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Cover image: Nabors' RZR system for retrofitting a land rig to be fully automated. Image shows a robot arm for picking up a new length of drillpipe. **See page 8 for more**

How to get better at Data Operations

Data Operations, or 'DataOps' is what companies need to get good at, if they are to become 'digital companies'. A webinar with Forrester and Cognite reviewed what that means for heavy industry companies

"Data operations" or DataOps is a term for practises for managing data in pipelines, rather than static or periodic data, such as in reports or files.

Most data is originally created as a continuous stream, such as from continuous sales or emissions. But we have got used to treating it in batches, such as for annual emissions data, annual revenue data, or subsurface survey data, because that makes it much easier.

But if we are going to do more with data, such as helping people get a better situation awareness of where they are right now, and what to prioritise, then it will help if we are looking at data in pipelines of continuous flow, rather than waiting for the next interim report.

The data infrastructure needed to handle data as pipelines is more complicated and evolved, and demands more data standardisation. But once we have a data pipeline system, it is comparatively easy to build new valuable solutions, such as tools to inform our situation awareness and decision making.

A challenge is that it is hard for a company to justify the expense and effort of turning their existing data management systems, which we could consider 'static', into pipeline-based systems. That is, until we reach the point where we can provide exciting digital solutions. Then the value is obvious.

A webinar organised by data operations technology company Cognite, with a speaker from Forrester, explored the topic.

What maturity looks like

Michele Goetz, Principal analyst with Forrester, sees 3 levels of maturity with a company's data operations, which she terms 'walk, run and fly'.

The highest 'fly' level looks like your idea of a 'digital business', she said. For example, farms where the tractors are all autonomous, engineering work which is designed and tested using simulations. People with tools to help them continually prioritise work and refine schedules.

Many companies state something like this as their desired digital destination, such as

Michele Goetz, Principal analyst with Forrester

saying that they want to take certain data sources and build machine learning models and deploy them, she said. "It's not all that easy. We have to think about how we go about this."

One example of a company with good 'data operations' she provided was an oil refinery which has managed to organise or 'tune' its production to the expected arrivals of tankers to collect product orders. This can lead to savings over the conventional method of organisation at a refinery, where the refinery makes different product and then keeps it in storage until the designated vessel arrives to collect it.

With good data operations, it is easier to bring in machine learning tools to simulate different scenarios and use cases and work out the most likely best berthing schedule, she said.

The data operations combines data streams from the refinery process, with data streams about expected future vessel arrival times.

Normally, scheduling the berth for ship arrivals is an extremely manual process, based on making estimates when different ships were due to arrive based on their current location.

Walk and run levels

The most basic maturity level for data operations, which Ms Goetz defines as 'walk', is similar to the processes most companies have now, with enterprise data management systems. Data is often handled manually and brought together to give useful views to decision makers, she said.

The data sets themselves are often large and

messy, so cannot be organised by machine - only manually.

It can be tricky to get investment to do more with it, because it isn't obvious what the direct benefits of this would be. "You are hunting for a use case," she said.

The next level, which Ms Goetz calls 'run', builds on the 'walk' level. It brings in more of a data engineering type approach.

You have people with data competency working in different areas of the company, improving the data flows, and building tools people want.

You might invest in data quality tools, and data 'virtualisation' systems which make it easy to search and retrieve data from multiple systems at once. You may also have cloud data pipelines, where data is sent to cloud servers, and data preparation tools.

But there are still challenges in identifying, sourcing, and understanding the data, and challenges getting executive support for projects, and not much centralised data management, she said.

The fly level

The 'fly' level, building on the 'run' level, is when you can get to 'solution engineering', the ability to develop tools with specific outcomes.

Data operations has more of a 'federated' structure, with data engineering staff working within different company divisions also co-ordinating back with the centralised enterprise data management.

This way they might find ways to re-use data assets and systems within the company.

It should be management culture to rely on data-driven decision making, and trust that the data is correct. There should be improved collaboration and co-ordination with different data and analytic processes.

The company supports the data related skills of its employees, such as for advanced analytics / data science, and AI. There is co-ordination and collaboration between data related roles, such as data science, cybersecurity and IT.

The company is able to contextualise data, bringing different data sources together.

Technology products

It is unlikely that you can purchase a single 'data operations platform' to do all this, because every company's data streams are different, you can't just purchase a 'data operations platform', she said.

You will probably need a number of different tools, and a focus on "data product portfolio management" to manage these tools, "or everything becomes chaos."

"You need to manage the pipelines, synchronising the different processes, continuously deploy new capabilities."

You will probably also see company 'business users' getting involved in choosing and configuring tools, and perhaps making models, rather than leaving all this to the IT department, she said. "The literacy of subject matter experts to work with the data is going to increase."

Cognite perspective

"Working with data is very hard, it has a unique set of challenges," said Knut Vidvei, lead product manager with Cognite. "There are specific complexities which come in the industrial space, asset heavy industries particularly."

Knut Vidvei, lead product manager with Cognite (Screenshots from webinar)

Cognite is a Norwegian company which describes its core product, Cognite Data Fusion, as "The Industrial DataOps Platform". Mr Vidvei works as a product manager on Cognite Data Fusion, developing better ways to make data available to subject matter experts and data scientists in a company, and building solutions to do it.

Typical projects can involve large volumes of data, very specific types of data, and challenges of matching data from the IT and OT side, such as sensor data, images and 3D data, he said.

And while the data is complex, the tools and practises to get value out of it need to be simple, user friendly, and 'understand the industry's language', he said.

"Finding data, having trust in the data, understanding it in context, is really time consuming."

The goal is "easy access to all IT, OT, engineering, visual data, available to you in a simple way in context," he said.

"We want to empower everyone, specifically people with domain knowledge, to rapidly build and scale solutions."

It should also be possible to re-use these solutions, rather than building a new one every time, he said.

Data Operations processes can enable machine learning processes, Mr Midvei said. You can have large volumes of data in a standardised format, which is ready for analytics, such as to look for patterns.

Classes of data

A starting point is to identify the different classes of data, which all need different techniques. Mr Vidvei segments data found in an oil and gas company into engineering, operational, visual and conventional.

In this categorisation, engineering data includes documents and piping / instrumentation diagrams. Operational data includes time series sensor data, simulations, and documents. Visual data includes 3D models, laser (LIDAR) scans and video. Conventional IT data includes work orders, tabular documents (spreadsheets), equipment data, and ERP data.

Domain experts

Company domain experts are very important in helping you work with this. Mr Vidvei defines a domain expert as "a person with expertise in the field, typically an engineer or specialist." Examples are engineers specialising in maintenance, production, mechanical / reliability, process / chemical, petroleum, and performance. Also plant managers, asset managers, asset operators and data analysts. "These people are all over your company," he said.

"They are not transitioning to become 'data professionals' but using data as part of day-to-day work."

"Most of them don't code or prefer not to code to solve day to day problems. So, we need 'out of the box' tools which work, with no code."

Any software tools "should be simple and speak your language," he said.

It would be useful if ready built models were available for specific tasks. "You can just launch them and start the job," he said.

For example, Cognite produces packaged but customisable models for production optimisation, smart maintenance, 'digital worker' and sustainability.

Watch the webinar online here

https://www.cognite.com/en/webinar/unpacking-the-technology-behind-the-practice

Low code – are we there yet?

Low code shows great promise – but many who tried it have been disappointed, said Martin Fischer of Neptune Software, which makes low code tools to make apps for SAP. It may be better seen as a step in a long evolution

"Low code no code" (LCNC) technology promises to make it possible for software business users to write their own apps, to do exactly what they want. It promises to enable software developers to make apps much faster.

This is very appealing for companies, who see that it is hard to recruit skilled developers to build the apps they want. There is a recognition that the need companies have for developers could be greater than the education system could ever produce, said Martin Fischer, senior product manager at Neptune Software GmbH, a company which makes low code tools to work with SAP.

Martin Fischer, senior product manager at Neptune Software GmbH

Yet, "There are not that many developers out there who embrace LCNC platforms," he said.

Mr Fischer is himself a software developer, who has worked with SAP products for 20 years, 15 of which as an architect.

One reason is technology marketing over-promising, saying it will enable customers to "produce software with no effort," he said.

"We heard that for years, it never became true. In the end the developers were the ones who had to clean up afterwards."

One developer likened people's enthusiasm for low code to their enthusiasm for puppies, saying, "everyone likes puppies, but no-one wants to clean up after the puppy."

The idea of low code software is not a new one. Before the term was used, systems promising the same thing were called "Rapid Application Development platforms," he said. This goes back to the 1980s.

It was common for customers to reach a dead end when they tried to use these platforms, where they found it was not possible to make apps which did what they wanted, or they would not run, or they would not connect to other systems in the enterprise environment.

At that point, the only way forward was for a developer to edit the code which the system generated. But this meant that the model in the low code platform could never be changed further, because the code the system generated would not contain the handwritten edits. So it is a 'dead end'.

"We saw all those problems over the years," he said. "Software developers are fed up with that kind of platform."

Software language development

Meanwhile, there has been a steady evolution in programming languages which add more abstraction, and create the machine code from this abstracted language. This can be seen as similar to the way low code platforms generate code from models, since abstraction and making models amount to the same thing.

"Nobody would nowadays start software development with an assembler [machine code] he said. It would be "time consuming, cumbersome, complicated. The level of abstraction is that low you need to do everything from scratch."

The original Rapid Application Development platforms asked people to describe business processes in a specific language, and the platform could develop the software application from that.

One of the languages was Unified Modelling language (UML), first seen in 1994-95. Version 2.0 of UML was released in 2005.

"It became that complicated with version 2.0 that it was easier to write software than creating all the diagrams to model with UML," he said. "That was a shortcoming of the UML language and also, in the end, of the modelling tools."

"If you want to generate software out of a modelling language, that modelling needs to be very complete and very detailed. That's the point where that approach never worked in real life," he said.

"I don't want to say it doesn't make sense to model things. Models are adding a level of abstraction to something. It can be very useful. If you are working together with your business department, it's easier to work with a model, both have the same understanding. In theory, I think, that can work."

Business process modelling

Some companies do Business Process Modelling (BPM), with the purpose of better understanding and improving business processes, not to help make software.

"I think that's closer to the business than UML," he says.

"But it is also not easy for business users to model processes. The people who have that end to end knowledge and modelling skills are very rare."

"I think it is not efficient in the end, or very time consuming, to create BPM models that are complete [enough] to generate software out of them."

Development frameworks

We also have "development frameworks", as an evolution in tools to make it easier to make software. These manage the 'boilerplate' code which is used multiple times within the software, so that it does not have to be written more than once. "You don't need to create, for example, a master user interface again and again."

These could be seen as an evolution of programming languages with a high level of abstraction, he said.

Software frameworks make it "easy to deliver a kind of template or ready to use building block, not waste time with getting that no brainer part of the solution done."

Software frameworks also bring in structure to the process of making code in a team, rather than letting all the developers develop code in their own way. It means that coding gets more efficient, and it is easier to understand the code that other people make.

Integrating with other systems

A low code platform should not be a "special snowflake" in your enterprise landscape, he said. It needs to connect with the other systems.

"Low code platforms are not living on an island in the enterprise. It is rarely the case that this tool will be able to fulfil the whole process," he said.

But the broader availability of APIs, and their

increasing simplicity of use, makes it more likely a low code platform will be able to integrate, he said.

"We have a great evolution within the API space. For example, it is very common today for systems to have a REST interface, he said. "It makes things much easier."

"15-20 years ago we didn't have as many APIs as we have nowadays. There were so many proprietary protocols between different software systems and vendors, it was not possible to get the integration you need."

Where there were APIs in the past, they often used SOAP (Simple Object Access Protocol) technology. "There was so much overhead compared to REST (Representational State Transfer) nowadays."

It makes it much easier if the low code platform can use tools and standards which are used by the other software platforms you are using, such as sign-on / authorisation tools, and code repositories, he said. And they need to be able to support more than one different system.

In today's software landscape, data comes from multiple software systems and the user does not need to know.

Enterprise software today also needs to support SOAP APIs, because there can be many older software systems still in use, he said.

Developers would like to be able to integrate services by other cloud providers, such as on MS Azure, Amazon and Google, into their low code environment.

"Leverage stuff which is already there, probably already used within your IT department," he said.

It is also easier for users if you can have the same user interface for different systems. If different pages can all access the same JavaScript libraries through the framework, it makes it easier to have the same colours, theming, and the same kind of design language.

What low code must do

Today's low code platforms need to do everything which is needed in business IT systems, including security, handling trade restrictions, ERP functionality.

Regulators are not bothered about what platform you use, but they want to see you comply with the rules.

If a low code platform is not able to do what a developer wants, then it is no longer the platform of choice, he said.

Low code platforms need to follow a modern software architecture, with modular, composable micro services. If they become a single monolith of software, it would take much more skill to manage than any citizen developer would have.

The low code platform should also be able to connect with a business user's idea of what the software should do. "I think its very important to have a seamless integration and handover to no code," he said. "Letting the business user start with a sketch of a map or a process."

Working with developers

It is still unlikely that low code will enable apps to be built without any software developers, he said. Building software in low code still requires the ability to model software and build data structures, something which most people are not used to thinking through. "I don't see that citizen developers will develop the majority of apps we are using in the enterprise," he said.

"I see the advantage with low code platforms is that we [developers] can guide them a bit more. We can offer toolboxes as IT departments to business users. We can make fusion teams out of that, working closer together with the business."

We can also let citizen developers start the building process, or make small apps themselves, he said. "We shouldn't be afraid of the marketing buzz around the citizen developer."

The IT staff should have an involvement in the decision about which low code platform a company chooses, because they will need to integrate whatever is built into the enterprise apps landscape.

"There are parts of the whole software development process which can be done by the business users, sketching apps, modelling a process. They know the process better. They have a modelling tool which is not that complicated.

"Make it a fusion development, don't put the developers too far away from the business," he said.

Neptune and SAP

Mr Fischer's company, Neptune Software, produces the "DXP Platform" for low code and no code. It has a version of the system designed for making apps to work with SAP software, generating code in SAP's programming language Advanced Business Application Programming (ABAP). It can also make use of ABAP knowledge which the IT staff may have.

You can make tools and functions on the front end, including analytics, user interfaces and charts, Mr Fischer said.

Many companies using SAP are keen to write custom apps for their staff who do specific things. It means that data can be entered or retrieved without having to navigate the full software. For example, people who need to see a list of maintenance tasks they need to do today, or enter data about spare parts in stores being utilised.

To watch this video as a webinar, see **https://youtu.be/IB9PE5OGwsU**

Combining data standards with flexibility

When your data comes in as many different formats as with Wood Mackenzie, trying to be completely standardised is too ambitious. It may be better to make decisions on what you do and don't standardise

Wood Mackenzie provides data, analytics and insights to customers in the natural resources industries, including for corporate valuations and markets. Its traditional focus has been oil and gas, but it is expanding into the products and chemicals, renewables, metals and mining sectors. So it deals with many different types of data.

It provides its clients with a product called a 'lens', a data analytics platform with all the content in one place.

The data would ideally be presented in a consistent format in this platform, so clients can make analysis and comparison, without having to do any further 'data wrangling'. So all the data behind it should ideally be in a standardised format.

The data itself is gathered from many different sources, both purchased and freely available data. "We have thousands of places we are bringing data in from," said Robyn Robertshaw, data director with Wood Mackenzie, speaking at a PPDM event in London.

This data includes raster image scans of maps, structured data in files, and data feeds from a sensor, she said.

It has also made a number of acquisitions of companies who work with data in different sectors, including specialist chemicals and power modelling. All these companies have

their own data stores and naming conventions.

The data is also handled in different ways within the company, with different teams working on it, creating different data products.

Developing standards gets very complex and takes a long time, even if it is only a standard for one organisation.

"When you've got lots of competing views, when you are trying to meet every different use case, you need so many people to be involved, it feels like wading through, so many meetings," she said.

Greatest impact

So Wood Mackenzie took the approach of trying to look for what standardisation would have the greatest impact, for the company and its clients, she said.

The company decided to keep its master data minimal. "Things like IDs, names, perhaps status, location," she said. "We need to focus on things that are common across the enterprise."

For example, Wood Mackenzie has a master data entity "assets" of the physical assets a certain company is involved in.

"I think there's a tendency to try to cram everything into the master data."

Alongside it, people involved in certain industry sectors can define what they consider master data within that domain. "A refinery will have very different attributes to a wind farm," she said. "You can't have a data model exactly the same for those things."

Where possible, international standards such as UN standard codes for countries are used.

There are ways to use 'hooks' to connect the company master data with other master data codes, such as stock exchange company IDs.

Wood Mackenzie is looking to increase the amount of metadata it captures, including of the background / source of the data, and enter that as early as possible. This could be partly done with automated systems.

"It gives you that context and real understanding of what the data is," she said.

Metadata is particularly important for forecasts. "We have different teams with different perspectives who can produce a different forecast based on a different methodology," she said. "They are all valid."

"If we just present that, there's no context why the prices are different. Ambiguity can lead to thinking there's an error or not knowing which one to use. If we lack the metadata we are providing an ambiguity problem."

"Data management and data governance probably should and always will be a journey," she concluded. "A perfect standard in theory is wonderful, but we will never see the value of it."

Working with complex subsurface data

Complex subsurface data, such as laboratory data, well core data, and regional studies data can be hard to aggregate and assimilate. James Tomlinson of IKON Science explained how the company does it

Complex subsurface data, such as laboratory analysis data, well core data, and regional analysis data, can be hard to bring together and manage.

IKON Science, a UK company probably best known for its rock physics software, explained how it does it, with a talk at the PPDM mini workshop in London on Oct 20.

IKON Science was originally a specialist in modelling tools for rock physics and seismic conversion. It became involved in subsurface data management following its acquisition of subsurface data management company Perigon Solutions in 2018, said James Tomlinson, VP data solutions with IKON Science.

Better managed data is much easier to work with – it takes less time to find, and does not need further manipulation to integrate together. This should ultimately lead to better decision making from the data.

Many companies talk about digital transformation, meaning making all your products and services digital. This is "not something that will magic all your problems away," he said. Some solutions presented under the banner of digital transformation are like "one small cog in one large [business] machine", he said.

It is a continual challenge for data managers to build a business case for their work, he said. A flexible approach can be very valuable, making progress with small steps and building on them.

One client was a laboratory which wanted to get better utilisation from its data over the long term. It wanted to bring all of its data together into a single data platform so it could be made available for the future.

To build this platform, IKON created processes and tools for getting data into the system. It built an automated data quality control process, tools for managing data security, and tools for integrating data together, he said.

Spreadsheets providing results of laboratory testing can be directly ingested, in the same way that many pieces of survey data, such as directional surveys and well headers, are ingested into specialist databases, he said.

A second client was an operator who wanted to do more with its well core data, with new digital workflows.

Ultimately the client wanted to be able to use the data to make predictions about other areas of the subsurface, or use the data to calibrate its reservoir models.

The data needed to be in a consistent format, if it could be used for data science or machine learning. Ikon Science was able to build the database.

The first part of the work was aggregating the data, including photographs of cores, and calculating 'colour attributes' of each image.

There was a lot of work to be done to get data to the point where it can be accessible – and there is no fixed boundary between data management and interpretation, he said.

Ultimately it would be useful to turn unstructured data into structured data, for example identifying that the well core shows it has come from a turbidite system, and putting that in the database.

A third case study was Ikon's own projects, providing regional studies, to its clients, and looking to see if they could be more useful.

"From our point of view, we don't really know the value that clients are getting out of them," he said.

The studies could be used as a basis for various geoscience workflows. For example, a geoscientist might take well data such as logs and core information, do a petrophysical interpretation, and take that to understand rock properties and their volumes, including saturation of oil.

Geoscientists ultimately want to understand how the seismic properties would be different if the rock properties were different, so you can make models to calibrate seismic data with rock properties.

Experiences moving to OSDU

While there is a lot of activity around OSDU at the moment, it does not mean companies with OSDU will stop using any data model. Simon Kendall of Interica presented his experiences

OSDU "has been central over the last 3 years of my life," said Simon Kendall, CEO of oil and gas data management and consultancy company Interica.

It tends to be larger companies which are most committed to OSDU, he said speaking at the PPDM mini workshop in London on Oct 20.

Shifting to a new standard takes time. When looking at oil and gas industry standards, it can be quite surprising how long some standards have been around and how long it took them to develop, he said. "OSDU started in 2019, maybe 2018, as a genesis of an idea."

"Migrating has a series of challenges in itself, we're not going to get there overnight."

Through his work at OSDU, "we can see there is a long way to go in defining those data models and the sub components," he said.

"And these subcomponents in general are not enough. If you're a petrophysicist you want to see pore analysis. If you're a geophysicist you might want to get gravity and magnetic data."

PPDM

Meanwhile, other data models, such as the one developed by PPDM, still have an essential role to play, he said.

"We can deploy the PPDM model, deliver applications and develop data to people," he said. "It is a mature data model with many applications built around it."

"But it has to fit into a migration pathway to OSDU."

Oil and gas technical specialists, such as core analysts, are not necessarily aware that these data models are available and need to be applied, he said.

And you don't need to use the entire PPDM data model, you can use subcomponents.

One oil and gas company said that they were committed to getting to OSDU, but needed help getting there.

They use a number of different geoscience applications, which they load data into, or get outcomes from.

Interica developed a solution for them totally based on the PPDM data base, although still with a migration pathway to OSDU, he said.

"It gives us model richness to allow us to gather that data together ready for the migration."

PPDM was founded in Canada in 1984. Chevron had purchased Gulf Oil in 1985, and learned that it wasn't easy to transfer technology to Gulf Oil Canada.

One first step was to promote the use of a LAS (Log ASCII standard) file format for well logs, so data could be transferred.

Everything in OSDU?

There are many different data types in geoscience, which all need to be supported by OSDU if it is going to be used universally for data storage.

There are also large data sets generated from seismic, he said. Equinor has said it generates 26 Pb data a year from operations, and this could be 2,500 Pb a year by 2030. There are increasing numbers of multi azimuth and wide azimuth surveys. Single surveys become very large data sets.

Companies want to keep the raw data and intermediate data, as well as the processed data.

When people are thinking of moving their working data 'environment' into OSDU, they have to consider how much of it they are going to migrate across, and it probably wont' be all of it, he said. "Only some portions of the data are a critical thing to have."

Then there's the question of what to do with the data you don't move.

"If I don't do something to preserve and protect that data, it could be lost. [Technology] generational change is happening in our industry very quickly ."

Another factor is that some geoscientists prefer to use software for certain tasks which may not be compatible with OSDU. It may be that the software should be integrated into the OSDU compatible software with APIs, he said.

"We're on a journey with OSDU, but the journey has quite a long way to run. The outcome has significant impact, let's be honest."

Energistics standards

Mr Kendall raised concerns that the Energistics standards, such as PRODML and WITSML, may not be so actively maintained, now that they are managed by the Open Group.

"I see little evidence that the standards are going to move forward, or being widely thought about."

"We could be looking at a time where you have large amounts of work, knowledge, getting forgotten."

Mr Kendall says he has seen signs some industry professionals are not as aware as they should be about the standards. "As an industry of technical data managers, we have a long way to go of educating those in the operational side of the business as to what we can do," he said.

"If something isn't being used and adopted it dies behind a natural mechanism."

PPDM reorganisation

PPDM has re-organised around data community, resources and professional development

The Professional Petroleum Data Management Association (PPDM) has re-organised around data community, resources and professional development, explained Andy Moore, PPDM Leadership Chair, Europe, and a former IS manager knowledge and data with Santos in Australia.

The 'data community' pillar manages events and publications; the 'resources' pillar develops tools such as standards and best practise guidance; and the 'professional development' pillar develops professional data qualifications.

PPDM promotes a number of standards, including for reference values, and for common language such as for wells and facilities.

Mr Moore was speaking at the PPDM mini workshop in London on Oct 20.

PPDM is seeking to raise its presence in other industries, he said, rather than being specifically about upstream oil and gas.

PPDM is working closely with OSDU, and there is a web page describing the collaboration (Google 'PPDM OSDU collaboration').

For professional development, PPDM is providing online training modules, with topics such as managing data about well depths and elevations, and a specific definition for a 'well' and a 'completion'. The courses are put together by the Professional Development Committee.

Technology developments

Land rig automation retrofit, 400 wireless sensors on a rig, 3D printing subsea, underwater seismic surveys

Nabors' RZR system for retrofitting robotics to a land drilling rig

Oil and gas drilling technology company Nabors reports that it has "fully automated" the rig floor of an existing land rig.

The land rig was retrofitted with its "Canrig Red Zone Robotics" (RZR) rig floor module.

As a result of the automation, it can improve safety and consistency, the company says.

The cost of installing the RZR system is a "fraction" of the cost of a newbuild automated rig, so a much cheaper way of getting an automated rig for companies which want one and already have a conventional rig.

The rig, "X29", has been used by ExxonMobil to drill multiple horizontal wells in the Permian Basin.

The automation covers the 'red zone' on the drilling rig, the rotary table (which rotates the drill pipe) and the pipe racking area (where new pipe lengths are screwed in). This is a particularly hazardous area to work, leading to a desire for automated pipe handling systems and further integration of robots.

The International Association of Drilling Contractors (IADC) has calculated that 64 per cent of lost time injuries in drilling in the US lower 48 in 2021 involved the catwalk (a platform where drilling tools are put together), the pipe rack, rig floor or derrick. With RZR, nobody needs to be in these areas.

RZR is electric powered, so has precision control. It can enable offline stand building. It can handle casing in upper, intermediate and production sizes.

Nabors has its own rig operating system called SmartROS which can be used to drive the automation system. This can be installed on existing rigs.

Nabors and ExxonMobil have already worked together with a rig which was originally built fully automated, called R801. It drilled nine wells with R801 with zero recordable incidents and well times approaching Nabors' best West Texas fleet averages, Nabors says.

"R801 proved fully automated land drilling is possible," says Anthony Petrello, Chairman, President and CEO of Nabors. "Now RZR has demonstrated those same levels of automation can be scaled across existing assets."

"This rig floor automation module is a game changer for the drilling industry as it seeks to increase safety and achieve true factory drilling."

"We are excited to integrate RZR on our high-spec rigs over time and offer the system to any drilling contractor."

"Retrofitted automation capabilities, like the RZR Rig Floor offers, are an efficient way to support safer operations, increased drilling performance and meaningful opportunities to upskill our workforce," said Jesse Chando, Permian Basin Drilling Manager at ExxonMobil. "We look forward to continuing to collaborate with Nabors on advancing innovative drilling-automation capabilities,"

The Disruptive Technologies wireless sensor inside an electrical box on a rig

Drilling rig fits wireless sensors

400 wireless sensors have been installed on semi submersible drilling rig COSL Innovator, based in Bergen. They measure and transmit temperature and humidity data.

The rig is owned by COSL Drilling Europe, which is owned by Shanghai listed China Oilfield Services Limited.

The systems were installed by Disruptive Technologies of Lysaker, Norway. The company claims to produce the world's smallest wireless sensors. It has over 100,000 sensors installed globally, mainly on buildings.

Humidity sensors are used because humidity leads to corrosion. If you can be sure that humidity is not too high, there may be no need

Wireless sensors on a drilling rig - What a manual inspection involves. and the wireless sensor avoids

The 3D printing technology under development

to manually inspect anything for corrosion.

In the first phase of the project, humidity sensors were installed in the junction boxes and floodlights that were physically the hardest to reach.

COSL expects to install many more sensors.

Temperature sensors are used because variation in temperature can be a strong indicator of something going wrong with equipment, the company says. So it is a form of remote monitoring of electrical components.

Otherwise, electrical components need to be manually inspected by expert electricians, to check for any possible explosion risk. This is known as an 'ex-inspection'.

Manual inspections involve opening a box containing the electrical components. This introduces another risk – that the box is not sealed properly when it is closed, and so allows water to enter and increase corrosion risk.

The data from the sensors is collected and transmitted every 15 minutes to Disruptive Technology's Cloud Connectors (gateways). These upload it to cloud servers.

COSL uses software from a Norwegian company called Inspection for all its inspection management. This integrates the sensor data into its reports and sends out notifications.

One of COSL's goals in installing the system was to find ways to reduce the number of people required onboard from 52 to 44, which was achieved by reducing the need for manual inspections.

"It is a revolutionary technology, as the footprint of the sensor is so small, and the battery life is long. This makes it very attractive to us," says Torfinn Kalstø, ICT and OT Manager at COSL Drilling Europe.

Disruptive Technologies also works in partnership with a company called Ex-Tech Group, which creates sensors which monitor any possible ignition sources.

The wireless devices can be also used to detect corrosion of pipes which are encased in insulation. The task is otherwise done by dismantling pipes and inspecting them manually.

3D printing in the ocean

Could it be possible to 3D print metal subsea equipment components actually in the ocean, and do repairs?

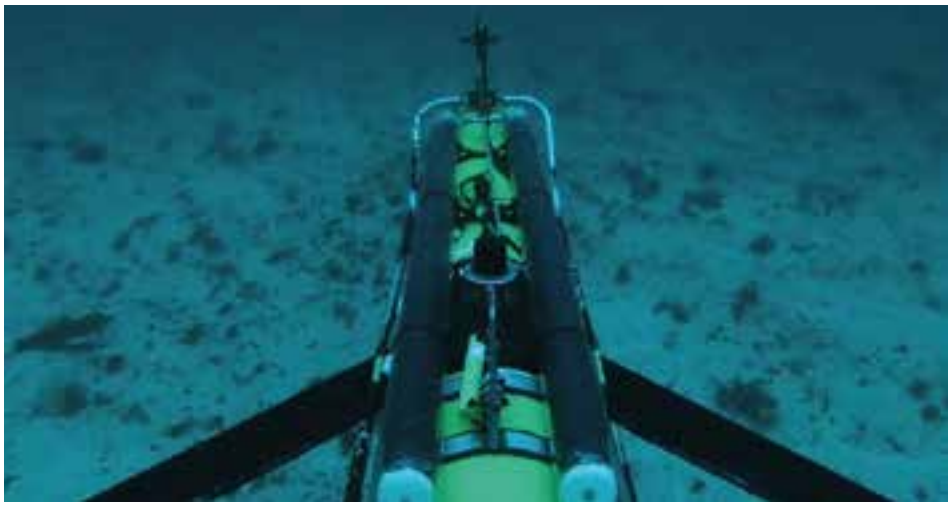
Kongsberg Ferrotech, Equinor, Gassco and SINTEF have had a joint industry project running since 2021 to try out the idea, and now Shell has joined.

This project, named SAMLE, is supported by the Research Council of Norway through its "PETROMAKS 2" program.

The technology could be used to repair cracks and dents and replace lost materials.

In the repair process, a 'dry environment' is created around the area being repaired, by the robots.

It could be much less expensive than closing down production, lifting the material to a surface facility for repair. It should mean that lifetime of individual pieces of equipment is longer, and less replacement is needed.



The Blue Ocean Seismic Services seismic survey AUV

At present, the project team is qualifying the technology for cracks and dents.

The technology is planned to be integrated into Inspection, Repair and Maintenance (IMR) robots operated by Kongsberg Ferrotech.

"When we discovered this joint industry project, we realized that the repair methods have many applications within Shell's global operations," says Angeline Goh, 3D Printing Technology Manager, Shell. "The technology fits nicely into our portfolio of advanced technology for subsea robotics and 3D printing."

"We're excited to welcome Shell to the team and consider their decision as an important recognition of the potential represented by our technology," says Torgeir Bræin, CTO at Kongsberg Ferrotech.

Underwater seismic surveys

Blue Ocean Seismic Services of the UK and Australia reports that it has completed a round of sea trials for seismic data collection from underwater.

The company is developing a fleet of autonomous underwater vehicles for seismic surveys, which it believes is the world first.

It plans "pre-commercial" trials in the second half of 2023, leading to commercial operations in 2024. It anticipates that the technology will help reduce the cost and increase the speed of seismic data collection, as a better alternative to capturing seismic data using streamer cables or ocean bottom cables and nodes.

The company is backed by BP Ventures, Woodside Energy and Blue Ocean Monitoring.

Testing has taken place in Plymouth (UK), the North Sea and Australia, looking at the vehicle command and control systems, its underwater 'flight' performance, and seismic data acquisition.

The company now plans to assemble 'up to' 250 of its version 1 nodes in batches. It also plans to open an office in Houston in early 2023.

The company has appointed Dr Fabio Mancini as chief geophysicist. He was formerly chief geophysicist with Woodside Energy, and before that spent 5 years at TotalEnergies in R+D and operations, and led seismic activities for Hess in the Eastern hemisphere.

Wall-climbing robots to inspect tanks and pipelines

Gecko Robotics of Pittsburgh has developed a range of wall climbing robots which can do ultrasonic inspections of the inside of tanks, piping and boilers

Gecko Robotics of Pittsburgh, Pennsylvania, US has developed a range of wall climbing robots which can do ultrasonic inspections of the inside of tanks, piping and boilers.

The robots can capture much more data, and at greater resolution, than human inspectors, and also avoid the need for people to enter dangerous areas, and work at height.

It has a 3 year collaboration agreement with Siemens Energy's European Field Service organization to offer ultrasonic robotic inspections across Europe.

The contract covers the oil and gas industry, and also pulp and paper, conventional and renewable power generation.

In support of the collaboration, Siemens Energy has established a new Product Competence Center in Rotterdam, Netherlands, with expansion plans underway. Gecko has also opened an office in Rotterdam.

The robots

The robots move using wheels, and have magnets to stick to the steel. They are equipped with ultrasonic sensors for measuring steel thickness, pitting, cracks, corrosion, and other forms of degradation. They also have HD cameras to capture visual images, and localization sensors so they know where they are.

The TOKA Flex robot can climb to a height of 23 metres at a speed of 9 metres a minute. It can climb piping at diameters of above 61cm, and operate in temperatures up to 135 degrees C. For sensors it has between 12 and 18 single element transducers.

The TOKA 3 robot is designed for higher temperature surfaces, and has 8 sensors.

The TOKA 4 GZ is designed for large flat surfaces, such as on rectangular tanks.

The device positioning is typically done with 'encoders' which track the positioning of the robot as it moves.

Ryan Herman, Managing Director, Europe, Gecko Robotics

The positioning is precise enough for the same point in the tank to be inspected multiple times with a long gap between, to see degradation trends.

"If you do a manual inspection there's a zero percent chance someone can touch the same point," says Ryan Herman, Managing Director, Europe, Gecko Robotics.

The robots have been designed with a modular / platform type architecture, so it is possible to put on different sensors.

The technology could be adapted for other tests of tank walls, such as to test if a cargo tank has been effectively cleaned of the previous cargo and is ready for the next one. Although "we haven't done anything like that yet," he says.

Gecko is unique in the inspection robots market in that its robots have been developed from the start to serve industry, while other robots in the market were originally developed through academic research, he says.

Data processing

The data collected is stored on the robot itself, and downloaded later.

The data processing can pair ultrasonic data with a photograph of the same area of the tank. It can make a map of corrosion, or show how thickness is changing over a period of time.

The data can be used to make a report within 24 hours, so inspectors can make decisions about maintenance or repairs.

Gecko works with the customer to understand what sort of damage mechanisms may be present, and how to detect them from the data.

"Engineering firms love having our data," he says. "It makes it much easier for them to do 'fitness for service' analysis."

Commercial challenges

The biggest sales argument for the robots is that they make inspection much easier and safer than doing manual inspections. A typical robot inspection crew is 2 people and 1 robot, he says, and you can survey nearly all of the steel surface.

A manual inspection may require putting up scaffolding. With manual methods, there are also limits to how much area of steel can be inspected.

But companies are often happy with manual inspections, and sometimes don't see a big enough need to change from their current practises, he said.

Some customers are reluctant to try robotics after having problems in the past, such as, "they rented a drone which got stuck and they had to retrieve it and it was a real problem," Mr Hermann says.

Technical challenges

To do well in robotics requires both digital and physical problems to be resolved at the same time, Mr Herman says. Physical problems include ensuring that the robot can carry the necessary sensors, as well as being able to move.

The digital challenge is ensuring that the final data set meets the customers' specific needs, whether that is to monitor the health of assets in the facility, find ways to extend their life, or evaluate the risk of continuing to operate an asset.

There are domain specific challenges. Although lots of industry sectors use tanks and vessels, the damage mechanisms are different. Some customers are looking for specific types of damage, such as hydrogen induced cracking, or hydrogen sulphide damage.

Customer needs are different. For example, an owner of a tank might want to fill the tank up as much as is safely possible, to maximise revenue.

The company

Gecko was founded in 2013. Since then it has done around 500,000 hours of inspections.

The CEO developed the technology in his evenings while working as an electrical engineer. He raised seed funding from Y Combinator in 2016 and looked to build a team.

The technology was initially designed to gather inspection data for coal fired power plants, with ultrasonic sensor data combined with visual data. "We were able to make some big impacts and reduce downtime," Mr Herman says.

After coal, the company moved into the pulp and paper market, then oil and gas. It has more recently been working with military and navy customers.

The work with the US Navy includes inspections of the outside of the hull of a ship while at sea. It has also done inspections of welds on submarines.

The company works with "all the oil majors" in the US, he says, and many of the same companies in Europe.

Today it has 250 employees, and has raised $120m investment. "We're pedal to the floor here on growth," he says.

The working relationship with Siemens is partly a way to help the company grow its footprint in Europe, he says.

www.geckorobotics.com

NAPA – how to make ship design more collaborative

More collaborative working between the various parties involved in ship design could make it easier to design more energy efficient ships, says maritime software company NAPA

The ship design process, like most design processes, involves coming up with an outline design and then adding detail or other factors to it as the design work progresses.

For example, a designer may determine later in the design process that a certain area of the ship needs to be stronger, and so add extra steel support.

But for the most energy efficient ship, it is better if this doesn't happen, because if you have more steel than you need, it means more weight to the vessel and more fuel needed to propel it. The most energy efficient design probably gets everything right in the first stage.

Meanwhile, the quest for more efficient ships is adding complexity to the design in other ways. The vessel may need much larger tanks due to lower energy density of a low carbon fuel. Companies may want to maintain an option to add wind propulsion. And the choice of wind propulsion system may depend on the strength of wind in the region where the vessel is operating, which is not known at this stage.

Janne Huotari, Senior Research and Development Engineer, NAPA

It all means that better collaboration in the design process between all the parties involved, or who have different areas of expertise, and as early as possible in the process, would help make a more efficient design, says Janne Huotari, Senior Research and Development Engineer with Finnish maritime software company NAPA. Mr Huotari has a PhD in alternative ship energy systems.

NAPA provides software for ship design, safety and stability, and voyage optimisation.

Companies might want to plan for the ship to be capable to run on different fuels in the future. For example, if they want the option of running the ship on ammonia, they might choose an ammonia-ready engine in the future, and a ship design capable of handling it.

Predicting operational efficiency

With the increased industry focus on vessel efficiency, designers want to make the most accurate possible predictions of how a certain ship design will perform.

Up to now, design criteria has largely been concerned with structural strength, buoyancy, and a little with propulsion efficiency. But it may be that certain designs are a few percentage points better, Mr Huotari says.

The energy performance of a certain ship design will also depend on the weather conditions where the ship will operate, which is not usually known at the time it is being designed. There are some exceptions, such as offshore support vessels being designed to operate in a certain part of the world.

Ship designers are increasingly able to access real ship performance data, so they can see how this relates to the design choices, he says.

Wind propulsion

While only very few vessels are being built with wind propulsion today, many owners would like the option of adding it later, Mr Huotari says.

In practice, this might mean having an arrangement of piping on the deck which would leave space for some kind of sail to be added later, he says.

The technology is still seen as being in the early stage, and there are not yet any standard ways to consider how it should be incorporated into a design.

"Wind propulsion is a quite hard design problem, because you're going to want to have some estimate how useful that wind propulsion will be," he says. "For that, you're going to need to analyse what the wind conditions are along the route, so you can simulate how much wind propulsion you're going to get."

Normally in ship design it might be the provider of the wind technology which runs a simulation of how their system works, and this simulation would then need to be incorporated into the overall design.

"So, again something where multiple different stakeholders have to come together," he says.

Maersk Tankers reported 8.2 per cent savings on fuel on a tanker fitted with two rotor sales, in a trial in 2019, a big enough saving to be significant.

3D model-based approval

To support collaboration, NAPA has developed a "3D model-based approval" software platform, where designers, shipyards and classification societies can see the proposed design as a 3D model, see alternative options, make comments, and ultimately approve it.

The NAPA Viewer software for collaboration on ship design

NAPA is working with a number of classification societies, including DNV, Class NK and BV, on 3DMBA. The collaboration is done via sharing files in the open .ocx format, or using its online platform NAPA Viewer. This enables higher data security than traditional file transfers, NAPA says.

Classification societies have a role in the process of approving the design on behalf of regulators and insurers. It is still common today for class societies to demand 2D drawings to use to review a design, Mr Huotari says.

The designer generates these from their 3D model. The class society takes the drawings and builds their own 3D model out of them. This is extra work, and all error prone, and the extra steps are an obstacle to collaborative working.

All users need to log into an online NAPA tool called "NAPA Viewer" to see the model. Whilst some people might prefer if the model was exchanged as a file which could be viewed on any software, there is not yet any universally used standard data format for 3D models for ships, Mr Huotari says.

However, NAPA software is the most commonly used in the industry, particularly in the preliminary design stage, he says.

New design technology

NAPA is also developing new digital technology methods to improve design.

It is working together with Japanese shipyard Sumitomo Heavy Industries Marine and Engineering to develop automated tools to find the optimum structure of a tanker, looking at the midship section. It found it was possible to make big time savings this way, as well as developing new possibilities for hull weight reduction, cost reduction and performance improvement.

This method means that new competencies may be required for designers (i.e., software skills such as design standardisation and system design).

It is also developing ways to utilize methodology called "Finite Element Meshing (FEM) analysis" in structural design. This is a method of breaking down a complex structural design into small components and analysing whether this small component of the structure will be able to take the required stresses.

Such analysis might impact the stability and efficiency of the whole structure. It is a way of finding the weakest point of any proposed design.

Finding the best strategy for IoT connectivity

If IoT data can make a difference to the success of a project, then so can reliable connectivity to communicate the data. Ground Control shares advice about how to improve connectivity reliability

By Alastair MacLeod, CEO of Ground Control

The value of IoT (Internet of Things / sensor) data can plummet without reliable connectivity. And these data interruptions can lead to poor business decisions.

So, without the connectivity infrastructure to transfer sensor data from anywhere in the world, regardless of location, the value of IoT falls dramatically. So, connectivity is often identified as a barrier to IoT deployment success.

But connectivity can prove expensive, particularly for oil and gas firms who need to cover assets in remote areas, across vast distances.

IoT projects consist of connected devices which collect and analyse data from multiple sources in real-time, or devices which provide backhaul connectivity.

Communications strategy

Connectivity costs are largely dependent on the amount of data sent. So to reduce costs while maintaining maximum project value, it is vital companies understand how to best optimise data mobility.

Often, firms apply the same communication strategy to all devices, across all applications. For example, opting to have sensor data sent every 5-15 minutes.

Not all applications or projects require such frequent data points. Choosing which communications strategy is best for each application can help companies reduce overall connectivity costs.

Alastair MacLeod, CEO of Ground Control

It's likely that there are some applications where it would make little to no difference, if there was a longer delay between data packets.

Consider whether your project could move to sending/receiving data every 30 minutes or even once an hour. Consider whether your company requires all sensor data.

Much of the data coming from sensors simply confirms that operations are running as expected. Instead of sending all data, in these cases, it's much more efficient to only send data which falls outside set parameters.

Remote terminal activation

Given the remote environments in which oil and gas plants are usually situated, most companies will run operations with always-on, active terminals.

Though this is rarely required, physically sending field technicians or engineers to deactivate terminals wouldn't be worthwhile. Being able to control the activation and deactivation of terminals remotely, can unlock further cost savings.

Some airtime and hardware providers offer platforms which allow remote activation, suspension, and deactivation.

In these cases, companies can use their API to integrate this service into their own platform. Or they can use the online user interface to proactively manage their device portfolio, irrespective of terminal location. In addition, these value-add services can help you stay on top of data usage.

Typically, better data rates are available within a plan, so being able to monitor your operation's data usage and amend as appropriate can have a significant impact on overall costs.

Edge computing

Edge computing means companies processing data where the data is being generated (at the edge), so there is less requirement to send data to the cloud.

There is a lot of noise about data processing within the cloud, but doing this requires sending all data to the cloud.

If your devices are reaching end of life, consider an edge-computing-capable device to lower costs.

These devices can also extend the life of your current terminals. So even a relatively small investment could prove beneficial.

Different satcom providers

Satellite connectivity is widely used in the oil well lifecycle because there's no more reliable and secure way of getting your data from remote locations back to your engineering or HSE team.

It's fair to say that it's viewed by some as an expensive and a necessary evil.

But as more and more satellite companies have started offering commercial services, competition has expedited both the diversification of airtime services, and lowered the cost.

For oil companies it may be worthwhile revisiting their current setup, to see if they could save money by adopting different forms of connectivity at different stages of the oil well lifecycle.

Not every part of the well lifecycle needs the relatively high throughput of an Inmarsat BGAN device commonly used in the oil and gas sector.

So exploring the full range of satellite or connectivity options can be beneficial.

In the coming decade, potentially thousands of satellites, including Nanosats, will be launched into orbit.

This will continue to drive competition within the satellite industry. Ultimately it will alter how all industries operate, providing greater opportunity at more affordable costs for oil and gas companies.

About Ground Control

Ground Control is a satellite and IoT service provider specialising in communications from remote areas. It was formed from the merger of US-based Ground Control, and UK-based Wireless Innovation and Rock Seven.

The company designs and builds its own hardware, with manufacturing facilities in the UK and United States. It has long term partnerships with airtime providers including Inmarsat and Iridium.

Supplier emission data – better ways to work with it

To work with supplier emission data, understand the transition from top down to bottom up data, understand commercial incentives, manage master data, and make product codes easier to update. A PIDX webinar explored

Supplier emissions data is one of the largest categories of oil and gas emissions, along with emissions from use of the products, and emissions directly caused by operations. But it is also one of the hardest to accurately gather data from.

"Purchased Goods and Services" is the first of 15 categories of Scope 3 emissions in the Greenhouse Gas Protocol.

The World Business Council for Sustainable Development (WBCSD) has said, "Measuring carbon and greenhouse gas emissions across product value chains today is almost impossible."

Most oil and gas suppliers are not yet able to provide audited emissions data for all their individual products.

Pathways to make it easier were discussed at the PIDX webinar on Nov 16, "Journey to Net Zero Part 2 – Supply Chain Interfaces", including understanding the transition from top down to bottom up data, understanding commercial incentives, managing master data, and making product codes easier to update.

PIDX is an open data standards organisation for e-commerce in the oil and gas industry. It has been developing the Emissions Transparency Data Exchange (ETDX) standard since February 2019. It has also been building its understanding of how suppliers could best report emission data, where this data should be exchanged as part of a supply chain transaction, and what standards and interface would be needed, said Chris Welsh, COO of PIDX.

Bottom up

Many companies estimate emissions from suppliers using a 'top down' method, Mr Welsh explained. An example of this is if you know the number of truck miles made by your suppliers, you use that, multiplied by a figure of average emissions per truck mile, for your reporting. The advantage is you get a number for your report; the disadvantage is that it may not be accurate.

But the supplier may not know, or have systems to provide, the specific emissions from fuel consumption in delivery of your company's products.

While some numbers may be technically feasible to calculate, the suppliers are judging that the staff costs of doing the calculation are not justified by extra business, or business retained, as a result.

Some suppliers are following an 80:20 rule, starting by calculating emissions from the 20 per cent of their products which cause 80 per cent of their total emissions, Mr Welsh said.

As they seek to gather emissions data for more of their products, they will see diminishing returns, where the effort to gather the data is decreasingly commercially justified.

So, we are likely to see a mixture of bottoms up and top-down reporting for quite a while.

"Bottoms up reporting on a line-item level is possible," he said. "But there's a lot of work to do before we get there."

Commercial incentives

There are many different commercial reasons for companies to take emissions into account when rethinking their supply chains at the moment, said Youssef Mestari of accounting and advisory firm PWC.

Mr Mestari is managing director, industrial products and services, enterprise strategy at PWC, with a focus on industrial decarbonisation and digital transformation. He is based in Atlanta, Georgia.

Oil and gas companies are looking to switch to lower carbon fuels or electrification to drive equipment. Oil and gas companies are entering new markets in the low carbon economy, which can be described in business jargon as 'market entry adjacent play'.

Government incentive schemes are prompting companies to reconsider what they are doing. In the US there has been a "massive wave" of looking at Renewable Energy Credits, including putting them under scrutiny.

Climate issues are being considered in the context of overall profitability. For example, if an oil and gas company switches an offshore platform from diesel to electric powered boilers, that would increase costs. Since the product is sold at a commodity price, it is "driving margin erosion," he said.

Some E&P companies are starting with a mindset of thinking about deploying CAPEX on reducing emissions. This means that the spending is competing with other CAPEX options.

Mr Mestari noted that when carbon reduction capex is competing with ROI driven capex (i.e., spending that provides a direct return on investment), normally only the 'low hanging fruit' of options gets chosen, which might amount to 25 to 30 per cent of all emissions.

After that, for the next 50-60 per cent of emission reduction, the average cost per ton reduced gets higher, he said. For the last 10 per cent of reduction, the costs get higher still.

"The path to decarbonisation is a mountain to climb," he said. "Every single new idea being implemented will be more expensive [than the last]."

In other words, the agendas of decarbonisation and value to shareholders are competing.

Companies in downstream sectors of the oil and gas industry, selling product, are seeing more of their customers asking for 'lifecycle assessment' of the fuel. A problem is that "Every buyer is asking for a different template," he says.

Buyers are looking at emissions and costs of different fuels and ranking them.

Supply chains

There are many other reasons companies are looking to change their supply chains now, he said. This includes emphasis on resilience and redundancy rather than cost reduction; changes to chosen locations for manufacturing in response to changing costs in different parts of the world; geopolitical changes; companies seeking to be less dependent on labour, perhaps relying instead on advanced technology.

Supply chain resilience has been 'stress tested' by the war, inflation, costs rising, climate pressure and energy pressures, he said. Companies are seeking to reduce dependence on single suppliers or countries and considering other ways their supply chains might be disrupted in future.

North American companies are seeking to avoid doing all their manufacturing in China.

Recategorising

Some companies are looking for ways to re-categorise emissions. If you purchase something rather than make it, then its emissions go from your scope 1 to scope 3, Mr Mestari said.

Similarly, if you buy electricity rather than generate it, the emission goes from scope 1 to scope 2. Some companies are even considering selling their generators to an outside company and buying the electricity back from them.

On the other hand, companies bringing manufacturing back in house see the emission go from scope 3 to scope 1 and 2.

"Oil and gas companies, upstream and downstream, don't necessarily need to see the scope 1, 2 and 3 as 'fixed' boundaries and frontiers," he said. "These can be moved depending on what is the most cost-efficient way to run the organisation."

Mr Mestari advised that companies should try to "control the game" – such as from building carbon data models, measuring, monitoring, reacting, and reporting. They should be able to prove what they are doing by having traceable data.

Master data and supplier emissions data

To work well with supplier emissions data, we need good data of what we have, what we need, what we are buying, and who we are buying it from. In other words, good master data

To conceptualise why master data is important in reducing carbon, consider the idea of the circular economy, explained Tom Cave of Fraser-Cave MDM consulting, speaking at the PIDX webinar.

This is the idea that we have a cycle of purchasing items, using them, re-using them elsewhere, then recycling them, and selling the recycled materials to someone else.

For this to be managed within a corporate system, we would need to know exactly what we need and have bought; we would need to know exactly how we are using it, and when we no longer need it. This means good data.

The reality might be more like this. We don't know exactly what we need. We are purchasing an item which has been manufactured to order, rather than coming from any catalogue, so we don't know exactly what we are buying. When its initial life is over, it is not described well enough with data to be able to evaluate if it could be used elsewhere, Mr Cave said.

It is common for companies to buy spare parts they don't need, because their systems are not kept up to date. For example, one company switched from using both Volvo and Ford trucks to just using Ford trucks, but it did not update the spare parts system and continued to buy Volvo truck light bulbs.

Meanwhile, many people are getting asked by their senior management, "what is your department doing to reduce your carbon footprint," Mr Cave said.

If you have no control over the carbon emissions in the materials you buy, and you don't have any management controls over the stock you keep, you can't measure the carbon emissions, and so getting to net zero gets very hard.

If we are talking about maintenance and repair purchasing and spare parts, the key master data is data about your own asset, the materials you need for it, and the vendors you work with, he said. If you have all of these in good quality, working together, "you have a really stable platform."

Master data should be the company's golden record, he said. "Engineers have to be entirely certain that the item they are about to fit is the correct item."

Asset data is at the heart of it. Knowing what

Tom Cave of Fraser-Cave MDM consulting

equipment you have, what you need, and which elements are critical, he said.

When it comes to asset data (your own equipment), you need a unique way to recognise it – such as a code – and a familiar name. You want to be able to describe all the subcomponents.

It can be useful to be able to describe if a component is critical, although that may depend on where it is used – a pump may be a critical component in one location, but not so critical in another.

Sometimes the same item has different names in different parts of the world, such as the term "Kelly Cock" used in Scotland for a well control valve.

If we are purchasing an item not in our normal catalogues, then having a good item description is very important, he said.

Ways an oil and gas company can be net zero

How can an oil and gas producer reach net zero on Scope 3? One option could be through sales of commercial CCS services. Here are some possibilities

If an oil and gas company is to be on a pathway to net zero with scope 3, that means there needs to be some way of negating the emissions from customers using the product.

One way of doing this might be for the company to offer CCS as a commercial service.

"Scope 3" emissions are value chain emissions, differentiated from emissions from a company's own operations.

An oil and gas company could reach net zero with its own operations (Scopes 1 and 2) by eliminating leakage and flaring, running all equipment on electricity from renewables, and using zero carbon transportation.

Scope 3 is different, because it includes emissions made by an oil and gas company's customers in using its product. If the company is still selling oil and gas, then it cannot prevent its customers from making emissions, unless the products are never used in domestic homes and cars, and only used in facilities with carbon capture, which sounds impractical.

But a possibility, not yet formally written into the Greenhouse Gas protocol which defines emissions categories, is that an oil and gas company could provide CCS as a commercial service, and count that as a negative Scope 3 emission. It would also be part of its 'value chain'. It would be sequestering another company's emissions, so it would not fall under Scope 1.

There is no formal definition of negative Scope 3 emissions, but the idea has been considered.

Equinor announced its plans to be "net zero by 2050" in an announcement in November 2020 (https://www.equinor.com/news/archive/20201102-emissions). In its 'assumptions' behind the plan, it said, "We assume a well-functioning market for carbon capture and storage and natural sinks, and that these mechanisms can be accounted for as negative scope 3 emissions."

In Norway, there is the possibility for Equinor to do carbon capture as a service for the same industrial customers which purchase its gas. So it is handling the same carbon molecules it is not a form of offset. So surely this would count as a negative scope 3 emission.

Lord Turner perspective

We had an opportunity to pose the question of net zero oil and gas companies to Lord Adair Turner, chair of the international think tank Energy Transition Commission, a former chairman of the UK's Financial Services Authority, the UK's Committee on Climate Change, and a former Director-General of the UK's Confederation of British Industry.

If you have a company producing oil and gas, and providing CO2 sequestration as a service to others, the accounting is more complicated, because it becomes a discussion about offset, and Scope 3 emissions, rather than Scope 1 and 2, he said.

"I think the answer is that there aren't definitive standards on how you deal with scope 3 emissions."

"Fossil fuel companies talk about getting to net zero - even on scope 3. Shell has said it will do [so]."

One pathway could be a form of offsets. "Certainly, we envisage they would be doing some storage activities such as direct air capture activities which offset the scope 3 emissions. We need to get that clear."

"We need clear accounting for the role of offsets, but we also need a very clear, rigorous discipline about how much we're relying on offsets," he said.

The Energy Transition Commission has also written a report about how much CO2 removals will be needed to get to net zero. "It is a crucial area for us to get right."

The Energy Transition Commission recommends that 95 per cent of emission reduction should be achieved as direct reductions, so maximum 5 per cent though purchase of offsets, he said.

For the industries which emit large amounts of CO2, such as shipping, aviation and steel, there has been a big change in approach in the past few years, in that companies are now planning to achieve reductions in their actual emissions, rather than through offsets, he said.

"6 years ago, if you asked anyone in aviation, 'how am I going to get to net zero', 50-60-70 percent would be through purchase of offsets."

"Now there are sector transition strategies using synthetic fuels, biofuels. 95 per cent of reduction is in the sector itself."

"Scope 3 is an interesting thing. At one level you could say, 'if everybody got their scope 1 and 2 to zero why do we even need to bother about scope 3 because that is double accounting'".

"But when you are talking about oil and gas companies it is sensible for them not to take that attitude, but have the point of view that they are going to 'own' in some sense' what happens in their scope 3 reductions as well."

Lord Turner also noted that many environmentalists have been turned off CCS because of its possible use in enhanced oil recovery. But "the crucial thing is to get the accounting right," he said.

PWC perspective

We asked Youssef Mestari, managing director, industrial products and services, enterprise strategy at PWC, based in Atlanta, Georgia, how he thought oil and gas companies could get to net zero, and if CO2 sequestration could count as negative scope 3 emissions.

"It is a very good question, we have clients on the same topic," he replied.

Some companies are using CO2 for enhanced oil recovery, which makes it more complicated. The CO2 pushes oil out and takes it place.

The oil produced can count as 'low carbon oil', because there are lower overall emissions involved in creating it, he said.

"We've seen clients I'm talking to leaning towards [CO2 + EOR]," he said. "There is a missed opportunity when used only for sequestration. "They are still considering and using that sequestration but in a smaller proportion."

O+G 'needs to lead'

However the commercial incentives are organised for oil and gas companies to do carbon capture, there is a global need for them to do it, said Stuart Haszeldine, Professor of Carbon Capture and Storage, School of Geosciences at the University of Edinburgh, speaking at a recent London conference organised by the Carbon Capture and Storage Association.

There is a "need for the oil and gas industry to lead this," he said. They should "spend more than 2 per cent of their revenue on this."

"If we want to go 100x faster [with carbon capture], we'd better find ways of pressing the accelerator."

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