digital energy journal

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Cover image - Collecting seabed data on Ormen Lange with an autonomous vessel – **page 19**

Tom Siebel – how to make AI work in oil and gas

Technology veteran Tom Siebel, CEO of AI company C3, shared his views about making AI work, making digitalisation work, a model driven architecture, and oil and gas AI success stories, with a keynote talk at the "Engenious" forum

Tom Siebel, CEO and founder of AI company C3, and formerly co-founder of customer relationship management software company Siebel Systems (sold to Oracle in 2005 for $5.8bn), gave a keynote talk at the SPE "Engenious" conference on Sept 22nd. He has been working on the C3.Ai offering for 11 years.

In Mr Siebel's telling, the specific problems which AI might solve have been known about for some time – but it is only now that it is technically possible to tackle some of them.

"Not too long ago, the technical issues associated with deploying these [AI] solutions were non-trivial and non-tractable. Today they are not trivial but they are certainly tractable - we can do it," he said.

An example of a tractable problem could be predictive maintenance or optimisation for a specific equipment.

"if you take a tractable problem with high economic value and mandate it be in production in 6 months these projects are the type that succeed," he said.

On the topic of getting AI to work, Mr Siebel said, "The people who are succeeding are doing tractable (manageable) projects that are going to result in measurable, significant economic benefit this year," he said.

"The people boiling the ocean on multibillion dollar AI projects with professional service organisations, IT driven, they don't seem to go anywhere. When you get these grand visions - companies have spent millions of dollars and got no economic benefit whatsoever."

"A number of people think AI is magic. It is not. There are classes of problem we can solve with AI, and classes of problems we can't solve," he said.

An example of a problem which can't be solved with AI was presented to C3 by a large bank, which wanted to be able to predict when stock would be recalled by its owners, which it was borrowing to back lending.

This would mean building an AI which could predict when someone wants to buy or sell stock. If anyone had such AI they could accumulate all the money in the stock market, a good indication that it cannot be done. "It is a non-tractable problem," he said.

"Many organisations try problems which are impossible."

Another way people fail is when they focus on data lake projects. "They say, before we get started we need to get all the data from the entire industry into a unified federated image," he said. "This is a non trivial problem. You can spend decades at this, you will not get it done.

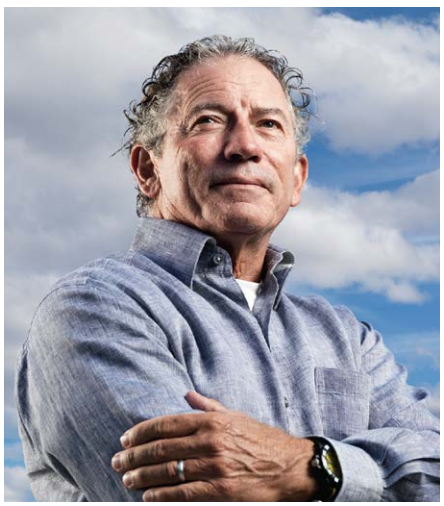
"This idea of a unified federated image for any industry is extraordinarily difficult. But, "to aggregate the data you need for any given problem is tractable," he said.

Digital transformation

While working on C3.AI, he visited former customers and colleagues in company boardrooms around the world, and often found that the CEO was telling everybody to do digital transformation.

"For the life of me I couldn't understand what they were talking about," he said. "It understandable that companies felt pressure to "transform", but they would not be considering an "analogue transformation."

On further probing, it would be clear that companies felt that they had to do something, but they "weren't quite certain what it was."



Tom Siebel, CEO and founder of AI company C3

Mr Siebel believes that what is really happening is that company boards are recognising that so many traditional companies are closing down or being acquired, while there are so many digital-driven companies which are "spouting up and upending industries" like Tesla, Amazon, Uber and Spotify.

So as a matter of corporate survival, we can see it similar as the companies which don't exist anymore, after they failed to make the transition out of mainframe computing, or they didn't make the transition from having bespoke software written in FORTRAN to buying enterprise application software.

We are hearing estimates from consultancies such as that 70 per cent of companies will try to go digital, 21 per cent will succeed, and the remainder will be acquired. "I'm not sure there's a lot of oi and gas companies that survive unless they reinvent themselves," he said.

The common theme of these successful tech companies is that they are making good use of technologies in four categories – elastic (adaptable workload) cloud computing, big data, internet of things, and "predictive analytics or AI", Mr Siebel said.

To Mr Siebel, Internet of things is really about "sensoring value chains," to sense the state of devices. An example is all the sensors being installed on electrical grids which monitor how everything is working. The electric grid is "the largest, most complex machine ever built," he said.

The idea of digital transformation sits "at the convergence of these vectors," he said. "The idea is we can harness these technologies to solve classes of problems previously unsolvable. These problems are generally in the area we call predictive analytics or enterprise AI."

Discussions in boardrooms have changed over just 6 years from "Tom, what don't you understand about how our data will never be in public cloud" to "Tom, we have a cloud first strategy," he said.

"The top priorities of CIOs are digital transformation, cloud computing, analytics and AI."

"I would say we've seen an order of magnitude increase in digital transformation and enterprise AI since this COVID disaster. This is likely to sustain itself for next couple of decades," he said.

In companies which are successfully managing digital transformation, you typically see "the CEO is taking person responsibility for this initiative, driving the digital transformation of the company, not delegating this to IT. Very frequently the CEO is appointing a partner - "chief digital officer" and they talk daily. These are top down driven initiatives," he said.

Model driven

What C3 has actually built, under the hood, is a workable way to gather together all of the various AI tools so that it works together.

If you want to do enterprise AI, you need to put together many different software systems, including data integration (to bring data in from other software systems), data connectors (to put some basic structure in the data) various data storage systems (including relational databases, graph databases, big data storage). Then you might have both batch processing and stream processing tools, tools for visualising data, tools for exploring the data, and then finally the actual machine learning software. You need tools to manage the whole thing, and develop new tools.

You can still be using open source or commercial software to do specific parts of this, such as using Jupyter to develop applications, Tableau to visualise data, Map Reduce for continuous analytics processing. But C3 is addressing the challenge of getting everything working together, not building individual components.

Every single one of C3's customers had already been through the challenge of trying to build all of this themselves, he said, spending between "a few hundred million and $6bn in one case."

But it is actually a "mind numbingly complex problem" to get everything connecting together – which is why hardly anyone has succeeded in building it in house, he said.

The challenge today is that there are hundreds of software utilities which appear to be "enterprise AI platforms", something a company can use to manage their AI.

"On their website they all appear to do the same thing. Apache Spark, Cassandra AI, Databricks.

"If you tease it apart they are really not. Cassandra is a database for storing telemetry. TensorFlow is a math library put in open source by Google - useful for facilitating certain types of ML platform.

Databricks is a virtualisation technology. Virtualisation allows us to manipulate hundreds of petabytes of data in a device which only has a few gigabytes of memory. It's a pretty great trick critical for some ML programs.

Companies everywhere are taking a number of these tools to put together to be their "enterprise AI platform".

But to make it all work in the big data world, with sensors, data integration, data storage, and machine learning models, "The complexity of this is 10 to order 13," he said. "To our knowledge no-one has ever succeeded."

C3's approach, which it calls "model driven architecture", is "kind of the secret sauce," he says.

By defining the overall model of the components, and building an infrastructure to make sure they can all work together, it "reduces the complexity of this to about 10 to the 3rd," he said. "It enables us to reduce the time and cost to build these applications."

In other words, the deployment is now only about adapting the model of components to the specific needs of the client, rather than actually putting the components together.

All of the software runs in the cloud, or "multi-cloud" – a number of clouds at once. The applications can run on AWS, Microsoft clod, Google Cloud, IBM cloud. C3 works with all these companies, although its closest partnership is with Microsoft. "We take advantage of all that Azure is doing, all the Azure services," he said.

Leave to the experts

Mr Siebel has seen the same story happen before in the software industry. In the early 1980s, many companies were trying to build their own relational database systems. "Not many people succeeded, not one to my knowledge," he said. Oracle (where he was working at the time) built a relational database and sold it.

In the 1990s, companies were trying to build their own enterprise resource planning (ERP) systems, for tasks such as order management, purchasing, inventory, payroll and accounting. Some companies did it in-house, some asked a IT service organisation to build it. "You can count the number of organisations that succeeded on zero fingers.

Sooner or later, they bought their CRM from Siebel, and ERP system from SAP or Oracle, because those people were professionals."

C3 Customers

One customer example is Italian electricity company ENEL, which has installed 60m smart meters in 40 countries on its grid. It has 40m meters just in Italy and Spain.

The C3 system aggregates all of the data, combines it with data from billing and

customer relationship management systems (SAP / Salesforce), and also data from SCADA automation systems from Schneider and Siemens, and Topology mapping software. It also adds data from weather, social media and terrain.

It all works out as 1m transactions per second.

"We can look at the whole grid as a machine and bring much higher power quality, reliability,

Cybersecurity. We can do predictive maintenance, replace a transformer before it goes out".

Enel states in its annual report that it sees 5.1bn euros of benefit every year from the system, he said.

Another client is Engie, a French "integrated energy company" with 70bn euros annual revenue. It has a project called "Engie IOT", looking for 1.5bn euro a year of economic benefit.

C3 has a project with the US Air Force to gather data about aeroplanes which can be used for predictive maintenance, identifying which systems and subsystems are likely to fail before they do, so aircraft can be repaired at a suitable point in their schedule.

This means that the availability of aircraft "increases dramatically." For some aircraft is has been increased from 50 per cent to 85 per cent.

C3 has reached a point of having 30 "flagship accounts" in 15 industry verticals. Now it is ready to offer services to smaller and medium sized companies.

We're also recognising our company to be able to meet the needs of small and medium businesses.

C3's "stack"

Over the past 10 years, C3 has "spent $750m building a software stack, to provide software services necessary for customers to design, develop, provision and operate these enterprise AI applications, so they can digitally transform their businesses," he said.

"Typically this stack is being applied to problems like AI based predictive maintenance, fraud detection, money laundering, production optimisation, AI based yield optimisation, inventory optimisation."

Markets C3 serves include oil and gas, defence, utilities, aerospace, manufacturing, health and financial services, transport, telecom, retail.

"Some of largest iconic companies are working with us," he said.

Oil and gas projects

In the oil and gas sector, it is partnering with Baker Hughes, so it can combine Baker Hughes' 70 years of deep oil and gas expertise with C3's ability to build mission critical enterprise systems.

As an example, one oil major client (name withheld) is expecting Eur 4bn a year in benefit every year from the system, across upstream, midstream and downstream. In upstream it will use the software for drilling risk and productivity; Well placement and completion; Well integrity and health; production optimisation; predictive maintenance; LNG predictive maintenance; asset investment planning.

In midstream it will use it for hydrocarbon loss accounting.

In downstream it will use it for demand forecasting; refining analytics; Customer segment targeting; fuel station analytics.

Together with Baker Hughes, C3 has a plan for oil and gas applications to bring to the market in the next 24 months. It will start with equipment reliability, then move to well production, well optimisation, energy management, inventory optimisation, production schedule optimisation, production optimisation.

With Shell, C3 currently has about 200 projects going on, including predictive maintenance for control valves, compressors, electrical submersible pumps (ESPs), centrifugal pumps, and subsurface production monitoring and centrifugal pumps.

Deployment process

A typical deployment will start with a trial – for example, for one oil company, it built a predictive maintenance tool for low pressure offshore compressors in 4 weeks. It demonstrated that it could identify a device failure about to happen, 18 hours before it did, with 85 per cent precision and 85 per cent recall.

Precision is the fraction of relevant instances among the retrieved instances, and recall is the fraction of the total amount of relevant instances that were actually retrieved. "it turns out 18 hours is enough notice for that asset," he said.

A project to do predictive maintenance for coal seam gas and LNG operations in Australia took 16 weeks. A production optimisation will normally take 1-4 months.

After this smaller scale pilot, it can be deployed across the company.

A typical project will start with a meeting, selecting a use case which is deliverable ("tractable") and representative of what the company wants to do, which would have substantial economic benefit, and could be done in 4-16 weeks.

C3 will aim to demonstrate it can solve "a large class of applications" at the same time. At the end, it aims to agree a 24 month application road map. C3 will provide the technology, and 2 or 3 of its staff to help train the clients' staff. Although it does not intend to be in the professional services business actually managing the implementation. "I'm not here to send you 100 people for 5 years. I want to send 5 people for 3 months, so your team can build applications yourselves."

"Doing proof of concept, if properly engineered and crafted, is not very different to production deployment," he said.

If you have 3000 electrical submersible pumps (ESPs), you can build an AI based predictive maintenance system on data from 300 pumps using 5 years of data, with an offline connection. You build a machine learning model which demonstrates that you can predict device failure, so you can avoid the downtime which would occur after an unscheduled failure. After that you can run the system on live data and extrapolate the system to 3000 wells.

"I'm not talking about a conference room pilot. I'm talking about production level applications," he said.

Negative impacts

Mr Siebel was asked what he saw as the negative impacts of AI.

"There's been no interaction of technology and mankind - from which there have not been significant negative impacts," he said. An example is the invention of the printing press which led to bible printing and religious wars, and the industrial revolution which led to big labour abuses, communism and arguably both world wars.

There are big issues related to privacy and AI, but perhaps more importantly the way AI is used to make social media addictive.

"Social media companies are manipulating billions of people at the level of the limbic brain," he said. "This is the part of the brain that releases dopamine. This is how you become addicted to heroine or methamphetamine. How many 13-14-15 year old kids are addicted to clicking on their computer, they get a release of dopamine when someone likes their photo."

Another example of bad AI could be if it is used on medical records to let insurance companies assess someone's risk before

taking them on as a customer. It may be possible to use AI to predict what diseases someone is more likely to get in the next few years.

"We have either a [health] insurance company or in the case of the state, a single provider situation. How are those people going to use the data? The idea they are not going to misuse the data is laughable. Governments do bad things, companies do bad things, see Facebook for details."

And in any case, "do you want to know you'll be diagnosed with a terminal disease in 24 months? I'm not sure I do."

Another example of bad AI would be if it is used in HR systems to perpetuate bias.

"It is something people commonly want to use. We have conversations with US army about this."

An AI may look for patterns in successful soldiers and say they are "white, male, and went to West Point". But that is because that description applies to most soldiers. "Those biases are in the data," he said. "We need to be very concerned about those types of systems."

"I said, Mr Secretary, we won't do it. This is a mistake. If we do it, we'll find ourselves on the front page of the New York Times in a few years, dragged before Congress. It is not going to be good. This is just a bad idea. Companies who mis-use these technologies - will be extraordinarily sorry."

Removing the bias from algorithms is "a really difficult problem," he said.

When we deal with physical systems - pumps, electrons, fluids, hydrodynamics, geospatial issues - Subsurface geology, physics, we don't have bias. In many systems we're deploying - e.g. in utility or O+G, I don't think we have bias. Bias does not exist in physical data.

It certainly does exist in sociological data. When we deploy AI to HR systems, criminal justice systems, credit approval in banks, there is bias in data.

"Right now, it is beyond the state of the art in AI - to assure we don't perpetuate cultural bias."

So we need to basically not be applying these technologies in areas where we'll perpetuate social bias. The answer is basically NO.

"By the way, Europe, thank you for what you are doing on GDPR," he said. "Europe is a leader in this space - raising the visibility of problems associated with AI. if government does not regulate in this area we will be sorry."

Another negative of AI is when you don't know how it reaches its conclusions. With supervised and unsupervised learning, where we are following structured methods to reach a conclusion, it is possible to explain how the results were achieved. But with deep learning methods, no human readable explanation is given. This has been used by banks to make decisions about loans.

Training people

When it comes to workers, it is usually easier to train your current workers than try to recruit new, AI competent ones.

The learning never ends. At C3, about 46 per cent of employees have advanced technical degrees. But the company still has an internal curriculum, in topics such as predictive analytics, cloud computing, supervised and non-supervised learning, and deep learning.

The company pays people bonuses when they reach a certain level in these areas, and on average employees have taken 3 classes.

"If someone wants to go get an advance degree in data science - we pay for it - and give them a bonus when they get it," he said.

"We need to retain our workforce. The idea of replacing workforce is a particularly bad idea."

"In oil and gas, there are really bright people, well educated. We just need to give them new skills and it's not that hard."

New technologies may mean people need to change their roles. For example power companies may have a large workforce of unionised employees who have spent their whole lives doing a job in a certain way, such as going out to equipment in their truck and writing down the readings from meters.

"Now we go to an AI predictive maintenance program, we have to change everything about the way we manage business. The hard part is the change management. We need new compensation structures, organisational programs, new union contracts. Otherwise people will reject the technologies and people will not receive economic benefits they are looking for," he said.

Tightly integrating RESQML with reservoir modelling

It would be useful if RESQML, the data exchange standard for reservoir data, could be integrated tightly within reservoir modelling software itself. Soumik Dutta and his team from Emerson shares an approach for how to do it

By Soumik Dutta, product specialist and a team lead for the Emerson E&P software group

The upstream oil and gas exploration and production life cycle, from seismic data processing to production optimization, is extensive.

Operations performed at each stage of the workflow are unique, and need to be carefully integrated with the next step in order to obtain a meaningful result. A compromise at any stage can cost the operating company billions of dollars.

Reservoir modelling stands at the very core of this value chain – it reads information gathered from different sources (seismic, well and field data, to name a few), creates a logical model, and transmits the model

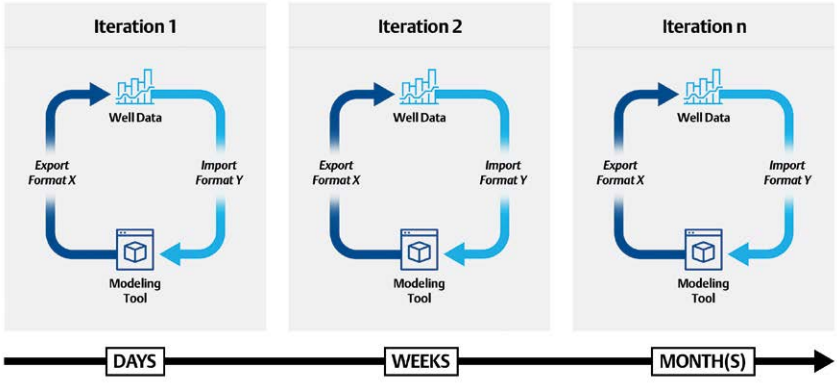


Figure 1. A typical data exchange workflow includes multiple iterations, which must be performed every time new data is acquired or interpreted. These increase both the duration of the project and the workload of the geoscientist.

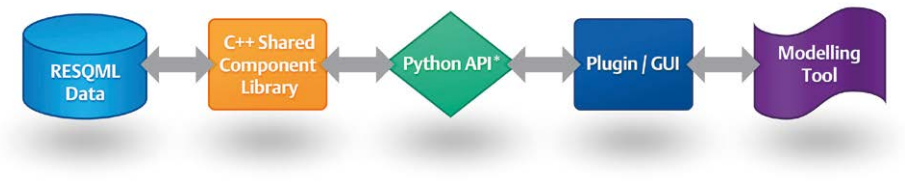


Figure 2: Flowchart explaining the solution developed

further down the workflow for reservoir simulation and reservoir performance management.

The data (both raw and processed/interpreted) currently comes from multiple sources in different formats. As an example, well data alone can be in LAS, DLIS, JSON or another format. The formats are not easily transferrable, and the transfer can take a lot of time.

Geoscientists have to spend weeks and sometimes months accumulating data from different sources (e.g. seismic data from the geophysicist, well data from the petrophysicist and field cultural data from the geomatician) and create a master project to perform reservoir modelling.

In addition, applications in any given domain may be tailored exclusively to that domain, and be incompatible with other applications developed by third- party vendors. The result is that users are prevented from using the best applications for their needs.

The applications usually have a huge source code base which is not easy to maintain and needs extensive testing. Adding an interoperability feature on top of it may create additional complications.

Another important criterion is scalability, so that the software can be easily deployed as a web application or easily handshake with other tools in the end-to-end workflow.

Plugin integration solution

Emerson had a project to develop a plugin integration solution that could talk to the 'existing developed code library' (developed using C++) which already understands RESQML and can translate it back to a reservoir modelling tool and vice versa.

This will ultimately result in a seamless data handshake across applications with less iterations and no loss of data.

Multiple approaches were considered and evaluated based on ease of deployment, minimum or no impact on the source code base of the reservoir modelling tool, and scalability.

The main application is a reservoir modelling tool written in C++ with a huge code base developed over the past three decades.

An existing plugin framework is available, with APIs available in both Python and C++ as add-ons.

The obvious choice is to use the existing plug-in framework to develop the RESQML solution. However, considering that the users are mostly geoscientists, using C++ APIs is not considered a good idea.

Also, dependency on the source code base is unacceptable from an architectural point of view, and it would considerably increase the overhead on code maintenance.

Since Python APIs are currently in wide use by customers, introducing another set at this point is meaningless.

Python wrapper

The optimal solution is to generate a Python wrapper over the existing Python API and use the existing developed code.

During data import, the Python wrappers will communicate with the existing code, read the data and map it to the reservoir modelling tool.

During export, the Python wrappers will fetch the data from the modelling tool and map them to the existing code, thereby writing them back as RESQML data.

The job of the Python wrappers in this process is to convert the data returned by C++ into an array of numbers, establish connection with the developed code and send metadata for the graphical user interface (GUI).

How it works

When a user needs to transfer data from one software package to another within a single vendor or across vendors, all they need to do is ensure the source and target are both RESQML V2.0 enabled.

As part of the exchange, two files are created – one .EPC file and the other .h5 file. The .EPC file is the equivalent of a zipped file containing XML files. The .h5 file contains the bulk data of the objects such as coordinates and property values, in the form of data tables.

Software that supports RESQML V2.0 can write as well as read the standard format.

This will ultimately improve workflow flexibility and will also enable selective data transfer, using only the one which is newly acquired or updated.

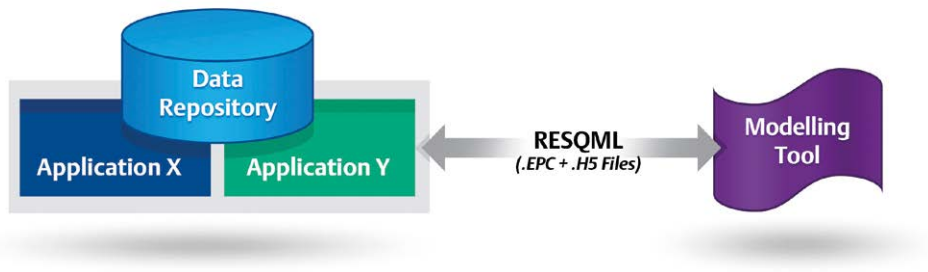


Figure 3: A schematic diagram showing the data exchange across applications or data repositories using the RESQML data format.

About the author

Soumik Dutta is a product specialist and a team lead for the Emerson E&P software group, based in Pune, India. He is a geologist with 14 years of experience in the oil and gas industry.

Schlumberger puts DELFI on open ecosystem

Schlumberger has put its cloud software system DELFI, which can carry its full petrotechnical software suite, on an open cloud technology architecture

Schlumberger, IBM and Red Hat say they plan to "convene the ecosystem of energy producers and partners to unify on a common technology architecture".

Schlumberger has its own cloud system, which it calls DELFI, which has been sitting on a public cloud service (Google or Azure).

But now DELFI will be moving to sit on Red Hat OpenShift platform, which can either be on IBM's public cloud, or on a company's private cloud or internal servers. The system makes it possible to use the same code on multiple technology set-ups, rather than having to rewrite code for every cloud provider.

Red Hat was acquired by IBM in 2019. OpenShift is described as a "family of containerisation software", which allow a single computer to operate as though it was a number of separate computers, each running in a separate 'container'.

One immediate benefit of the move is that companies which need to keep some data within the boundaries of a country for legal reasons will now be able to use Schlumberger's cloud software.

The number of people using DELFI has grown 400 per cent over the past year, but until now it was inaccessible to oil and gas companies which have data under data sovereignty restrictions, Schlumberger says.

Software available on DELFI includes the full petrotechnical suite (including Petrel), drilling interpretation tools, and drilling operations tools. There are also tools for a range of analytics and machine learning processes.

From now on, they will be able to use data stored within the country they are currently in together with data stored outside the country which they are allowed to access, in an integrated manner.

They can do this because they can run DELFI on any server system which can use Red Hat OpenShift servers.

There are other reasons why companies might want to run software on a priate cloud – there may be unreliable or slow telecoms between their location and the nearest public cloud data centre, or just a long distance which adds a delay to the connection.

"We have shown that adopting a hybrid cloud architecture can be 2.5 times more valuable than relying on public cloud alone," said Manish Chawla, a member of IBM's Industry Academy and IBM Global Managing Director for Energy & Natural Resources.

"Practically, this means customers can now access DELFI in locations that previously were not possible," Mr Chawla says.

"By expanding market access to the DELFI environment we take a major step forward on the journey to establishing the open and flexible digital environment our industry needs," said Olivier Le Peuch, chief executive officer, Schlumberger in a press release.

Trygve Randen, Global Director Digital Subsurface Solutions, Schlumberger, says that the project "will help place new technology capabilities in the hands of many more energy companies, helping them to accelerate their digital transformation."

The development follows Schlumberger's announcement in August 2019 that it would make the data ecosystem part of DELFI open source and available to OSDU, "Open Group Open Subsurface Data Universe Forum". This is a project to develop an industry standard for oil and gas data.

Self-service industrial analytics

Many people believe that the best pathway to industrial digitalisation may be in making it easier for experts to design their own analytic methods. We asked TrendMiner how this can be done in oil and gas

We often hear that digitalisation implementation in industrial situations may go easier if the domain experts were able to create their own analytic methods, just as they do with Microsoft Excel, rather than being given analytic software with methods embedded in them.

TrendMiner, a software tool owned by enterprise software giant Software AG, does this, providing domain experts in companies with "self-service industrial analytics".

These domain experts might be process engineers, reliability engineers or production engineers, either working in central groups or directly on the field.

The company sees the approach as supporting "democratisation of analytics", making analytics available to far more people, to do however they want.

It is too common for experts to be presented with "black box models", a software tool which promises to explain something, without telling you how the analysis is done, says Julian Pereira, Head of Customer Success EMEA at TrendMiner, and a former chemical engineer on petrochemical and gas plants.

The analytics is based around time series data, such as series of pressure, temperature or flow measurements at specific time intervals.

Domain experts analyse time series data to try to get a better understanding of what is going on, resolve problems, make predictions, or make optimisations.

With TrendMiner, domain experts can do their own analysis, finding answers to their own questions, or testing their hypotheses.

The software can be used "out of the box" without a great deal of learning, TrendMiner says.

For example, if a domain expert wants to find out how many trips a compressor had in the last 2 – 3 years, and then for each of them, bring up complementary data, to try to see why it happened, this is quite easy to do with the software.

"You can do this in a matter of half an hour without having to make a model. That's what we mean by democratisation," says Mr Pereira.

There are tools to search for patterns in the data. For example if you see an unexpected spike in one of the data streams, you might want to search past data for other times a similar spike happened.

It can also be used in a more customised way, for domain experts who want to try out different ways of analysing the data to see what gives them the most insights.

For example, you might want to calculate a particular KPI for a piece of equipment, such as the percentage of time it has been in operation.

If you understand the cause of a certain problem, and then recognise the data "signature" which shows that this problem is emerging, you can set up alerts to be warned if this signature is seen again.

There are tools to look for correlations in data patterns on multiple sensor streams, which might help you identify the cause of a problem.

If you identify a particular data pattern as interesting or problematic in the data streams from one asset, you can search for the same pattern in data streams from another asset, or thousands of different assets.

Oil and gas use cases

The software is used in the chemical, petrochemical, upstream oil and gas and other process manufacturing industries. Oil and gas customers include Total, Dominion Energy, OMV, Wintershall.

Specific areas the system has been used in upstream oil and gas include working with well production data, analysing compressor data to try to identify the causes of problems, monitoring seal leakage, analysing fouling on a cooler, and monitoring MEG injection to stop hydrates forming.

One oil and gas operator studied the impact of different start-up speeds on how long the well would stay in operation.

"They figured out that the production time depends on how fast they start up the well," Mr Pereira said.

Then they could identify the start-up time which would lead to the longest production time.

The start-up process was very manual, with different tasks, and it could work out the best way to do them.

Another interesting use case looked at critical equipment reliability. One customer had seen a number of "trips" (automatic switch-offs) happening for two months.

TrendMiner was used to identify factors happening before the trip, which could show it followed the erratic behaviour of particular valve.

By bringing in data from maintenance systems, it was possible to identify that this erratic behaviour followed a rework done on the electrical system, thus identifying the root cause of the problem.

The data can also be used to analyse data which is used to generate allocation models, which oil and gas companies develop to try to determine which reservoirs their production is coming from, when the production streams are comingled upstream of a flowmeter. You can create "soft sensors" – sensors which give you flowrate data, which is compatible with the observed sensor data, without actually having a flowmeter in place.

The system is also being used to monitor the performance of electrical submersible pumps (ESPs). In one case, it could identify a data pattern which would occur 30 minutes before a problem occurred, and so this problem could be prevented.

About TrendMiner

TrendMiner was founded in Belgium in 2008 as a standalone software company, and was acquired by Software AG of Germany in 2018.

The software has standard integrations with a wide range of historians such as OSIsoft PI, Yokogawa Exaquantum, AspenTech IP.21, Honeywell PHD, GE Proficy Historian and Wonderware InSQL.

TrendMiner works closely together with clients to help them work out what they can do with the software, and talk about different value cases.

There are three main applications inside TrendMiner. One to example time series data, one to look at contextual information (what else might be going on at the time a problem happened); and one to create your own dashboard to monitor what is going on, which people in management can monitor. These dashboards can be used by operations staff and management, as well as process engineers.

2020 upgrade

In July 2020, an upgraded version of TrendMiner was released, version "2020.R2". The upgrade has a better user interface, better trend analysis tools, and 8 language options - German, French, Spanish, Portuguese, Dutch, Mandarin and Simplified Chinese (previously it was only available in English).

"A common saying in product development is: 'If your customers love your app and what it does, they'll love it twice as much in their own language,'" said Rob Azevedo, Product Manager at TrendMiner in a press release.

The company says that the new release "sets new standards in usability for self-service industrial analytics" for operational experts, making it easier for them to make "data driven decisions" on how to optimise performance, and solve production problems faster, analysing time series data.

Other new functionalities include a recommendation engine, and a "tag builder".

There are new analytic functionalities, and better ways to search for data, and easier ways to share work with colleagues. The company is continually improving ways to integrate data sources, such as connecting to different data historians and maintenance data.

Repsol, Wood and Microsoft on IT management during COVID

Senior IT staff from Repsol Sinopec UK, Wood Group and Microsoft shared their experiences managing IT and cybersecurity during COVID, in a webinar organised by Oil and Gas UK on Jul 29

Covid has had a big impact on the operations of IT departments, including supporting remote working and managing cyber security.

Trade group Oil and Gas UK organised a webinar on July 29 with senior representatives from Repsol Sinopec Resources UK, Wood Group and Microsoft, "Rethinking IT and Cyber in a Post-Lockdown World."

Repsol

Martin Ogden, Head of IT and Digital, Repsol Sinopec Resources UK, said that when he joined the company in late February, there was little idea about the ramifications of COVID, except for concern about workers coming from different parts of the world and going offshore.

Repsol Sinopec UK operates 38 fields from a head office in Aberdeen, and has interests in 48 fields in total.

Mr Ogden had previously been CIO of services organisation Expro for 8 years.

Mr Ogden set up an incident response website, using software he had used previously, enabling information to be shared between employees and contractors, including by e-mail and text message. It took about 2 weeks to set up.

By early March, "it was becoming obvious this was bigger than we thought," he said. The company looked at implementing more rigorous cleaning regimes at its facilities, prohibiting visitors, prohibiting employees from visiting clients, identifying staff at particular risk.

Plans were put in place for home working, including asking line managers to see if groups of staff could work at home for short periods as a trial, also looking to see what the company would need to provide for them, including finding out which people did not have suitable equipment at home, or did have equipment but usually left it in the office.

"We had to issue advice, if you've been issued with a laptop or portable device, make sure you take it home in case you're not allowed into the office the following day."

A number of new software licenses needed to be taken out, including with CITRIX and RSA tokens, so people could use their own devices.

The company also purchased 180 Microsoft Surface Pro laptops, and started working with

Screenshot from OGUK's remote working and cybersecurity webinar on July 29. Top row: Martin Ogden, Repsol Sinopec; Daniel Brown, CDA; Andrew Thom, Wood. Bottom row: Rik Irons-Mclean, Microsoft; Sakthi Norton, CDA; Jocelyn Fraser, Repsol Sinopec

Microsoft Teams, getting people used to remote working.

The company had been working on a "modern workplace project", intended to be a 6 month project to deploy tools and technologies, supported by a training program, branded as a "business enabling activity", not just an "IT upgrade", to get more enthusiasm behind it.

But it had to speed this up, setting up 180 computers in a week.

There was uncertainty over specifically when the government would issue a "lockdown order", so the computers were distributed as fast as possible. The computers had all been distributed by the time the decision was taken to close the office. Two thirds of company staff were ready for remote working with company devices.

People were asked to attend a specific session and get their devices registered on the network.

Eventually, there were only 20 people in the office on the day lockdown came into effect, March 22nd, and already it felt very weird being in the office, Mr Ogden said.

"In addition to company efforts to prepare for lockdown everyone was dealing with personal stresses - childcare, home schooling, panic buying," added Jocelyn Fraser, Information and Risk Manager, Repsol Sinopec Resources UK.

Post lockdown

After the UK's lockdown in March 2020, there were a lot more support calls in the first few weeks, with requests ranging from asking how to switch on the computer to how to configure advanced features. There were many requests for more basic computer equipment.

The phone call directories were changed from desktop numbers to cell phones.

Before Covid, it had been hard selling the case for remote working, to people used to working in offices. But now people are geared up for it, "it will open up a huge raft of opportunities," Ms Fraser said.

"We have seen productivity maintained during remote working and in some cases even increased."

The organisation previously had a culture where many managers were not very in favour of home working, Mr Ogden said. But now they have done a complete about face. Although there is still a mindset of counting the "time spent online".

People were allowed to adjust work time so they could meet home commitments, such as working early mornings and evenings so they could care for children during the day.

It was also important to keep in regular communications with people, Mr Ogden said.

People were spending more time in front of their computers than they would do in a typical office work day. The company started encouraging virtual coffee breaks, quizzes, step counting challenges. "You get out of bed, have breakfast, walk into your kitchen and sit there for 8 hours and realise you haven't moved," he said.

One of the biggest issues turned out to be variable broadband performance, including because of competing demands from others in the house, something which is largely out of the control of the IT department. This was sometimes wrongly blamed on the company network being slow.

Post Covid, the quality of home broadband connection should be taken into account when deciding whether someone can work effectively from home, Ms Fraser said.

Another issue is the quality of people's working spaces. Some people had fully equipped offices in their houses, others used corners of the kitchen table. "That's acceptable in the short term, but over long term we'll have to give it more consideration, to ensure physical and mental well-being is being maintained."

The IT team was challenged by the wide range of different devices, connection methods and systems it had to provide support for. Previously it would have been a much more predictable environment, and narrow suite of applications, she said.

By early August, most personnel were comfortable with the work practises, and had established a routine which enabled them to be productive, Ms Fraser said, although some people still need some technical support, or skill development.

The company is looking to develop a network of "business champions", who will act as a link between the needs of business units and the IT people, identifying problems and opportunities, and keeping people engaged in the discussion.

The company has also used the live broadcast functionality of Microsoft Teams, for a speech from a CEO who was appointed in April, which 600 people watched. In the past, a speech would have been made from the head office, which meant the offshore audience could not hear it. There would also have been work involved finding a suitable venue, and people would need to get to it.

The company is doing equipment monitoring and competency assessments with remote working technology, which would have been done face to face in the past.

There was an increased use of video training, where it is also possible to get a bigger audience than doing it face to face.

As of the date of the webinar (Jul 29), Repsol planned to bring staff back to the office from August 7th, but splitting people into three groups who would come into the office on alternate weeks.

There may be challenges with this when people go back to the office, when they have new desk plans to allow social distancing. There may be times when a desk does not have anyone sitting at it, but their computer is in use.

The company has not one much new recruiting into the organisation during the Covid period, but it is something it would need to do "moving into the new normal", he said.

While people may be familiar with the technology, they would not be familiar with the duties they were expected to do, and might not have the skills. "It's something we need to give consideration to," Ms Fraser said.

For the geoscience / reservoir engineering teams, some remote desktop technology was used, so they could access their office machines.

Mr Ogden was asked if the company's Business Continuity Plan proved helpful. "Not really," he replied. "A lot of business continuity plans have a starting position of a natural disaster or fire, you don't have access

to equipment. I suspect few organisations had global pandemic busines continuity plan."

Managing digital

In terms of managing the digital operations, a lot of processes have become more complex. On example was replacing hardware in a computing centre during the lockdown. There were concerns about whether staff might be stopped by police if they visited company data centres.

There was one offshore asset which had problems going live with a new permit to work software system, because the company had restricted the number of staff who could go offshore. The workaround was to have support staff connecting via virtual meeting rooms who could ask questions. People are now asking why they were not using remote working for tasks like this before – it would have been much cheaper.

Improving performance

Overall, the company needs to improve performance as well as just survive, Mr Ogden said.

Methods to do this include embracing agile work practises, collaborating more, deploying standard repeatable processes, and trying to move away from doing things on Excel, and perhaps finding more ways to learn from other industries, he said.

The company is keen to explore more continuous reporting systems, rather than monthly or yearly reporting, he said.

Cybersecurity at Wood Group

Andrew Thom, Business Information Security Officer with oil and gas services company Wood, has founded and chairs a "Service Organisation Cyber Security Forum." It is a body for representatives of the oil and gas service industry to collaborate on cyber security.

It is structured as a Special Interest Group of Oil and Gas UK, and has 32 members including the UK National Cybersecurity Centre (NCSC) and Police Scotland. The members range in size from 100 employees to 100,000. It is structured similarly to HSE collaborative organisations.

The forum holds weekly online meetings to share threat intelligence over Microsoft Teams, and quarterly face to face sessions.

Threat intelligence includes talk about phishing accounts and compromised accounts. Typically, "threat actors" target a number of companies in the oil and gas sector, so targeting multiple forum members.

As a result of this threat intelligence, it has been possible for other companies to search their e-mail servers to see if the same phishing e-mails have been sent to anyone in their company, and contact the recipient.

Forum members review cyber security practise, such as how they secure cloud data, how they manage multifactor identification, how they manage work on Microsoft Teams, their incident response plans, and what metrics they report to the company board. There are also collaborations with other security forums.

The forum promotes skills development, and identifies skill gaps. It can also promote the cybersecurity capabilities of the members to the wider industry.

It is keen to ensure people coming to work in cybersecurity have appropriate skills. "Usually they are not lacking technical skills, they are lacking business skills," he said.

Graduates who start working at Wood in cybersecurity sometimes imagine they will be spending time staring at a dark screen wearing a hoodie. "the reality is they will probably be completing a spreadsheet on something," he said.

The group is looking for better ways to share threat intelligence, including on secure platforms. It is keen to grow membership and participation.

Remote working and cybersecurity

The group have discussed cybersecurity issues around remote working. One issue is when people are working somewhere where others can see their screen. Another issue is that they may be using malicious applications at the same time as their work applications.

During March and April, there were large numbers of malicious e-mails talking about Covid. "We took a lot of action to block those, and domains registered to scammers," he said. Then, when governments started issuing grants and loans, there was a growth in the number of scam e-mails pretending to be from the government.

Many employees received fraudulent phone calls, such as someone saying, 'I'm your broadband provider we noticed something strange about the account.'

"It is important people recognise these scams exist," Mr Thom said.

There were concerns at once stage about whether Zoom was secure.

There were challenges working out how people could connect to high performance computers, such as those used for engineering drawing (CAD), which they had previously only used in the office and were not necessarily network connected.

If the company IT department does not find ways to provide secure access, there is a risk that people will find their own way to gain access, he said.

People may be more vulnerable to phishing attacks when working at home, for example if they do not have a colleague sitting next to them they can ask for a second opinion about whether something feels legitimate.

The company previously had some multifactor authentication systems which used the specific machine as one of the factors of authentication. So there was a need to find a way around that if they were working at home on a different machine.

There were many discussion about best practise when using Microsoft Azure, including the concept of a 'network perimeter'. If a laptop, as a "perimeter device" does get compromised, then there is a challenge of getting it back online again.

"Best practise can be a bit of a grey area. Ultimately we're all trying to solve the same types of problems. It is good to get an insight on what others are doing," he said.

Ensuring the cybersecurity of the network turned out to be a similar task to ensuring the network is secure when people are working in the office, he said.

"You have to make sure you have visibility into what is going on. Multifactor authentication is the key to remaining secure," he said.

For new employees, one challenge would be "onboarding people remotely" – including from a cybersecurity perspective. If the person could not be seen face to face, you would need some other way of ensuring you have the person you think you have.

Future of home working

Wood Group has done a number of surveys asking people how much they would like to work remotely if they had the choice. "A lot of companies recognise it is the new normal. They haven't seen the drop in productivity they've been concerned about. A lot of people prefer it, such as for spending time with kids. Some people will work at home permanently for sure."

Contacting people to "just check in" is especially important for new employees, he said, "to make them feel part of something."

Microsoft

Rik Irons-Mclean, Director, Industry Strategy – Manufacturing, Energy & Resources, Microsoft UK, said that Microsoft's framework to support its customers has three tiers – "navigating the now", "planning the comeback" and "shape of the new normal".

Global trends Microsoft is observing include companies looking for more flexibility in working patterns, more visibility and intelligence about their supply chains to improve resilience, (particularly in construction and maintenance), finding better ways to optimise assets (keeping equipment running reliably

and production quality high), and better ways to manage security.

Microsoft is very interested in low code / no code, as a means that new applications can be "spun up quickly," he said. It plans to do a hackathon about low code / no code during the Engenious online forum in September, together with the Oil and Gas Technology Centre of Aberdeen.

Microsoft did an analysis of the transition one of its own company teams made to remote working, to gain insights which it could share with its customers. The team was 350 data scientists.

It observed that managers were communicating more than previously, and holding more virtual meetings.

There was an increase in 30 minute meetings – and now efforts going on to finish them after 25 minutes, so people get a short break before the next one.

There was actually much more collaborating happening between employees, he said.

The "working window" was shifting, with people doing most of their work "in the last 3 hours of the day", taking advantage of the flexibility to do their work whenever they wanted.

Mr Irons-McLean thinks 90 minutes is a sensible limit to be in front of a screen.

People are showing increased satisfaction with their business technology. One oil and gas customer had satisfaction levels of 36 per cent before Covid, now it is average 81 per cent, he said. People in senior roles are also increasing their levels of trust in technology.

Business lines are proactively asking how IT and technology can support operations.

Technology is breaking down some barriers, in that some companies had employees in remote locations which no-one had even seen before, now they are engaged in video calls, he said.

Microsoft was able to put a value on its Microsoft Teams collaboration system, with a Forrester Research study of 260 organisations across multiple sectors, all with 5000+ users of Microsoft Teams, which found that they saw benefits on average of $30m and costs of $3m from using it, he said.

Cybersecurity is seen as more of a people issue than a technology issue, with most problems caused by human mistakes, such as misconfigurations or accidents, he said.

digital energy journal

You can watch the webinar online at **https://vimeo.com/442992760**

Further information about the Service Organisation Cyber Security Forum is online at

https://oilandgasuk.co.uk/groups/service-organisations-cyber-security-special-interest-group/

Daniel Brown – perspectives on data maturity survey

Daniel Brown, executive director of Common Data Access, a subsidiary of Oil and Gas UK, presented his perspectives on the Data and Digital Maturity survey, in a Society of Petroleum Data Managers' Webinar

Daniel Brown, executive director of Common Data Access (CDA), a subsidiary of OGUK, presented some further perspectives on the survey, in a webinar organised by the Society of Petroleum Data Managers (SPDM).

Mr Brown noted that some companies are now spending 2-3 per cent of their global revenue on IT at the moment. It means we really ought to be fully digitalised by now.

One sticky point seems to be collaboration. In this year's survey, as in previous years, many respondents say they agree collaboration is beneficial, but there are not so many examples about where the collaboration is taking place.

Meanwhile daily work for many people in oil and gas companies still involves a lot of form filling and spreadsheets, Mr Brown said.

Digitalisation brings benefits to the working environment as well as business efficiencies, he says. With a good digitalisation infrastructure, people can have new tools built for them in a few weeks rather than waiting years for new software. And the new generation of workers usually prefer working in digitalised environments.

One cause of the slow progress to digitalisation could be the "asset focussed mindset" the industry has, he said.

Deloitte publishes a "digital maturity index" ranking different industry sectors, which puts oil and gas at the bottom. Other similar surveys either have oil and gas at the bottom, or close to it – perhaps with construction at the bottom and oil and gas next, he said.

Most oil and gas companies only started digitalisation projects 2-3 years ago.

"We reckon there's still a third of organisations don't have a digital strategy," he said. "If you're working for an organisation that doesn't have a digital strategy, there's an opportunity to get behind one."

Improvement

There are improvements happening. Mr Brown says that the commonly quoted figure, that geoscientists spend 70 per cent of their time looking for data they need to do their work, no longer holds.

"Two thirds of organisations report they have the information they need to do their work. We have come a long way. The sense the data is there is very strong," he said.

Companies have also made significant investment in methods to extract value from data, including data processing and infrastructure. "That certainly helps us in terms of how we can collaborate and move data around," he said. "I'd argue that is just the first step."

Trust is an issue. According to the survey results, companies have a "pretty high" level of trust for data sourced from within their own organisations, but very low levels of trust for data received from other organisations.

Driving collaboration

One factor is that "in the UK we don't see any clear leader for driving digital collaboration." It is hard to think of examples of successful collaboration which did not have a clear leading organisation or body.

Daniel Brown, executive director of Common Data Access (CDA)

"Certainly, we think there's roles for main industry organisations in this," he said.

The OSDU (Open Subsurface Data Universe) project, an initiative to develop standards for subsurface data supported by Shell, is supporting a lot of collaboration, he said.

In Norway, "Equinor has shown a similar level of leadership", he said.

"There's questions for us as data professionals how we can build effective collaboration, up and down and across the supply chain, so we can do digital collaboration more effectively," he said.

Role of data professionals

Meanwhile, the role of data professionals appears to be changing, he said. The traditional role was loading and curating data. But today, data professionals are increasingly expected to be able to use data science tools, such as Jupyter Notebook.

These tools "let you deliver in days and weeks what might other take more formal standards processes months and years," he said. "It is now becoming important for data professionals to become familiar with that area. The ability to extract value from data is leading [increasing] in prominence."

OSDU

Mr Brown was asked what he thought the Open Subsurface Data Universe (OSDU) project would bring to the industry.

"OSDU has such promise and such potential [for having] the ability to deal with the issue of getting the data you need for your applications. [That's] a fundamental enabler in how you work. It will be a fabulous capability," he said.

"The big question is how the individual organisations that use it will apply it, and ensure it delivers the value and continues to deliver on it."

"I would encourage you to get to know it and contribute to it, so as a community we can make our own contribution."

One audience member (name withheld here) expressed scepticism, saying he was reluctant to spend too much time looking at it. "I remember how enthusiastic Shell was about Open Spirit, and before that how enthusiastic they were about Epicentre, and Mercury before that, and so on," he said.

Agile working

One audience member asked if there was any advice in how to persuade clients of consultant data managers to accept "Agile" working practises.

"When it comes down to it, they want a proposal, busines analysis, guaranteed outcomes, timescales, costs, which is absolutely not Agile," the audience member said. "They are not prepared to provide the level of input and support that Agile requires. They want you to take a problem away and solve it."

"So, there is a bit of a mismatch there between emerging new methods and our ability to absorb the uncertainty that sits with Agile. If we say at the beginning, 'we can't guarantee what we're going to deliver,' it doesn't wash very well."

Mr Brown replied, "the ability to figure out how to do Agile across the supply chain - I think that's symptomatic of the distance we still have to go."

One audience member said, "there's some people who don't want things to change - they want things to be where they've always been. When you say Agile - people think they are going to rapidly move to a new solution. "The flow of data is so complicated any change has unexpected consequences somewhere else - it would annoy somebody."

"There's a big difference between investing in IT as a way of trying to reduce your costs, and investing as an opportunity to improve your benefits," Mr Brown replied. "You're asking the companies to share some of the risks. Some companies do not like sharing risk with vendors - they want the vendor to guarantee this is going to work."

The webinar is online at
https://youtu.be/RsAoNUo6Cwo

The UK's data and digital maturity survey

OGUK, Deloitte, TLB, OGTC, ONE surveyed the UK industry to find out about the current digitalisation landscape and what sort of projects companies are currently tackling

A survey of digitalisation in the oil and gas industry revealed there's a strong appetite to ensure technology is matured to improve the sector's connectivity, efficiency and sustainability but highlight the need to promote collaborative working if these transformational changes are to become a reality.

With support from Deloitte, the UKCS Data and Digital Maturity Survey was launched in June 2020 by OGUK, the leading representative body for the UK offshore oil and gas industry, in partnership with the Technology Leadership Board (TLB), the Oil and Gas Technology Centre (OGTC), and Opportunity North East (ONE).

The intention was not to measure organisations, but to understand organisational attitudes, strategy and progress, said Sakthi Norton, Delivery Manager, CDA.

Digital transformation requires a holistic approach, looking at the whole organisation not just a piece of it, she said.

The survey looked at four components – data (as the foundation of digital), people (with regard to digital culture and capability), innovation (a process to driving ideas, developing pilots and developing successful ones), and how technology is focused on problems to be solved, and deployed in the right way.

There were 73 responses from organisations, of which 28 were from operators, 9 from service companies, 10 from "specialists", 6 from software companies, 17 from consultancies and 3 from "other". Most of the surveys were completed by the people responsible for digital in their companies. 15 follow up interviews were held with organisations.

The survey found that the drive to do more with technology is very much driven by operators, who are at the top of the supply chain. So operators are in a "critical leadership role". Suppliers are not given much space to participate. "Only a quarter of operators and service companies integrate supply chain partners in their digital transformation programs," she said.

Data itself is clearly regarded as the priority for driving digital value by all organisations, with a focus on increasing data quality and increasing the insights which can be gained from it.

So there has been much progress in data management and its effective use. It looks like data consumers have data they need and are effectively exploiting it, she said. "About two thirds of organisations report positive experiences with the company's data management processes, being able to access the data they need."

Sakthi Norton, Delivery Manager, CDA

Typically executives show a more positive experience with data than people in a middle management / practitioner role, especially in terms of access to data.

People find it much easier to work with data from internal sources than external sources, she said. That may be more due to the hassle of working with external data. It often needs more manipulation to import, including converting file formats and "having to deal with a lot of paper, surprisingly, including e-paper {like pdfs)" she said.

"There's an opportunity for the industry to work together to [work out how to] move data more effectively between organisations."

Technology investment so far is largely focussed on offshore operations, with the highest areas being production monitoring and optimisation, maintenance and operations readiness, asset information management, site and asset monitoring, engineering design.

While it makes sense to apply digitalisation for offshore operations, we may be missing something. "Many non-operational processes are complex too – procurement, logistics, which would also benefit from technology and digitalisation. So what we don't know here is, why there is such a focus on offshore operations. Is it truly justified, or is it just familiar territory? We do know that we must explore every possible opportunity."

Looking into technology implementations, of the top 10 technologies, we see that "visualisation technologies, especially reporting dashboards, are the most widely adopted so far," she said.

"This shows a natural starting point in building digital foundations by making use of existing data sets," she said.

The survey listed 39 different technologies for participants to rank their interest in. Of these, "data processing technologies" – including machine learning and analytics – ranked least of interest, which may be a surprise.

It is fair to say that organisations might first want to focus on organising their data before going into processing and exploiting it, she said.

But if that investment is left too late "once the data is ready, the organisation may not be ready to take that next step into processing. So it is one to keep an eye on."

On the people side, while organisational strategy and changes are being implemented, "the training and supporting of people that is required as part of this change is far less common," she said.

But the training is still mainly for specific tools and systems, not on "building an industry wide digital culture," she said.

It would be good if the industry's digitalisation culture would one day be as strong as its HSE culture, which has been built up over decades through a mixture of training, engagement and leadership, she said.

In terms of innovation, the research found that having an "innovation process" is a "strong marker" for digital maturity. But most organisations do not have an end-to-end innovation process.

An example could be a process to gather views and ideas from people involved in different business activities and involve them in developing solutions. Then have some form of funding available for pilots, and developing successful ones for wider roll out if they prove successful.

Many technology implementations go no further than the trial / pilot stage. "When it comes to taking that to widespread rollout - that's where it really drops," she said. Although it isn't clear why – if people are not trialling the right pilots, or not funding the scale-up.

"We found a desire for digital collaboration, but in reality, there are still very few examples of inter-organisational or industry-wide digital collaboration, like OSDU or CFIHOS," she said.

It sounds like "we all want to collaborate, but we struggle on how to do so."

"There's a need for clear business models to facilitate digital collaboration."

When it comes to sharing data, the question is not usually which data to share, but whether it should be shared at all, she said. When people were asked in the survey "are you willing to open up your data sets to other organisations," there was a larger "don't know" answer than for any other question.

The top four barriers to digitalisation reported were organisational rather than technical – legacy organisational processes, lack of available investment, absence of a co-ordinated strategy, lack of digital skills.

Data standards and cyber security concerns come far lower down the list of barriers to digitalisation, she said.

Digital represents a fundamentally different way of working. "So its no surprise that legacy organisational processes rank as the highest barrier."

"We have these monolithic enterprise wide systems which were an important investment at the time, but are they still doing what we need them to do?

We're used to capital projects taking several years from design to delivery, and by then the technology has likely moved on. We must make room for more agile ways of working."

Respondents other than operators said the lack of investment in digital technology was the biggest barrier.

In terms of overall progress so far, "the industry has clearly started on its digitalisation journey, and almost everyone believes digitalisation has the opportunity to make a positive impact," she said.

But at the same time, almost "three quarters of practitioner roles reported that they see the opposite in reality, digital initiatives have often resulted increased work and delivered little benefit."

"The key message is that digitalisation is happening, but many of us are yet to fully experience its benefits." There's still a gulf between perception and reality of digital, she said.

60 per cent of organisations indicated they had "implemented many digital initiatives" or "were a truly digital organisation."

But "implementing many digital initiatives" does not necessarily equate to maturity in digital transformation - without the accompanying culture transformation, she said. It means organisations are "digitised" rather than "digitalised".

Mikki Corcoran, TLB

Mikki Corcoran, general manager Europe with Schlumberger, and joint chair of the Technology Leadership Board (TLB), said, "The survey has allowed us to understand where we are today in terms of digital technology within the industry."

TLB's aim is to be "the single industry voice on technology on the UKCS, governing the overall strategy, with an objective to maximise economic recovery while achieving 'net zero'."

TLB sees that "data sharing" is one of the biggest challenges, including sharing data between oil companies, and between supply chain companies. This is a topic "which has been on the table for many years."

"If we don't overcome this, we won't be successful. That is going to require a lot of commitment and leadership from across the board and energy sector," she said.

"Sometimes the only way we communicate value is through a competitive environment," which makes it hard to communicate the value from digital technologies, if it does not directly improve the competitiveness of one player. "I think it is time we do this in a non-biased environment," she said. "We can share in a nonbiased way."

Ms Corcoran said that culture "is quite a challenging topic," and has to start with leaders understanding what the culture should be, demonstrating what it looks like and communicating it, then letting it develop over time.

OGA

John Seabourn, chief digital officer of the UK's Oil and Gas Authority (OGA), said he appreciated that "people are being a little bit more open about data and data issues we are having.

"Once that is sorted, or at least open, we can move forward with digitalisation," he said.

The idea of a "digital strategy" means people start focussing on the value and benefit from

digital technologies rather than seeing it as a cost, he said.

"It is good to hear skills being mentioned. We're encouraging people to take personal responsibility for digital skills," he said.

One of the biggest difficulties with the various incubators doing analytic tools is "getting data to feed those," he said. But, "with our executive powers we can ensure data from across the industry can feed into those projects."

"One of big recommendations of the Wood Review in 2014 was improving access to data." Then the Energy Act of 2016 basically encouraged compliance with what had been stated in the Petroleum Act of 1998, he said.

Deloitte

When oil and gas is compared to other industries, such as telecom, media and automotive, it is clear it has put a lot of money into technology, but still lagging in its digitalisation, said Guri Neote, Director - Infrastructure & Capital Projects Consulting, Deloitte LLP.

The industry does not actually have that many "formal innovation processes" to nurture digital ideas, with sponsorship behind them, he said.

In terms of capability, Deloitte observes that the industry has many digital "enthusiasts", but it does not have so many people who know how to implement it, or as she describes it, "people Who come from a digital background - who understand what it takes to be a bit more agile in developing an idea."

The industry also suffers from a notion that "digital can be cracked through piecemeal investment - or piecemeal problem solving," he said.

"What you'll in other industries, such as automotive or telecoms - they look across the whole value chain, back office and front office."

And in other industries, the drive to do more with digitalisation has often come from a need to provide a better customer experience.

Some other industries have looked at better ways to share information. For example the automotive industry is just as "dis-aggregated" as oil and gas, but "there's been a real pull on having the supply chain involved," with ventures like product lifecycle management, and sharing design data.

You can watch the video online at **https://vimeo.com/453908536/e1fec24363**

To download the full report, Google **"UKCS Data & Digital Maturity Survey 2020"**.

Dräger – 120 wireless gas detector North Sea installation

Dräger Marine and Offshore has announced a Eur 1m order to install 120 wireless gas detectors on a North Sea oil and gas facility, thought to be one of the largest wireless gas detection systems in the world. There are big improvements in reliability of connectivity, battery life, and capability to discriminate between different gases

Dräger, an international leader in the fields of medical and safety technology reports that its Marine and Offshore division has just signed a Eur 1m order with a North Sea oil and gas company to fit a network of 120 wireless gas detectors covering a facility, thought to be one of the largest wireless gas detection systems in the world. The installation of the equipment commenced in September 2020.

Dräger was not able to reveal the name of the operator, but it is able to say that the project needed to be done quickly with minimum installation costs. The client wanted freedom to position the detectors where the risk of gas leaks was thought to be highest, but without having to consider the complexity of laying cables through old infrastructure.

They were installed because the company safety department thought there was a need for additional gas detection.

Dräger is a German-headquartered company operating worldwide and specialising in the fields of medical and safety technology. Its marine and offshore division, based in Aberdeen, supplies gas detection and monitoring equipment, breathing and protection equipment, and other safety equipment and training.

Wireless gas detectors can be much easier to install than traditional cabled systems, because you don't need to worry about cables, and drilling holes in equipment to run cables through, or positioning devices in places which are easy to connect to a cable.

But until now, battery life and data communications reliability (and commonly dropped connections) have also been big weaknesses.

The technology has improved massively in recent years, says Megan Hine, account manager - Fixed Gas Detection Systems with Dräger Marine and Offshore.

Today, the installation and commissioning costs for a wireless system are typically 25 per cent that of a cabled system, she says.

Equinor has published figures saying that the savings in installation cost from using wireless detectors instead of cabled are 60 per cent for an offshore installation, and 80 per cent for an onshore installation

And wireless systems can do a better job, because the inflexibility of cable-laying means that you may not be able to put a detector in the best location if you need cables.

The detectors are "sniffer" type – detecting gas when the gas molecules actually enter the detector – so they need to be positioned carefully to try to get them in the line of flow of any leak.

The communications reliability can be affected by the positioning – and this is something which specialists are learning more and more about.

Megan Hine, account manager - Fixed Gas Detection Systems, Dräger Marine and Offshore

A blast wall, or a hill, will block wireless data transmission. But congested pipework can actually reflect the signal and make it stronger, Ms Hine says.

The low power draw of the battery device also makes them intrinsically safe – they don't have enough current to make a spark. This means they can be installed and commissioned without shutting the plant down.

Wireless gas monitor

Dräger's gas detectors have batteries designed to last up to 2 years. The battery life cannot be defined precisely, because it depends on the amount of data being sent, and if the detector has a heater (see below). But it compares to other wireless gas detectors on the market which have a typical battery life of 3 months, she says.

Wireless systems have been installed on FPSOs. They have also been deployed on a vessel on a temporary basis, where there is a temporary need for more gas detection because of how the vessel is being deployed.

Communications

The detectors use the ISA-100 communications protocol, which uses the same 2.4 GHZ frequency as Wi-Fi.

The protocol is specifically designed to carry short data packages, perhaps equivalent in size to 10 text characters, within a specified time with absolute reliability. In contrast, cellular communications (3-5G) and Wi-Fi are designed to carry large data files at high speeds, but the transmission reliability is less important, Ms Hine says.

The two standard industrial wireless protocols are HART and ISA-100. ISA-100 is the only protocol which has a "Safety Integrity Level" (SIL) – and Dräger's devices are SIL 2 rated. "We can't do that on HART," she says.

Infrared & electrochemical sensors

Dräger has also developed an electrochemical infrared based sensor "Polytron 6100" which can detect and identify 144 different toxic gases.

A basic "sniffer" gas detector uses electrochemical methods, oxidising the target gas at an electrode and measuring the resulting current. They use very low power.

The infrared detector, "GS01", works by sending out an infrared beam, which is absorbed and reflected in different ways by different gases. By analysing the reflected beam to see which wavelengths are missing, you can determine which flammable gases are present.

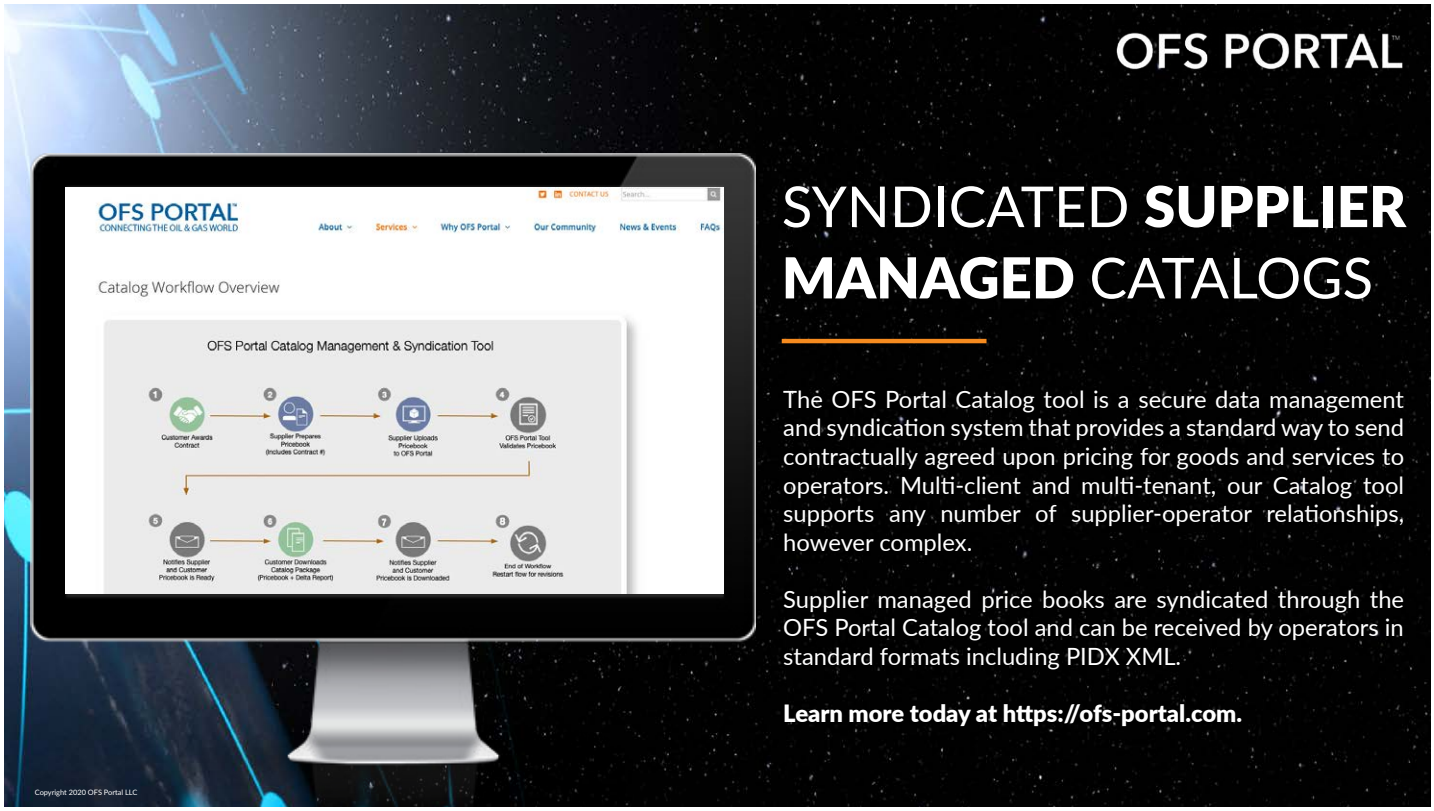
Using the Polytron 6100 It is possible to detect 144 different toxic gases, including hydrogen sulphide which may suddenly appear in the production gas stream from a well.

The technical problem with wireless infrared gas detectors is that they need a heater – which drains battery life.

This is because the beam is sent out from behind glass, which must have a heating system on it to prevent water from condensation on it. Any condensed water will stop the sensor from being able to detect methane, because it absorbs the same frequency of light as water.

The innovation with the GSO1 was to only heat up the part of the glass which the beam is going through. This way it was possible to reduce power consumption from 5 watts to 5 milliwatts.

The system is also switched on only when it senses a pressure change in the gas. If pressure is constant, the detector beam can be left switched off. This leads to further big improvements in power consumption.



PIDX's Emissions Transparency Data Exchange Initiative

For accurate greenhouse gas reporting, a great deal of data needs to be exchanged between companies in the oil and gas supply chain. PIDX has a plan to develop a standard

PIDX, an oil and gas organisation making standards for digital business, has a plan to develop a set of standards for exchanging data about greenhouse gas emissions.

The focus of the work is not the accounting for emissions themselves – that problem is being tackled by many other groups. The challenge being tackled here is finding trustworthy and reliable ways to share data between companies.

From a technical perspective, it is a similar challenge to making standards for electronic commerce documents, such as electronic field tickets, electronic invoices and payment documents. PIDX's standards for this are used around the world.

To illustrate the data exchange challenges associated with emissions, consider that companies are being asked to report their "Scope 1" emissions (defined as emissions from activities which the organisation does or controls), and "Scope 2 emissions" (defined as emissions made from items which you purchase and do not control). These are added together in some way to provide a number for "Scope 2" emissions for a company downstream in the value chain.

To explain that in less abstract language – consider that a drilling company drills a well. To do that, it buys equipment and uses fuel. The well is handed to an operator, which produces oil which is sold to a refinery, with more energy being used at all of these stages. The refinery sells the refined oil, and needs to quote how much greenhouse gas was emitted in the production of the refined oil to its customers' scope 2 emissions.

For the standard to work as a reliable means of exchanging data between companies in the oil and gas delivery chain, people need to trust that the data is accurate enough for their needs, and any confidentiality requirements are carefully looked after.

There is a big question about how to set the scope. The number of details which might be included in a calculation could get infinitely long and varied. For example, the CO2 which is emitted by operations 'under the control' of the refinery is not constant – it may depend which pumps are in operation, what the outside temperature is, extending to very small factors such as how many staff were at work that day, the emissions made by their cars and in cooking their lunch.

If electricity is used, the CO2 emissions will depend on whether generation of that power is allocated to wind, coal or nuclear.

A further complication is where a company has purchased CO2 offsets and used that to reduce its emissions data – because there can often be doubt about whether an offset is reasonable, such as when someone gets an offset income for not deforesting a piece of land, but then saws down some trees elsewhere.

Where a manufactured item is used to make something else, you need to estimate the lifespan of that manufactured item in order to allocate the emissions further down the chain. To illustrate, you might calculate the CO2 emitted in manufacturing a car, but if someone is driving the car to work every day in a refinery, you need to somehow translate this into part of the CO2 emitted making a certain cargo of refined oil.

There is a practical limit to how much of this can be included. But there may also be a commercial incentive for companies to include as little as possible in their calculation, so it makes their emissions numbers look better.

It would be possible to simplify the calculation without adding in too much error by calculating the annual emissions made by all services the refinery controls, and then dividing that by the number of hours of operation, and then calculating the number of hours the refinery needed to operate to produce a certain cargo of refined product.

Another factor is having clear differentiation between scope 1 and scope 2. There are services which could be reasonably included in either category – for example, when an oil company asks a driller to make a well, it is both a service it "controls" (so scope 1) and a service the company buys (scope 2). While it may not make any difference in the long run whether a certain emission is classed as scope 1 or 2, it is important that it is not counted twice.

A further complication is that there are many projects around the world to develop schemes for counting emissions in oil and gas – perhaps as many as 16. While PIDX does not wish to duplicate this effort, and is able to adopt any or many different schemes, PIDX will manage the trustworthiness of the data. So while it does not need to adjudicate or select a specific accounting method, it does need to determine whether the accounting method is adequate.

Chris Welsh, chief operating officer of PIDX

Many companies are also quite far along the road of developing internal schemes for accounting for CO2, but they are not all the same or necessarily comparable.

There is increasing need greater for data granularity. Until now, emissions data has largely only been provided on an annual basis. But companies will increasingly need to provide data about specific greenhouse gas emissions from specific assets for specific times of the day, or in the production of specific products.

Overall, providing good emissions numbers can be a source of competitive advantage, if a company wins business on the basis of having lower emissions numbers than a competitor. But again, this can only work if the data is seen by all parties as credible, so there needs to be a system to ensure this.

We may soon see a need for companies to report estimates of emissions together with any quotes they provide for services. For example a shipping company would provide a price to move a certain cargo, and an estimate of the emissions which would be made in moving that cargo. After the cargo is moved, the actual emissions would need to be included on the final invoice.

Regulatory reporting

Another driver for this project is to make it easier for companies to do their regulatory reporting. Energy companies are asked to provide data to an increasing number of agen-

cies, from their local authority to the United Nations, and they are all asking for data in a different way.

If there is a standard way to store granular emissions data, then it should be relatively easy to build software which can 'roll it up' into whatever format an authority requires.

"A big international company may have the exact same facility in 2 different countries with identical processes, producing similar emissions, but the reporting may be different because they are in different jurisdictions," says Franz Helin of Chevron.

Mr Helin is project manager in a centralized group of IT project managers that oversees medium to large IT projects throughout Chevron, who is involved in steering the project.

"There starts to become a lot of friction and duplicative costs - reporting the same information in 2 locales," he said.

But to sum up, "if you want to be carbon neutral by 2050, you have to measure it and prove it. Today I don't think anybody can do that," Mr Helin said.

Work plan

The first phase of the work to develop the standard will be to try to develop a harmonised idea of what data should be shared between industry participants.

The second phase will be to develop a prototype system for collection and normalisation (matching scales) of data.

3 working groups have been formed, looking at the process and workflows of emission data exchange, the messaging and schemas to be transmitted, and the infrastructure to enable the platform.

The group has selected two "use cases", designed to be as simple as possible, to get started.

The first is for collecting emission data from one manufacturing company, covering two greenhouse gases (such as CO2 and methane) and one month of data. The second use case is to develop a standard emission report from this data. This will also be limited to one asset, one submitter, two greenhouse gases

The use case work will work out all the data which needed to be moved around for a specific real world example, and what factors need to be taken into account to make a reliable figure.

The research group will also look at other emission reporting initiatives, and ways to collaborate with them. "One of the closest

Franz Helin, project manager, Chevron

alignments we've come across is with a consortium led by Shell called "Open Footprint", Mr Helin said.

"They have a track record of enabling some open frameworks that allow for many players across industries to openly share data - and enable common ways to represent their data. That in itself enables third parties to be able to come in and develop applications that interface with this common framework. So PIDX can contribute to the standards and maybe some of the schemas to be adopted by Open Footprint."

The project may also be extended to setting up standards of what suppliers need to report to buyers. This would be slightly different to standard measurement schemes which other groups are working on, but there would be some overlap.

In terms of persuading companies to join, every company is under pressure to show how it is making progress and contributing to a better environment.

"Those who resist because they are not comfortable , or have other insecurities, may lose the battle of public perception, and investor perception. If you lose the battel of investor perception, your company is going to be quite handicapped," he said. "So I think it is going to be driven by that pressure."

Anybody who is interested is welcome to join the PIDX work group, they do not need to be a PIDX member. "We're doing it for the industry by the industry," Mr Welsh says.

Security

The cybersecurity adds additional complications. While some information is made public, normally a figure for emissions per year per company, companies may not wish to make all of this data public. There can be commercial disadvantages from making data public, if it makes a supplier look worse than a competitor – perhaps a competitor which does not submit data, or submits data which only counts part of the emissions.

There are intermediate levels of transparency with data. For example, a supplier can make their data available to a customer, on the understanding that it can be used by the customer to calculate their own scope 2 emissions, but the information specific about that supplier should not be made public. But again, there needs to be a clear legal system so everybody knows what can be made public, and feels confident that the system will be followed by others.

This is a framework PIDX can build, because it is similar to the framework it already creates for e-commerce systems, such as when a supplier wants to provide a "price book" which can only be used by a certain customer, not made public.

From Chevron's perspective, the system would not necessarily need any additional security measures beyond Chevron's standard processes, Mr Helin said.

If data is being shared outside the company, the owners of the data would need to agree to it. "They would have to understand the security inherent in the external system that's going to apply and protect that data," he said.

The external systems that people choose to share and exchange that data through, need to have a robust security element, he said.

The Open Footprint Consortium has a number of tech companies as members, including Microsoft and Intel, and they may use their cybersecurity expertise to develop good security features for companies to "share only the data they want to share with only the parties they want to share it with," he said.

Data storage

The work by PIDX may involve developing a shared data storage system for emissions data for many different companies involved in oil and gas, with appropriate controls to ensure that only the right people can see it.

The data storage "is pretty simple", like any kind of reporting database. It is getting the data to that point, which is the hard part, says Chris Welsh, chief operating officer of PIDX.

It is possible blockchain may be a useful technology for securely storing data about emission history for a longer chain involving lots of companies, Mr Helin said.

Microsoft - helping integrate methane data on GIS

Microsoft is offering free tools to oil and gas companies to integrate methane leaks data from different sources, including public data, on a cloud based GIS system so it can be further analysed. Bill Barna from Microsoft explained

Microsoft is developing free tools for oil and gas companies to help them gather and integrate data about methane leaks, including both their own data and public data, and put it together on a GIS system which they can use to try to pinpoint where the leaks are.

Bill Barna, a Microsoft data scientist supporting upstream O+G companies in US, explained how it works, during a session on the SPE "Engenious" online conference in September 2020.

Mr Barna is based in Dallas, and works with companies which work in the Permian basin.

The background to the project is Microsoft's plan to be carbon negative by 2030, and remove all the carbon it has ever put in the atmosphere by 2050, and also to invest in technology which can help customers reduce carbon emissions. "This program is a result of that commitment," he said.

In projects, it will normally work together with customers, including sending its data architects to customers' sites, co-developing a solution with the customers' IT teams. "We collaborate very closely with our customers, we learn from them and they learn from us," he said.

Nobody knows for sure how much methane is leaked, but there have been high estimates. Mr Barna quoted a study from the Environmental Defense Fund which estimated that 3.7 percent of all the methane produced from wells in the Permian basin is emitted, unburned, into the atmosphere.

Another study published by US National Academy of Sciences in 2015 on one gas producing region, found that 10 per cent of natural gas leaks contribute 90 per cent of emissions, he said.

Technologies

Technologies which can be used to detect methane leaks include private and commercial satellites, sensors on aircraft, drones, fixed sensor networks, SCADA anomaly detection systems, and infrared cameras continually scanning assets.

"Most companies use a mix of these techonlogies," he said. But the challenge is gathering the data together, or as he puts it, to "leverage these data sources holistically".

The methane detection technologies all have strengths and weaknesses. But they can be grouped in into "high cost, high precision, but very small scale methods", and "low cost, low prediction but highly scaleable methods."

In the first group, we have commercial satellites, aerial and drone surveys and infrared cameras.

Commercial satellites are expensive, have limited coverage and medium sensitivity.

Aerial surveys have good sensitivity poor revisit times and must be purchased. UAV (drone) sensors have a limited range, and subject (in the US) to regulations that they must be in the operator's line of sight, he said.

Infrared cameras are accurate, but they are expensive, and usually operated by technicians, so cannot be used at high scale.

In the second group, "low cost, low prediction but highly scaleable" methods, we have public satellite data, which is low cost and has "excellent revisit intervals," but poor sensitivity.

Analysing SCADA data for anomalies (such as a reduction in flow rates which may indicate a leak) can give imprecise results, but the implementation costs are low, particularly if you can use existing data.

Fixed sensors can potentially provide good sensitivity, but usually with limited coverage.

Public data

A useful public source of data is the Copernicus Sentinel-5P satellite, launched in 2017 for monitoring the earth's atmosphere. It contains an imaging spectrometer for Tropospheric Monitoring. It overflies the planet every day, and can measure many atmosphere gases including methane.

But the spatial resolution is only 7km, and you need to be emitting 4000 kg per hour of methane for it to be detected. This means you can't use it to find one methane leak, you can only monitor the change in large areas over time.

Also, natural gas travels from emissions point and settles in different areas because of wind, atmospheric conditions, and geography, he said.

Another useful public source is production data reported to authorities. For example, operators in Texas and New Mexico are required to submit production data to state regulatory bodies on a monthly basis, and the data is then available for public download, covering all wells in the region for all operators for more than 10 years.

Integrating data

You need is a way to combine all these data sources onto one

platform. Microsoft suggests a geographic information system (GIS), such as Microsoft's Azure Maps, or ESRI's ArcGIS maps. The data can be viewed as different "layers."

The first step is to 'ingest' the data. Microsoft has developed a number of tools available to oil and gas companies.

It offers scripted processes for ingesting publicly available data relevant to methane, including production databases from the states of Texas and New Mexico, satellite data from the ESA's Copernicus system, so it can be viewed as layers on a geographic information system.

Companies can then expand on this, adding in their internally gathered data, or perhaps by purchasing commercial data.

Data analysis

One data analysis step you may wish to make is to take the current atmospheric concentration of methane together with historical wind data, which is publicly available, to work out where the methane is likely to have originated from.

You can also use a low resolution form of data, such as public satellite, to get an indication of where to spend money on a high resolution form of data, such as an aerial survey, then leading to higher resolution analysis, such as going through control system records or fixed sensor data.

With data shown in layers, "users can leverage the strengths and weaknesses of each data source without being negatively impacted by weaknesses of any data source," he said.

Microsoft plans to develop AI tools which could go through data and identify leaks.

It has done something similar with a tool developed for agriculture, called Azure FarmBeats, where a farmer can combine data from "connected cows", drones flying over the field and other sources, to get a single view of the farm, and then mine the data for insights onto how to increase yields while minimising long term environmental impact.

Ormen Lange - autonomous vessels collected data from seabed

Norske Shell has used autonomous surface vessels to collect data from the seabed on its Ormen Lange field, with data sent from seabed sensors via acoustics

Norske Shell has deployed autonomous electric propulsion surface vessels to collect data from the seabed on its Ormen Lange field, with data sent from seabed sensors via acoustics.

The vessels are owned and operated by XOCEAN, based in County Louth, North East Ireland. The company was founded in 2017.

Its vessel design, which it calls "XO-450", is a catamaran about the length of a car. It has two electric "pod" drives, which sit below the vessel, made by German manufacturer Torqeedo. It has a lithium-ion battery. The batteries can be recharged with solar panels on deck.

The two drives can be controlled separately, adjusting speed separately for each side, steering the vessel.

There is an additional pair of very small "ultralight" electric motors at the bow to keep the vessel on station when it is gathering data.

The boat has a range of 1,500 miles on one battery charge, which can last for up to 18 days.

The vessels are controlled by qualified pilots at XOCEAN's operations centre. They can also monitor the status of batteries and quality of data colleted.

The data is communicated by a broadband satellite connection.

The company currently has 8 vessels in service, with 4 more vessels to be added during 2020.

In the Ormen Lange project, the mission was to harvest data from an array of 30 sensors on the seabed, which were gathering pressure, temperature and inclination data at 800 to 1100m depth. The data was sent to the surface using Sonardyne acoustics.

The task was completed in 3 days, including 160 miles transit from Kristiansund to the Orman Lange field, and 12 hours on station retrieving data.

The low noise signature of the drives was an essential element, since the data was being sent through water using acoustics.

The autonomous surface vessel

Propelling the vessel – XOCEAN thrusters

XO-450 USV at sea

EM&I – low cost solution for reducing piping integrity risk

By using probability theory, we can get an indication of the level of risk of a piping system failure with higher accuracy and far fewer measurements than the traditional method. We talked to EM&I

Probability theory is a well-known statistical technique where you expect a distribution of anything in the real world to follow a bell curve (technical name is the Gaussian distribution).

Bell curves do not all have the same shape – some are more condensed than others. The challenge is working out the shape of the bell curve, with the minimum number of data points so that the probable minimum wall thickness and an understanding of the internal condition of the piping system can be assessed much more quickly and at lower cost.

This is a technique which we could readily understand if applied to the task of – say – finding out the chances of having a person weighing above 115kg in a certain group of people, without actually finding a person who weighed 115kg. We can take enough readings to see what the rough distribution looks like and extrapolate it.

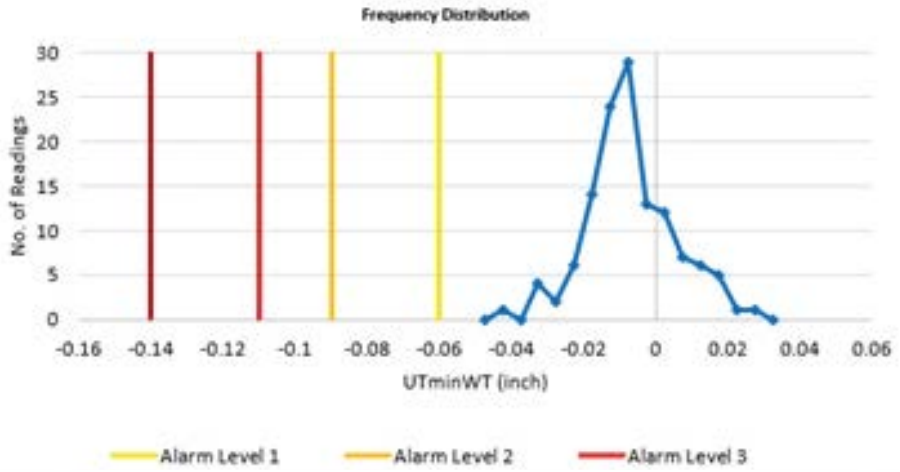
But this technique has not been much applied to tasks with big risks attached to them, like assessing the likelihood of a piping pressure system failure. People may be sceptical that data analysed through probability theory is as reliable and informative than data you directly measure.

However, data you directly measure involves challenges, for example, where it is difficult or uneconomic to measure everything, such as with seabed pipelines, or extensive piping systems. In these cases, the probability theory results can be more reliable and give insights such as the probable minimum with a known confidence level, and the type of corrosion that is occurring.

Asset integrity consultancy EM&I is applying probability-based risk assessment on 14 assets currently and is running pilot programs with a number of oil majors. The company believes this is the first time that an effective probability theory has been applied to asset integrity management. It calls the system "ANALYSE™".

EM&I says it has achieved greater than 60 per cent reduction in maintenance costs, while improving integrity assurance. Less maintenance work also means fewer people exposed to risk and of course lower costs and lower carbon emissions.

The same method can be applied to thickness measurements or pitting in steel structures, or anywhere there is corrosion, to help determine the risk of a possible leak or structural failure.



Blue line: you have a frequency distribution of pipeline thickness readings, showing deviation from the norm (zero). But what are your chances of having a reading which reaches alarm levels 1, 2 or 3?

The background is that asset integrity management companies like EM&I have spent a great deal of time taking readings on piping and pressure vessels over the past decades. 'Much of this data was never used for any modelling, just used for an immediate determination of minimum recorded wall thickness at the time of the inspection' says Danny Constantinis, executive chairman of EM&I.

For one client, as an experiment, EM&I took all the data it had collected for them over a 5-year period and tried, using conventional methods to look for useful trends – and found it was unable to do so.

This triggered efforts to look for a solution in a new direction which analysed all the data rather than minimum readings and point to point trends. The top statistical brains in various universities were consulted and in collaboration with in-house experts in corrosion and integrity management came up with the ANALYSE solution.

This had to be tested on real data and after extensive trials the system was introduced to a major client with a pilot programme which was successful and led to the system being implemented on 14 assets fleetwide.

Standard RBI methods

The standard way to plan an inspection program for pipelines is "Risk Based Inspection" (RBI), where you try to determine which piping systems might be most risky and survey those. Perhaps for each piping system you would gather corrosion data at susceptible points, around T connections, for example.

A first problem with trying to directly measure corrosion is that the inspection tools do not have enough resolution. You may have corrosion rates of 0.1mm per year, and equipment which is accurate to +/- 1mm – so it may take many years of reading in the same spot to notice any real change.

It is not therefore usually possible, using conventional methods, to calculate the safe operating life by calculating the corrosion rate.

Current inspection methods will provide the minimum thickness detected but do not calculate the probable minimum with a known level of confidence as does the statistical method, EM&I says.

Probability theory and pipelines

To explain the probability theory method in more depth, consider if we wanted to work out the chance of a young person dying in the next decade. The chances are low but not zero. But since not many young people die, calculating the chances by dividing the number of young people who die by the number of young people does not give a very useful answer.

But we can get a better sense by looking for other parts of the curve – for example

if we can get a more realistic sense of the chances of dying for people in their 40s and 50s, when death rates are higher, we could draw a curve and extrapolate it for people in their 20s.

A similar process can be used if we want to estimate the chance of a section of piping leaking (= thickness reducing by 100 per cent). It is quite rare for a pipe to leak, so we can't use the number of pipe leaks to calculate the odds of this specific pipeline leaking. But we may have data for a component of the same pipe which has reduced its thickness by 40 per cent, 50 per cent or 60 per cent, which we can use to draw a curve.

Consider that if you take thickness measurements of a new piece of piping where the walls are supposed to be 10mm thick. You will see that all the thicknesses are close to 10mm, and the average thickness will be slightly more than 10mm, to ensure the piping passes a quality control test.

There will be a range of thicknesses on a curve. You cannot guarantee that the smallest thickness you measured is the thinnest section of pipe, unless you measure the entire pipe.

But if you put your readings through a probability model, it can tell you that the thinnest part anywhere is (for example) 8.5mm – and what confidence you can have in that number.

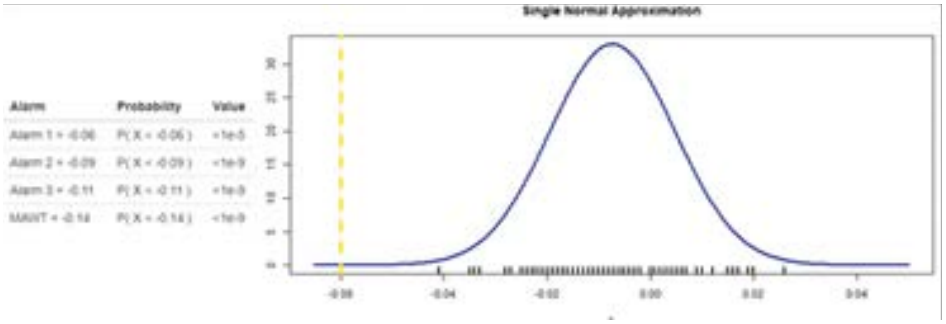
Then with statistics, you can calculate how sure you are of this. In one pipeline example, it said that the chances of having steel which leaks (= 0 thickness) is 1 in 1 x 10 to the power 12 (12 zeros).

The adequate level of risk is an engineering judgement based on what the consequences of an accident would be. If it is a pipe carrying seawater, and the only risk would be a seawater leak, 1 in 100,000 may be fine. If it is a high-pressure gas pipeline which goes past a potential ignition source, you may want at least 1 in a million.

You can calculate the number of readings that you need to take, to get the desired accuracy level. This may mean you need fewer readings than you would normally take on a normal risk-based inspection.

The owner of the asset can determine the risk level they want to live with, and the service provider can deliver an inspection scope that meets that risk level.

"We can find we can 'lose' 50 per cent of the data randomly and still end up with an excellent prediction," Mr Constantinis says.



The 'normal' distribution ' what you would expect anything in the real world to follow – and the probability of finding an extreme value

Enough data?

In terms of the statistical modelling, the method is not just about calculating the curve from the data available, it is about determining if there is enough data to calculate a curve with an adequate reliability level. In other words, whether you have made enough inspections and have enough data points, or where it would be useful to make more inspections.

The probability theory algorithm can run inside the handheld computers or tablets carried by inspectors, and continually tries to compute the risk levels from the readings they are taking – and also let them know if there are enough readings or if any alarm levels have been reached.

There is a colour coded advice showing green when sufficient thickness readings have been taken, and they can move onto the next task. Amber when more readings or further investigation is required, and red when immediate action is required.

The data might be sent to an engineer to look at in more depth, who might recommend shutting the line down while more analysis is done, or reducing the pressure of flow through it. If the asset owner resists the idea of shutting the plant down because of money which will be lost, it is possible to immediately send a photo of the area of concern of the pipe, to justify the reasoning.

It is possible that the analysis will calculate that you have a very high chance of a breach – although you have not yet actually measured any specific section of the pipeline which is close to being breached.

If the analysis shows you are taking more readings than you need, then it does not matter which readings you remove – you can choose them randomly, but in practice the system chooses higher risk points such as T's and bends.

This kind of statistical modelling does need high levels of statistical expertise. For this project, E&MI worked together with statistics experts at a well-known London science and technology university, together with an oil major. E&MI does not have authorisation to release their names at this stage.

Taking baseline pipeline measurements on FPSO Kikeh, Asia's first deepwater FPSO

Claroty – control system vulnerabilities increasing

The number of vulnerabilities being found in control system devices is increasing, according to Claroty's research, with the energy industry being more vulnerable than manufacturing or water management

The oil and gas industry still has a problem with control system devices running vulnerable software that could expose organizations to attack by hackers, according to the latest research by US-based operational technology (OT) security company Claroty.

The company published its "Biannual ICS Risk and Vulnerability Report" in August 2020 (download link below), with an assessment of all industrial control system (ICS) vulnerabilities disclosed during the first half of 2020.

Claroty's dataset for this research included 365 ICS vulnerabilities which are published in the US National Vulnerability Database (NVD), and 139 ICS advisories issued by the US Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) during 1H 2020. Vulnerabilities were found in products from 53 different vendors.

The number of vulnerabilities has increased since the first half of 2019, when 331 vulnerabilities were published by the NVD, and 105 ICS-CERT advisories were published.

Over 75 per cent of vulnerabilities were categorised as "high" or "critical" in the Common Vulnerability Scoring System.

The ICS-CERT advisories also include "Common Vulnerabilities and Exposures" (CVEs), showing which products are vulnerable and which industries may be more at risk from them.

Of the 385 CVEs analysed by Claroty, it found that the "energy" industry had 236, critical manufacturing had 197 and water and wastewater had 171.

Claroty found that more than 70 per cent of these vulnerabilities can be exploited remotely. This breaks down like this.

With 49 per cent of vulnerabilities, it was possible to execute code remotely (known as "remote code execution, or RCE). With 41 per cent, it was possible to read application data remotely. With 39 per cent, it was possible to cause denial of service (shut the system down). With 37 per cent it was possible to bypass protection mechanisms.

The research had particular focus on products which have a large installed base and integral roles in industrial operations.

Claroty's Research Team itself discovered 26 of the vulnerabilities included in this data set.

This was the first reported vulnerability for "many" of the vendors of these products, Claroty says.

Not so long ago, most industrial devices did not have any connection to the internet at all, or were "fully air-gapped" in the jargon. But now more and more devices are being connected to the internet in some way, and COVID and its drive for more remote working is increasing the desire for this.

Growth in vulnerabilities

"We see a rise in the amount of vulnerabilities we publish year after year," says Amir Preminger, Vice President of Research with Claroty. "This is not a surprise."

More and more companies are finding themselves included in the report, with vulnerabilities being found on their products.

Many products are still coming on the market which don't seem to have much attention given to them from a security perspective, he said. "Every company that goes into IT has to keep cybersecurity in focus - so they don't get attacked. You can see in ICS that's not the case. There is a need to improve the security posture of ICS products on the market. "

There are also many vulnerabilities which are not yet known about – just because a product does not have a CVE attribute, does not guarantee it as safe.

The most dangerous vulnerabilities are those which make it possible for someone to get control of the computer system.

Automation companies are starting to offer bounty programs, with money given to ethical hackers who can find vulnerabilities in their products. But it's important to provide ethical hackers with incentives such as bug bounties and pay-outs at contests like Pwn2Own given that the black market will always pay more, Claroty says.

Challenges with control equipment

While IT equipment may be used for 15 years, control system equipment may be used for 50 years. But software products would not normally be supported for that long. Software products are usually sold under license, and not many software companies would commit to supporting products for 50 years.

Control systems also have physical constraints – they must always be available in a specific place. Security controls often threaten the availability of such systems, if they take systems out of action.

Control system networks can be much more complex than IT systems, so the controls and rules around them are more complex.

Many control systems have aspects a hacker can exploit but are not considered vulnerabilities. For example, a device which can be stopped, started, even re-programmed, without any password being entered. "Those are not classed as vulnerabilities. That's just the way they work."

OT equipment sometimes uses IT equipment for its network communications. So if an ethernet switch is vulnerable, that risk is equally shared on the IT and OT networks.

Internet-facing industrial devices could be reachable through the vulnerable switch, and be put at risk for denial of service attacks or other intrusions. An example of a switch vulnerability could be the potential to launch an attack which causes denial of service.

Some companies do not change the passwords on control equipment from the default, such as "admin", or have firewalls installed. These issues could be considered "basic hygiene" with cybersecurity, Mr Preminger says. If you have very old equipment, with no in-built cybersecurity features, it may make sense to keep it away from the internet connection.

There are many small vendors of control system equipment, such as companies serving only a narrow vertical industry, and their products may have got very little attention from a cybersecurity perspective.

There may be problems installing software patches on control systems, if you don't have a license with a software vendor to receive software patches, or you are concerned that it would affect operations. "Patching is something that we want to strive to do but in some cases it is not possible," he says.

A typical dilemma is where equipment is difficult for people to access, perhaps offshore. There is a need for a mode of access for remote professionals, which is usually based on the internet. The devices might not have been designed for secure internet connection.

One customer, doing deepwater exploration, said "every second day we have a need for remote access." They need ways to do this in a secure manner at reduced cost.

Understanding your situation

Perhaps what companies really need is a better map of what equipment they have , what security is on it, and what can go wrong with it, rather than any particular technology solution, he says.

It would be useful to have more information available that a company security officer can take into account – understanding the security "posture" of a device, what the vulnerabilities are, and so what should be done with it.

"I recommend you keep track of your devices. The basic step is to understand what you have. Once you know what you have, you know what data you need to look for. You can read the different advisories and know how to reduce that risk," he said.

Amir Preminger, Vice President of Research with Claroty

Some companies may overreact when they hear that equipment they are using has vulnerabilities, planning to remove it from their network. It is important to recognise that all equipment has vulnerabilities, the issue is how they are managed, he said.

"I would measure a company by whether they are willing to do a quick and thorough fix of the issues."

The report can be downloaded here

https://info.claroty.com/biannual-ics-risk-vulnerability-report-1h-2020

Mendix – making low code easier for oil and gas

Low code platform Mendix has a number of developments to make it easier for oil and gas people to use, including easier underlying data management and integration, easier work flow management building tools, better ways to connected to SCADA control systems, and pre-built "industry solutions"

CEO Derek Roos sees low code as the way for companies to develop far more personalised technology "experiences" for customers and employees.

"Low code is the way to remove barriers - making it easy and accessible for any organisation to create "world class digital products and experiences," he says.

The company has been improving the "Mendix Data Hub" – the underlying system for providing the right sort of data to the right place in the software.

When developing tools, the data challenges include figuring out where the data you need is located, who owns it and how to access it. Then you have to understand what the data means, including attribute names, which could include abbreviations. Then you have to work out how to use the data together with what else you are doing.

The Mendix Data Hub should make it easier to do at least the data integration part, with integrations already built to software applications from SAP, Microsoft and Siemens (Mendix' parent company).

As an example, you could be building an app for managing company cars, which uses employee data taken from SAP software, so you can connect the car lease information with an employee's record.

"We move from thinking about apps to a platform view when all data is available," says Johan den Haan, CTO, Mendix.

Another new development is using low code tools for work flow management.

1500 customers have built workflow tools using Mendix, including the Municipality of Dubai, which used it to digitalise 250 paper based processes. A law firm Bryan Cave Leighton Paisner (BCLP) used it to digitalise high volume repetitive legal work.

A further development is "Mendix for industrial edge", with tools which people such as plant engineers can use to connect devices SCADA systems to low code applications, via OPC-UA interface or APIs.

For example, the control system might see the speed of rotating equipment is over the limit, and set off an alarm. That connects to a Mendix app which sends the appropriate information to the maintenance department to arrange a service call.

Or you could make a Mendix app which searches through historical information to see when exactly this condition happened in the past.

Mendix is planning a range of "industry solutions", applications and templates for specific industry applications, which it will sell, for companies which don't have the capability to build themselves. The first one planned an app for field service staff, who do service of physical products, including managing workflow for reactive and preventative maintenance, and spare part ordering.

Using the Mendix Data Hub, you can directly connect to data from SAP, Siemens, IBM, and Azure IOT.

"There are many more solutions in the pipeline," Mr den Haan says.

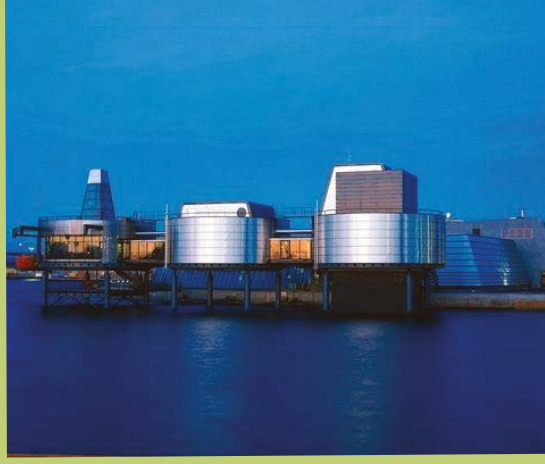
Mendix also plans a "marketplace vendor program" where anyone can sell apps they have built on Mendix. The system will include information about customers and a payment processing tool.

It is launching a "start-up accelerator program", to support start-up companies who might want to build apps on Mendix, including providing free licenses, training, support and access to the network of start-up experts.

https://www.mendixworld.com/session/introducing-low-code-to-industrial-automation-with-mendix-industrial-edge/

Finding Petroleum

digital energy journal



Understanding better ways to work with technology to meet business goals

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- What does responsible investing mean?

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