confidential, others released to the public. "It is very important that we don't automatically release a lot of documents that should be confidential."

A number of other tools were used. A "lemmatization" tool was used to remove 'stop words' - words we use in natural language but don't add any meaning to a computer, such as "the", "is" and "and".

There were tools to classify the language. This was typically Dutch or English, but there were some documents in other languages.

The researchers experimented with a number of different categorisation models and found that the Support Vector Machines (SVM) model linear classifier with Statistical Process Control (SPC) works best.

Altogether, 455320 documents (96.6 per cent) of them were processed. Of these, 5.5 per cent were considered 'trash' and 3.2 per cent considered 'irrelevant'. On 0.002 per cent, no text was detected (just images).

On 85.7 per cent of them it was possible to determine the main well.

The algorithm accuracy was initially thought to be 89 per cent. "We found out later the set on which we trained wasn't that representative," he said."

"We had to make decisions only for documents for which we have a high reliability in our prediction. For those where we can't achieve that high level, we put them aside for an improved model at a later stage".

One reason for the accuracy being quite low (89 per cent) is that data managers themselves do not always agree how to categorise documents. "If we gave 100 documents to data managers there would always be 10 per cent discrepancy in the categories they assign," he said.

An additional outcome of the work was that the documents became much more accessible. Before, the documents were available, but could only be accessed by someone who knew exactly what they were looking for.

Mr Faasse did a demonstration, where you search for a term like 'permeability' in 228 documents, and the results show you files either in plain text (scraped from the original handwritten document), or a link to the original document.

The search could be improved if there were ontologies of terms in the querying capabilities, he said.

TNO also ran a project to see if it could find specific objects, such as well scheme diagrams, stratigraphic columns and casing tables.

It did an experiment to see if specific data types could be identified, such as the aquifer porosity.

Developing it

TNO is still testing the system.

In future, the process will run on all documents added to the data repository every week and store all the results in the elastic search database, Mr Dijk said. Documents which are publicly released will be made available in this way.

A report of the process will be generated every week, so a data manager can check the algorithm did a proper job.

It would be good if there are ways that users can provide feedback, on whether they found what they are looking for, he said.

Writing geoscience SQL queries without knowing SQL

Writing complex database queries is quite a skill – better if they can be written in natural language. A project in Oslo is finding ways to make it easier for geoscientists

If it was possible for geoscientists to write their queries in natural language, they could get the data they want more easily, and so have better interpretations as a result.

A project run by the "SIRIUS" Centre for Research based Innovation (SFI) at the University of Oslo is looking at ways to make it easier. Adnan Latif, centre executive manager, explained further.

SIRIUS is a consortium of oil and gas operators and suppliers, including one operator, Equinor; service companies Schlumberger, Aibel, Aker Solutions, Robert Bosch GmbH, DNV GL and TechnipFMC; and IT companies Computas, Dolphin Interconnect Solutions, Evry, IBM, Kadme, Numascale, OSISoft and SAP. It is hosted at the University of Oslo. The web page is sirius-labs.no. Everything it produces is open source.

Mr Latif is an interpretation geoscientist who has been working in oil and gas for around 10 years.

The problem

Domain experts typically want an overview of all available data related to what they are looking at. But the data is spread over many different data sources and software applications. So they need to search through them all to find it, Mr Latif explained.

For example, a geoscientist might want information about permeability and porosity to train a machine learning model. Or they might want certain data and files about all the wells in a certain formation.

For a non geoscience example, consider how easy sites like Amazon have made it for us to search huge databases for commonly purchased items like trainers, but by searching for terms which make sense to us as a

Adnan Satif, Digitalization, Data Science, Innovation Lead and Centre Executive Manager at SIRIUS (screenshot from webinar)

buyer, such as by shoe size, colour, purpose of the shoe.

Unless there are tools to bring the search into the real (or 'domain') world, the search can only be done directly onto the database. Writing a database query is complex and needs database skills.

The geoscience world has multiple databases, and different queries need to be written for different data sources, searching for specific geological and petrophysical attributes.

The normal way geoscientists do it is by trying to explain the geological terms to a data specialist. This person then tries to extract the information from multiple data sources, while not being able to understand the geological and petrophysical attributes themselves. Then maybe the geoscientist will find that the database expert has been looking for the wrong thing. It can be a full week of work for one query.

There are also many data sources, so it is hard to be sure that something is not being missed out. There may be different people responsible for different areas of data.

It is common that the searches are just not done, Mr Latif said.

One idea is that the data sets themselves can be integrated, so you have a data set which only needs to be searched once. But this is also very difficult work, often tedious manual work that only a domain expert can do.

The solution

The solution, which SIRIUS is developing, is to build better tools for the 'subsurface data wrangling', which captures the special knowledge of data managers.

The process is known as setting up 'domain ontologies' – basically connecting the digital and domain worlds by creating a new language which both can understand.

Ontology-based Data Management technology can enable geoscientists to put together complex queries without worrying about the underlying database architecture, writing in G+G language rather than SQL.

Mr Latif presented an example of an ontology based query, which could be converted to a database query using the tool. "Find all wells with cores overlapping with the Hugin formation, with core permeability > 1 mD and porosity > 10 per cent. Wells where the Hugin formation is hydrocarbon bearing. Return Well ID, porosity, permeability and final well report."

A first project to try to do this was Project Optique, a Eur 14m project which finished in 2016 (see optique-project.eu). It aimed to create a formal vocabulary for the domain, called an 'ontology', describing geological concepts and how they relate to each other, and how they relate to what is in the database.

This enables a query written in domain language to be 'translated' into SQL. Then it can be rewritten if necessary.

It showed that geoscience knowledge could be captured in a knowledge graph, and then mapped to data in databases. So, complex queries over multiple sources, including within software tools and national data repositories, could be executed.

The work was run on the Volve dataset, around 40,000 files from Equinor's "Volve" field from 2008 to 2016 which were publicly released.

Some of the shortcomings of the project were that it was limited to relational databases, with no access to unstructured data; there was no built-in support; and there was no support for maintaining the mappings. Also it needed users with some understanding of semantic technology, Mr Latif said.

The follow up project, taking place now, aims to improve in some of these areas.

AI based subsurface image classification

Kadme has develop a tool to make images classifiable using AI, and then searchable, so that oil and gas companies can do a search of all the images in their electronic documents

We are used to using Google Images to search for photos. Many oil and gas companies would like to be able to search images in their own document store in the same way.

Oil and gas knowledge management company Kadme, based in Stavanger, Norway, has been building tools to do this, based on an algorithm to classify images. It can be a way to quickly search through unstructured data.

"We wanted to build a system that worked like Google Images, but instead of websites, it would have all our messy documents as the source," said Jesse Lord, Lead, Product Strategy at Kadme, speaking at the Society of Professional Data Managers conference.

The results of the search shows images in an interface similar to Google Images. By clicking on them, you can retrieve the source document.

To do this, the system needs to know which page on the document that image has come from, so it can take the user to the right page. The system does this by first splitting up each document into separate documents, one for each page.

The system has been in development for 18 months, and released earlier in 2022, as part of its search system Lumen (previously known as WhereOil).

Since the trend is ever more unstructured data, systems like this should have increasing value, he says.

System structure

The development of the system starts by running existing detection and classification algorithms over the documents. For this, Lumen uses tools provided by Amazon Web Services.

The search system uses elastic search. You can type in a phrase, type in the type or 'class' of image you are looking for, and then search. A text search can look for the specific text, in the same document.

The system also needs to verify whether the user has permissions to see the specific document.

The documents are stored on a Lumen server, which is accessed via REST APIs.

Image classification

Technologies to classify images are quite mature, including for oil and gas images. For example, it can classify images as a seismic image, seismic images with wells, geosections, and seismic inversions, Mr Lord says.

From a technical perspective, the challenge is to set up an automated pipeline for classifying the images.

Kadme's system, Lumen, is designed for 'speed at scale', capable of searching through systems of over 12 petabytes.

Companies can also train their own model, rather than use Kadme's pre-trained model. "As few as 100 pictures can produce a 'class'

which is useful," he says.

It does not use 'cloud AI' services from the cloud service providers, which can be quite expensive.

It would be less than a month for an operator to get up and running, allowing for things to go wrong, he says. If the information is all ready to index, it could be done in a week. It may take longer if the documents are on different systems, or if they want to deploy different systems in different regions.

The work involves connecting to the source data, downloading documents, and converting documents into pictures.

The AI model is "almost the least impressive thing," he says.

It is essential to have a system for users to provide feedback on whether they found what they were looking for, so the system can improve. "Whatever model you build - if you don't connect it to feedback, eventually it will become irrelevant," he said.

Examples

As an example, consider that you are trying to search for "thin sections of ferroan dolomite" (dolomite which has an iron content) in the company's database.

Other examples could be someone looking for an image containing the term 'dunlin' but not 'missed pay'. Someone might want to look at geo-section type images, or a geosection of 'Namurian' (a stratigraphic layer found in Northwest Europe from 326 million years ago).

You might be looking for authigenic quartz (minerals formed, in place, within sediments and sedimentary rocks)

The system will look for documents containing the text you are looking for, and the sort of image you are looking for.

Working with fibre optic sensor data

Oil and gas companies are increasingly using fibre optics to gather data, such as acoustic, pressure and temperature. But it all needs to be managed. Jess Kozman explained how companies are doing it

Fibre optic sensing data, known as 'distributed sensing' data, is being used more and more in the oil and gas industry. But it is leading to challenges managing the data.

"It is starting to contribute large [data] volumes from quite a lot of different applications and domains," said Jess Kozman, Senior Principal Consultant, Katalyst Data Management. He is based in Perth, Australia, and was speaking at the Society of Professional Data Managers conference in November.

Distributed fibre optic sensing was first used in the 1960s for vibration measurements, then we saw fibre optic gyroscopes in the 1980s, he said.

The basic technology is about sending light pulses down an optical cable.

The individual irregularities and faults in the cable back scatter the light back in a characteristic way. The back scattering is affected by various physical factors acting on the cable, such as pressure, temperature, vibration and acoustics.

So it is possible to build a model of how different areas of the cable are affected by different physical characteristics, and then determine for example the pressure at a point 300m down a 1km cable.

Jess Kozman, Senior Principal Consultant, Katalyst Data Management

This data can then be used for production optimisation, monitoring fracturing,monitoring wax build up and intelligent completions. It has been used in coal steam gas operations, monitoring for methane hydrates, and detecting leaks in casing in active wells, he said

The fibre optics are used for continuous seismic monitoring, replacing geophones in a well, and providing data which is much denser and higher resolution, and can provide continuous monitoring.

With CO2 injection into underground storage, it is necessary to monitor what happens to the field. Fields have traditionally been monitored using 4D seismic.

Some regulatory regimes in Southeast Asia are now mandating that CO2 sequestration operators are doing either 4D seismic monitoring or 3D vertical seismic profile monitoring, as well as monitoring from in the well.

CO2 operators are interested in using permanent fibre optics because it is much cheaper over the long run than deploying geophones periodically, Mr Kozman estimates $30m over the 30-year life of a field.

Other uses

Fibre optics are also being used to monitor pipelines for security risks and leaks, he said.

Companies are using fibre optics in the mining sector, including many oil and gas companies now moving into mining. They can use fibre optics to monitor for vibration and monitor if the mining operations are affecting the rock mass around mining tunnels, and monitoring pipelines.

Fibre optics can be buried along an embankment holding in mining tailings (left over materials). It can monitor for leaks, which could be detected by sound or vibration.

Fibre optics are also being used in geothermal wells, where they can measure the temperature gradient in the well and how it is changing over time. It may not be possible to use the alternative, wireline tools, because temperatures are too high and wells highly deviated.

Fibre optics are also being used on wind turbines to monitor heat, on solar panels to monitor temperature on different cells, and in the nuclear industry to monitor temperature of the core.

In oil and gas decommissioning, it is being used to monitor the cutting tool.

For greenhouse gas emissions data, fibre optics can be used to monitor for methane leaks from pipelines or drops in temperature.

Data

A single well with a fibre optic cable can generate 10 TB per day, and it may need to be monitoring for decades, perhaps longer. "People are starting to think about the impact of this kind of fibre optic data on their data storage," he said.

To reduce data volumes, many companies are using 'edge processing', where they just store data that is changing, not all of the data gathered by the system. For example, if you are monitoring for a casing leak, you only need to communicate data which indicates a leak.

Most of the systems which collect sensor type data can deliver it in the PRODML standard for production data. This can support time series data (how something changes in time). Also the distance along the cable the measurement was taken, which can be cross referenced to the position in the bore hole, or along a pipeline. It also has useful mandatory metadata fields.

"From a data manager's point of view, it is a very familiar format," he said.

This data can be used to develop digital twins and virtual reality systems.

3D seismic data can be provided in the familiar SEG-Y format, where each trace has a time and date stamp. The 3D picture is built up using 'offset' data, recorded using a seismic source in different locations.

Shell's CFIHOS digital models of Ormen Lange / Nyhamna

Shell has all of the data for its Ormen Lange field and Nyhamna gas processing plant in Norway in an integrated digital system. Having the data stored in the CFIHOS data model made it much easier. Endre Nisja explained

All the data for Shell's Ormen Lange field and Nyhamna gas processing plant has been in the CFIHOS data model since operations began in 2007. This makes it much easier to bring the data into an integrated system.

Endre Nisja, information management lead at Shell in Norway, explained how the digital system works, speaking at the Society for Professional Data Managers (SPDM) conference in November.

Over the past 5 years, since 2017, it has been building a system for integrating and sharing all of the available data. The platform was developed and delivered by Kongsberg Digital and has been in use since January 2020.

With data already in a structured data model, the work to set up the software only took 2 months, connecting different data sources, he said. There was no need to do work cleaning up data and implementing data structures, because this was already done.

Although the data integration and system has been under continuous development since 2007. "It has improved continuously, in terms of applying data to operate the facility smarter," he said.

The digital system could be considered a "dynamic digital twin", with all the available data about the field and the plant readily available. It covers the whole process from reservoir to market.

Shell's data about the facility was previously stored in many different software applications, files and documents. "Historically its been a challenge to find information, re-use and trust the information," he said.

Ormen Lange is Norway's second largest gas field, providing enough gas to supply 20 per cent of the UK's needs. The field has been in production since 2007. It is 120 km offshore. "This is an important facility for Shell, for Norway, for Europe," he said.

The Nyhamna facility is used to process gas from the field, for export to the UK. It is connected to the UK through the Langeled subsea pipeline, the world's second longest subsea export pipeline.

CFIHOS

The CFIHOS (Capital Facilities Information Hand Over Specification) data model was originally developed by Shell for its own facilities, and is now provided as a global standard. "It allows a structured way to store and maintain asset data," he said.

Under CFIHOS, all equipment in a facility has a unique 'tag' number. Data is stored in 'documents' referencing the tag numbers. These are the main 'data carriers' in the system, he said.

All the data is available via cloud servers.

Data can come from 3D models, drawings, telemetry (sensor data) or anything else. There can be real time data, transaction data and engineering / design data.

It can include subsurface data, well data, subsea equipment data, seabed data, onshore data.

By using tag numbers and documents, it is possible to find information about any specific piece of equipment, regardless of how its data is stored.

Visualisation and modelling

"We allow visualisation of data, making it much easier for the human mind to understand the data and see how data relates to each other," he said.

With the visualisations, you can easily show if any data starts drifting outside the range it has been within in the past, or the expected values, and so someone can make a decision about what to do. "This is a different way of thinking around data," he said.

Then it is possible to do data modelling and analysis on multiple data sources. "That's where the true value sits," he says.

This can include production optimisation, energy optimisation, surveillance, performance monitoring, and root cause analysis.

In maintenance, it is possible to get easy access to technical information, and do a 'virtual site visit'. You can also use the data for predictive maintenance.

In operations, the data can be used for work permit planning, turnaround (major maintenance work) planning, and also for isolating different areas of the plant for work, even tracking the required torque on bolts.

For a subsea asset, you can see the reservoir data and well paths. You could get data to monitor sea level subsidence. You can see a 3D model of the seabed equipment.

Endre Nisja, information management lead at Shell in Norway

You can do different views of the equipment, for example just seeing the process equipment, not the 'structures' which hold it.

If you select any object you can access data related to it, such as 2D drawings or photos. These can be very helpful when doing inspections with ROVs.

You can see ROV inspection videos of a piece of equipment, by clicking on the equipment, and also see the physical location of the ROV recording the video.

"P+ID drawings are very much used, but don't show distance and dimensions," he said. "That's what you get from the 3D model. You can see a pipe is several hundred metres long."

For physical buildings, the system can be used to understand piping systems, such as for heating, cooling, fire protection and process. By selecting a pipe, you can see the process system that pipe is part of .

It is possible to use the virtual model to take measurements, for example to see what size a certain new component needs to be.

"In the past we had people going to site to plan work, take measurements and find access routes," he said. "This work can now be done from the office."

On one site, there is a project to replace underground cables, because they were found to be not as durable as expected. The digital model can be used to see the cable routes, cable lengths, and starting points.

What is most valuable about the system is the ability to combine data, such as 3D models with data from databases, he said.

One system is used for making decisions about crew work permits. You can see all of the work permit requests submitted. There are colour codes to show which work has particular hazards, because it is being done at height, or because it involves hydrocarbons. "It is quick for the team to assess the work," he said.

Norway's research on sustainably utilising the subsurface

Norway has set up a "National Centre for Sustainable Use of the Norwegian Continental Shelf" looking at ways to maximise use of energy from the shelf while achieving zero carbon goals

Norway has established a National Centre for Sustainable Use of the Norwegian Continental Shelf, to look at how Norway's subsurface can help reach Norway's goal of reducing emission from offshore operations by 55 per cent by 2030, explained Ying Guo, Senior Advisor and Business developer, CCUS and IOR with NORCE (Norwegian Research Centre).

The centre, also called NCS2030, runs in collaboration with the University of Stavanger (UiS), NORCE and the University of Bergen (UiB). It is hosted at the University of Stavanger.

The centre has strictly time limited funding from 2022 to 2029, so 8 full years. The budget is 300MNOK ($30m) for 8 years. This money will be spent on staff members and PhD / masters students. It follows another 8 year project, running from 2013 to 2021, as the "National IOR [Improved Oil Recovery] Centre of Norway".

Areas of study include CO2 sequestration, temporary hydrogen storage in the subsurface, and using geothermal heat.

It is also researching ways to reduce CO2 emissions from oil and gas activities. Offshore oil and gas operations account for a quarter of Norway's total greenhouse gas emissions, she said.

Of these emissions, 85 per cent come from running turbines (generators); the rest is from well tests, rotational equipment, and "a little flaring".

"We aim to find solutions that maximize the value creation from the energy resources of the Norwegian subsurface reservoir, while still achieving the zero-emission goals," she said.

For example, it is looking at ways to reduce the need for water injection and water production, so less pumping operations are needed, without reducing oil production.

There will be increased use of renewably sourced electricity to power oil and gas production, but there will still be a large amount of production not powered by electricity in 2030, she said.

Oil production is expected to gradually decrease over the coming years, but unless the energy inputs into production also decrease, it will mean the carbon intensity is increasing, she said.

Outside petroleum, "offshore wind hopefully will be a big business," she said. "Marine minerals probably will be an industry coming, of course its controversial."

Subsurface hydrogen storage has been studied and tried. Salt caverns have been shown to be "tight" enough for the small hydrogen molecules, she said.

Digital

One of the themes of the research is "how we can use digital tools to facilitate the subsurface value chain".

On the digital side, the work will require quality data and modelling tools for evaluating the subsurface, she said.

CO2 storage

An important areas where it needs subsurface data and models are for offshore CO2 storage. It needs data to be acquired and managed to build subsurface models. Data is also needed for water management.

A vision is that there could be a 'knowledge cloud' interacting with a number of data repositories, such as a database of CO2 storage sites.

One question is how CO2 sequestration could balance out oil and gas production, and how this would be accounted for, including if the CO2 sequestration is provided as a commercial service.

When Norway starts accepting CO2 deliveries from other countries to store, this storage will not count against Norway's or Equinor's carbon balance sheet.

However, Equinor could be storing emissions from the use of its own gas, if it collects CO2 from the same industrial customers that it sells to, such as a power station in Germany, she said.

If the use of its own gas counts as part of Equinor's "Scope 3" emissions, then it would make sense if the sequestration of CO2 resulting from this gas would count negatively against Equinor's Scope 3 emissions.

How to have corporate governance with low code

Martin Fischer, senior product manager, Neptune Software, shared some advice on how to go about developing corporate apps with low code, so that it works with the rest of your company

Low Code / No Code tools, known as LCNC, theoretically make it possible for people with no programming skills to develop software applications. The reality may be not quite like that, but it is getting there.

Martin Fischer, senior product manager with Neptune Software, a company based in Oslo, shared some advice on how to do it. He was speaking at a company webinar, "How SAP IT can establish real governance with no-code/low-code."

Mr Fischer is a proponent of the idea of the 'fusion team', a term introduced by research company Gartner, meaning a team with both business and operations staff, perhaps security, the software users, and IT people in it. The 'fusion team' can define the app in its early stage of development.

"We include business people into the development process, as the people who know the business best, and [who can] clarify all the requirements and questions we might have," he says.

This can be a way to get the best results, not only with business requirements, but also with governance and compliance, he says, since you have people who understand these things involved in software development.

The fusion team should also include IT people. It is not true that low code software can be developed and implemented without IT people, he said. In particular, they understand about data structures, and whether the new software will fit with the rest of the organisation's digital systems.

Development process

The development process which Neptune recommends is to start with your fusion team creating a first 'mock-up' or prototype of the software. This can include designing the user interface, the navigation through different screens, and working out the data sources. This prototype can be shared with others and feedback gathered.

Neptune's no-code system "Neptune App Builder" can be used for this.

"We at Neptune think our platform is made to follow and support the 'fusion' concept, where we include the business user in the early development process, especially with design thinking," he said.

Then the development can be handed over to SAP and Javascript developers to actually build. Neptune offers the "Neptune DXP Rapid App Development" software for this.

You develop the actual user experience, data integration, connectivity and security. At this stage you can ensure all the governance / regulatory requirements are met, do all the testing, and start deployment.

This second stage could be termed "low code / pro code", with a mixture of low code tools and professional coding.

Governance

Governance is important in low code projects. If your company works in a regulated industry, then your enterprise software will need to make sure your company is compliant with the regulations.

It follows that the software should be under the watch of the company IT department, not a "shadow IT" project.

You will need a structured process to determine who is able to develop software and who makes decisions about what gets deployed to corporate systems, and ensure they have the necessary competence, including in software testing.

You will need some kind of framework to manage people's roles and authorisations. You will need logging, to keep track of what is going on with the system.

Integrations

When choosing a low code no code platform, an important consideration is how well it will integrate with all of your other systems. If it doesn't, it could be very expensive to do the integration. ""That is definitely something which needs to be in place from the beginning of your low code no code journey. A LCNC platform should not be the special snowflake," he said.

It will help if the platform can use tools which you already have, such as for people to create support 'tickets', rather than coming with its own tooling. This will make it easier for your IT department to manage.

Martin Fischer, senior product manager, Neptune Software

Some low code platform companies have been focussing mainly on developing the platform itself, and not paid so much attention to the tooling around it, "which is kind of surrounding the core of the platform," he said.

It is useful if there is a way to monitor the API connections with other systems. APIs can bring in security risks; they can also draw a lot of system resources, if one software system is making too many 'calls' to another, due to a programming fault.

It should be able to work with widely used standards. It should also be easy for your IT department to run. "That helps to get more acceptance within your IT department," he said. "If they need to upskill themselves just for that one platform, they will not be happy about that."

How to have a successful CMMS deployment

Stephane Planeix, who has been involved in deploying computerised maintenance management systems with SeaDrill and WesternGeco among other roles, shares advice about the best way to go about it.

By Stephane Planeix, digitalisation and supply chain management consultant

A maintenance plan should be created for all equipment, based on the manufacturers recommendation and the technical teams' capabilities.

Measurement processes should be created and attached to relevant work orders.

Certificates of conformity should be collected by equipment type, and stored in the computerised maintenance management system (CMMS), to qualify all works carried out and the equipment status.

Stephane Planeix, digitalisation and supply chain management consultant

A conditional maintenance plan based on measurement will improve the return on investment of the system. It will enable you to closely monitor information about the equipment performance (KPIs). The definition of degraded running modes should be in accordance with the equipment manufacturers to avoid the loss of warranty.

Inventory of equipment

Your chosen CMMS solution should have an updated inventory of all equipment in production, including all spare equipment in all storage areas.

An extensive inventory will avoid having non-functional equipment outside any maintenance plan.

CMMS systems should offer a 3D virtual navigation of all equipment for all the productions sites.

Navigation by family of equipment allows the QHSE department to focus on the deployment of safety procedures by category of equipment, and collect inspection reports and certificates of conformity required by law.

You can attach service agreements to families of equipment, including QHSE indicators, Productivity indicators (MTTF and MTTR) and the list of relevant spare parts to be qualified based on criticality and minimum quantity required based on their lead time and life cycle.

Stock and spare part management

Asset management activity will require the purchase and storage of parts and raw material allowing a smooth process moving forward.

Discrepancy of data about the spare parts in stock should be managed, at it may stop on-going operations.

Criteria such as quantity and status of the stored spare parts should be monitored as both criteria matter for the qualification of existing stocks.

Qualified spare parts and equipment should be linked to a maintenance plan and a service agreement.

Services contract definition and outsourcing

For each service provider or equipment manufacturer predefined rules for the provision of goods and services shall be defined.

Making a service agreement with service companies will allow you to define the role and responsibilities of the parties involved, set scope of work, express the minimum qualification expected for the technician involved and define the services delivery time.

Defining an agreement for the provision of goods will allow to define the role and responsibilities of the vendors, set the minimum quantity expected and schedules for delivery, define the specifications and quality expected.

Any agreement for the provision of goods and services shall include KPIs helping to monitor the performance of the goods and services purchased.

All parts and equipment should be attached to a vendor. The minimum quantity should be predefined based on criticality and the delivery time.

All processes involving offshore operations should describe how to execute the scheduled operations, due to the complexity to work offshore and the qualifications required by service technicans.

Data reliability management

Once the CMMS is in place and the information provided by all third parties involved for all equipment and work orders carried out, the system should have relevant data to work with.

Discrepancy of data is usually due to spare parts removed from stocks without being attached to any work order, or work orders not closed out after the work is carried out.

A built-in reporting solution can show information such as equipment status, MTBF, MTTR, spare part consumption, lead time on spares and services, resources required by equipment to carry out the maintenance operations.

Well known reporting solutions are Crystal reports for SAP, Watson analytics, Oracle analytics or Ms Azure analytics are alternative BI solutions allowing decision management based on data reporting.

QHSE Management

Each work order shall include information about the process to follow, protection equipment which are mandatory to carry out the work defined.

The company QHSE department should be involved to define and monitor the actions defined in the work orders.

Each measurement required to meet up the quality criteria pre-defined in the WO should be expressed clearly as a goal. For example, max pressure, torque, temperature.

All work permits should be managed in the CMMS to secure the workplace.

Any evacuation or emergency procedures can be defined as recommendation in case of identified risks and accident.

Offshore operations

When operating offshore, the drilling platforms and vessels are not always accessible.

To carry out the work, services technicians will need helicopter transportation from the shore and will be subject to safety offshore training.

Spare parts and equipment required will have to be imported into the location of work and be transported at sea by supply vessel.

The work order may only be closed out once the technical team is back on shore as connectivity is not always available offshore.

Periodic checks need to be run to make sure all work orders are closed out by the third parties involved.

Connection with sub-contractors

It can be useful to make it easy for customers to share their needs and technical requirements with sub-contractors. This concept embraces the idea of 'production on request', waste reduction and just in time deliveries based on pre-defined production schedules.

It is also possible to use predefined products design and maintenance plans from manufacturers.

Stephane Planeix was involved in the deployment of CMMSE for Seadrill and WesternGeco, among other projects and worked on the development of the product named Carl Pro.