digital energy journal

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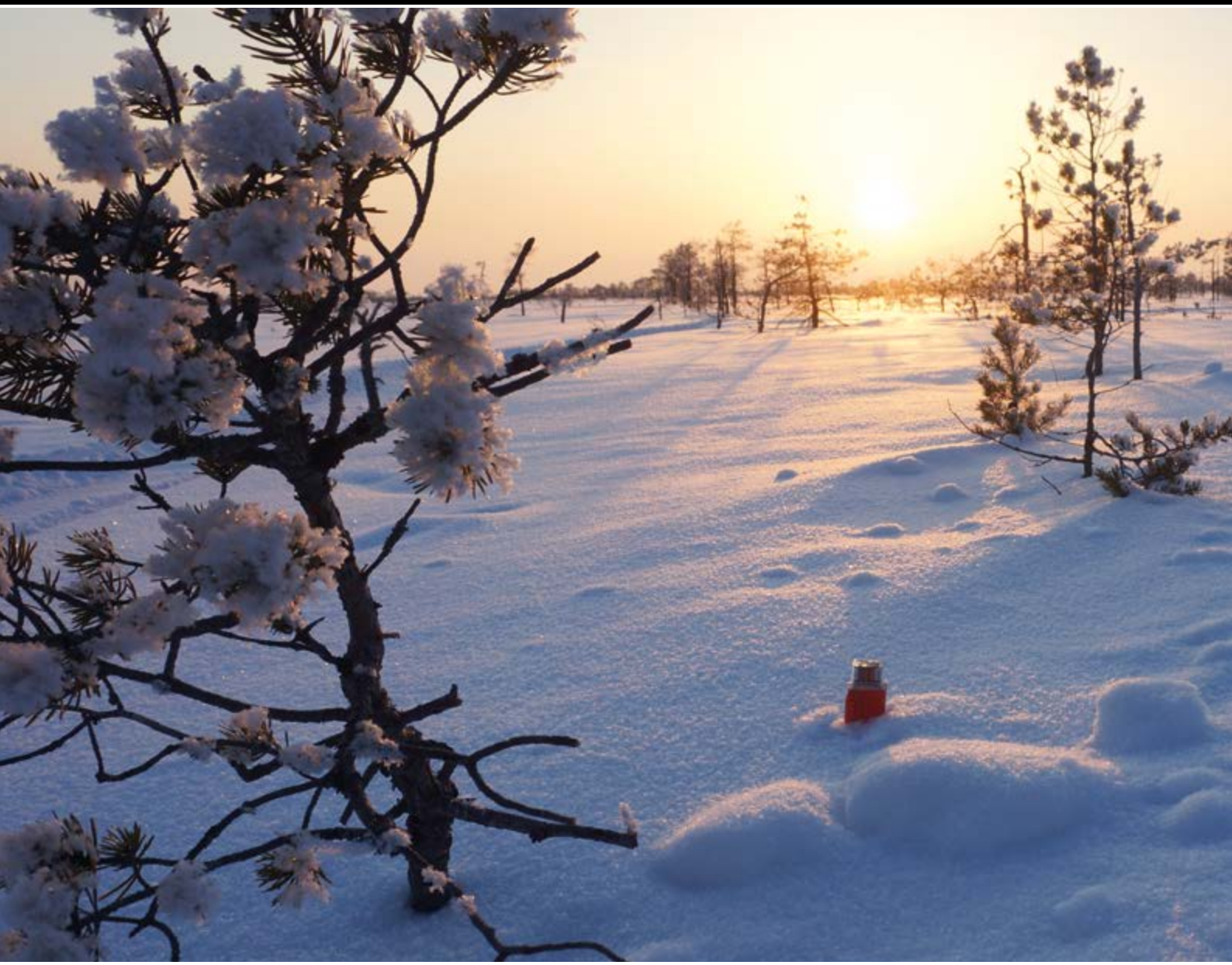
March - April 2021



STRYDE - a mission to make a 1m channel seismic survey affordable

Finding Petroleum

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Cover photo: STRYDE's seismic recording device. The company believes that a 1m channel seismic survey should be affordable. See page 9.

Baker Hughes' Annual Meeting

Microsoft's CEO talks oil and gas

Microsoft's CEO Satya Nadella was interviewed by Baker Hughes' CEO, Lorenzo Simonelli, during Baker Hughes' Annual Meeting in February 2021

"We've been partners with BP to drive their energy transformation. Same thing with Shell. What they are doing for real time insights to improve their operations, worker safety, all of that is being driven by increasing use of technology on all sides," said Satya Nadella, CEO of Microsoft.

He was speaking during the Baker Hughes Annual Meeting in February 2021, with a session where he was interviewed by Baker Hughes CEO Lorenzo Simonelli.

The pandemic was a driver of digital transformation in all industries. "You needed to have business continuity, you needed to have data to make decisions, dealing with constrained environments."

"Every industry is being transformed by that most malleable of resources, digital technology," Mr Nadella said. What is "most interesting and important" is the way that digital technology changes every company into a kind of software company."

"Every company will build their own proprietary software 'edge', and also use world class technology so they are not re-inventing the wheel."

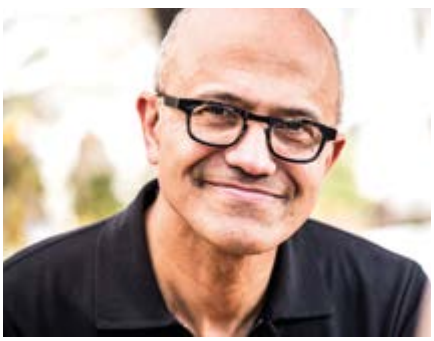
In the health sector, Mr Nadella believes that in the future, no outpatient visit (visit to a hospital) will be scheduled "without an AI triage first, a telemedicine visit second."

Exciting possibilities

"It is just an exciting time to see what the possibilities are, even just the computer architecture in the cloud or the edge. The amount of infinite elastic compute that is going to be available. Distributed computing fabric being embedded in the real world," he said.

From Microsoft's perspective, it is "cloud plus edge coming together", where he defines "edge" as computing where the data is gathered.

"You can reason in real time, you can create predictions and analytical power. The AI layer is going to bring about a lot of value to every firm."



Satya Nadella, CEO of Microsoft.

"We will also see more 'natural' interfaces with these digital systems, such as with augmented reality / mixed reality."

Sustainability

On the question of sustainability, Mr Nadella said he was inspired by the definition of the social purpose of a company from Oxford economist Colin Mayer, 'to create profitable solutions to challenges of people and planet.'

"That to me is the new social contract, each of us as organisations and companies have with the world."

One example of how Microsoft is working for 'planet' is its partnership with Norway's Northern Lights Energy Consortium to capture and store CO2, or as he puts it, "to develop a business model that chains together technologies to provide for that effective transformation."

It also has a partnership with a climate tech incubator Green Town Labs, which is expanding in Houston to focus on clean tech start ups in the energy sector.

Future of work

Mr Nadella said that Microsoft is collecting lots of data about how people are working during Covid-19. "This is the most at scale experiment, if you can call it that, of highly constrained remote work."

"I think we will all come out of this with more understanding of what we describe as hybrid work. I believe the key word is going to be flexibility."

"You can have a front line person working somewhere, calling to an engineer working remotely, using something like HoloLens. You can have a holographic input from the person."

"We have to use digital technologies in areas we haven't used them before, such as onboarding new employees. You have to help someone find the right people in the organisations with expertise to mentor them."

Wellbeing is an issue. "Someone described it this way to me, 'I don't know if I'm working from home, or sleeping at work.'"

"It is very important for us to have data and analytics to manage our most precious resources, which is our time. We take breaks, leave time for transitions so we don't burn out."

"Good old fashioned management practises will need to be more flexible in accommodating the needs for our employees."

Tom Siebel talks to Shell

Tom Siebel, CEO of C3 AI, had a discussion with Yuri Sebregts, Executive Vice President Technology & Chief Technology Officer, Shell, during the Baker Hughes Annual Meeting in February

"In the past year, Shell is really setting the bar with some very aggressive zero emission ambitions," said Tom Siebel, CEO of C3.AI.

He was speaking at a session during the Baker Hughes Annual Meeting in February 2021, in a public discussion with Yuri Sebregts, Executive Vice President Technology & Chief Technology Officer, Shell.

"Of the various oil and gas companies we're dealing with, I don't think there's any question, from what we see, Shell is really the leader in digital transformation. The scale you are taking on this project to reinvent Shell is really impressive and awesome."

"Thank you for the compliment, you work with a 'who's who' in most advanced areas of AI," Mr Sebregts replied.

"We see already significant positive impact in our operations. We are well beyond the stage of just testing new things. We are in the ramp-up phase."

One of the big 'use cases' is safety and environment. "A couple of years ago we had a few robots. We're now up to more than 100 cleaning and inspection robots, going to places we'd rather not send humans," Mr Sebregts continued.

"We have more than 1200 drone flights with sensors, [which help to] bring our environmental footprint of our operations way down. We can continuously monitor so much more equipment than we could do with humans in trucks."

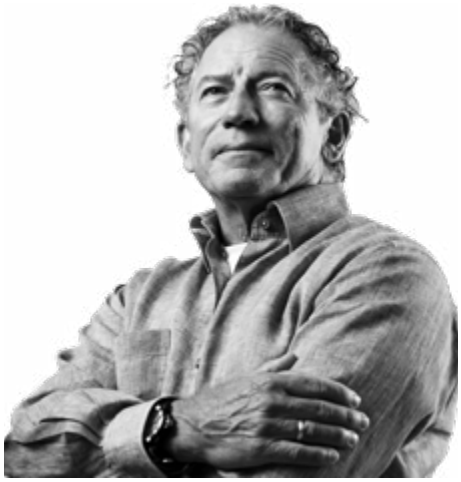
"The reliability of our assets has really been a focus area, jointly developed with you."

"About a year ago we had just a couple of hundred machine learning models up and running. The scale of acceleration is tremendous. Last week our count was 5,200 pieces in the field being continuously monitored. We're adding 300 each week."

"A third area is advanced optimisation and control. Controllers get you a good amount of optimisation. We can blend these with statistics based models, and can squeeze several more percent out of the assets."

Decarbonisation and digital

"If we want to be an integral part of society, as we do, and society wants to get to net zero, we have to get to net zero as well," Shell's Mr Sebregts said. "That includes getting our own operations to net zero, getting the energy intensity of our products way down, and helping our customers get to net zero themselves."



Tom Siebel, CEO of C3.AI.

"Energy transition is one megatrend we are facing. The other is digitalisation. They influence each other. I can see numerous ways digitalisation is going to help us get there.

"In order to get to net zero, most of the energy system in the world has to electrify. AI optimisation is going to be a big part of optimising the grids we have."

C3 on decarbonisation

"When we originally founded C3 in Jan 2009, the focus of the company was on energy efficiency, clean energy, and allowing companies to measure, mitigate and monetise their carbon footprint," Mr Siebel said. "Some 11-12 years later we're very active in this space."

"We're working with our partners at Baker Hughes, our partners at Microsoft, leading oil and gas companies around the world, to apply AI across the entire value chain of upstream, midstream, downstream and renewables."

"This could mean using AI for predictive maintenance, avoiding environmental hazards, increasing safety, improving process optimisation."

"In the renewables sector, it could mean helping manage electric grids with distributed energy sources. We're very active in electric utility grid globally - with companies like Enel, Duke [Energy], doing 'smart grid analytics'. We're applying AI at massive scale to basically optimise the entire grid infrastructure."

"A third area is in energy management, helping large companies measure and mitigate their energy footprint."

Comparing industries

Mr Sebregts asked Mr Siebel how he thinks the oil and gas industry compares to other industries in terms of its use of technology.

"As we've seen this digital transformation phenomenon evolve, I'd say it really began in energy," Mr Siebel replied.

"The first movers were electric utility businesses, 'smart grid analytics'. The grid is the largest and most complex machine ever built. Grid operators have been spending $2tn in the past decade to upgrade this grid, so all the devices are remotely machine addressable. This created an enormous opportunity to apply AI at grid scale."

"Shortly thereafter, we saw oil and gas companies move. The oil price forced these companies to make changes. There was a massive interest in digital transformation in oil and gas."

"We're active in financial services, banking, telecom, manufacturing, precision health. But the largest AI applications we're aware of are in the utility industry and in the oil and gas industry."

Success factors

When we hear that 9 out of 10 digital transformation projects fail, that leads to the question of why companies like Shell and Enel are succeeding.

Mr Siebel believes that a key to success is having a project led from the top. "In Shell the entire executive leadership team are aligned around digital transformation. The CEO is taking charge. It's not an option, it is not a 'project in IT', it is a mandate, something every executive has bought into."

Shell's Mr Sebregts agreed. "Very strong support and leadership from the top of the company is a prerequisite. Without that, it's not going to happen. As CTO of Shell I've got very strong support."

In addition, "of course you have to make sure that you focus on value, you're not just focused on technology itself.

"On top of that, focus on getting the basics right. Having really strong foundational platforms that force data standards. Making sure we can leverage what we've built through common ways of working."

Baker Hughes' Annual Meeting

The people side is also very important. "We need to be able to understand ourselves how this works in order to get it right in the field. [It is important to] have people inside the company that really understand it at the core. We have a team of 350 cutting edge specialists in AI and ML and other types of digital technology like blockchain."

"We've got a significant number of 'citizen data scientists, people we upskill using platforms like LinkedIn Learning, people who are first and foremost a process engineer, who learn a lot about AI. They can bring that into how they do their work."

"Finally it is really important to embrace the thinking, you have to adapt your work processes to the work AI makes possible. You want to be willing to change the core ways that work is done."

Ethical AI

Mr Siebel shared his thoughts on ethics and AI, saying that AI could be divided into 'artificial general intelligence' (AGI), social media, and things.

AGI is where computers can learn anything and so do anything. "I wouldn't worry about that anytime soon."

When it comes to social media, however, Mr Siebel believes that the way AI is "is very troubling, a global public health hazard. The impact that it is having on young people, simulating people at the level of the limbic brain [which releases] dopamine. It results in addictive behaviour on computers. It results in self-image issues, depression."

"As we look at weaponisation of these systems, it is causing the question whether it is going to be possible to run a democratic society going forward."

"We're seeing interconnect of these technologies with capital equity markets, GameStop and others. This is really troubling. This is an area [which] if governments do not regulate we'll be very sorry."

Thirdly, AI is used on things. "When we're dealing with pumps, wells, flow, pressure, temperature, rotational velocity, there's not a lot of ethical problems. We can use AI to deliver higher productivity, lower environmental hazard."

AI is not the first technology to have "potentially significant adverse social implications" associated with it. "We need to anticipate what these are and get ahead of them before these technologies blow up in our face," he said. "Leaders like Shell, Microsoft, Baker Hughes need to provide leadership for the rest of us. It is critically important."

The "Open AI Energy Initiative" launched

Shell, Baker Hughes, C3 AI and Microsoft have launched the "Open AI Energy Initiative", a plan to make specialist oil and gas AI modules commercially available to other companies

Shell, Baker Hughes, C3 AI and Microsoft have launched the "Open AI Energy Initiative", a plan to share specialist oil and AI modules through a commercial relationship, and develop what is described as an "ecosystem of AI solutions" for the oil and gas industry.

To get things started, Shell is making a number of its in-house predictive maintenance modules publicly available (although not free of charge), including for control valves, rotating equipment and subsea electrical submersible pumps.

Baker Hughes is offering interoperability to the Open AI Initiative with a range of its technologies including the "iCenter" turbomachinery advanced digital services, the "Bently Nevada System 1" condition monitoring software, and its valve lifecycle management technology.

These modules include pre-trained AI models, embedded subject matter expertise, and low latency data connectors.

There are also "thermodynamic and operating parameter libraries, global health monitoring services, deep diagnostics, failure prevention recommendations, and prescriptive actions."

The Open AI Initiative will also "augment" a number of its applications developed jointly with C3, including for reliability, production optimisation and inventory optimisation.

The idea is that oil and gas companies, service providers, equipment providers and independent software vendors could all offer AI and physics-based models, and related services, such as monitoring, diagnostics, prescriptive actions and services.

These models could be run on the Baker Hughes C3 AI platform, and Microsoft Azure cloud hosting.

They can be used to extend Baker Hughes' existing "BHC3 Reliability" application, which provides reliability, process, and maintenance engineers with AI-enabled insights to predict process and equipment performance risks. It can take data from a number of sources, covering full plant operations.

"Over the last few years, we have been working with C3 AI to scale our AI-based predictive maintenance solutions to reduce costs and improve the productivity, reliability, and performance of our assets," said Shell Chief Technology Officer Yuri Sebregts.

"We are monitoring more than 5,200 pieces of equipment using machine learning across upstream and downstream manufacturing as well as integrated gas assets."

"We are excited to take this capability to market, and want to develop an open ecosystem where others can offer AI solutions to help improve reliability across the industry."

"We really see this as core to the next step of where we might go. With higher reliability comes better safety, better economic performance."

Further information is online at

https://bakerhughesc3.ai/products/bhc3-oai/

Shell Chief Technology Officer Yuri Sebregts

Total's CEO on energy transition

Patrick Pouyanné, chairman and CEO, Total, shared his thoughts on the energy transition, during Baker Hughes Annual Meeting

Up to now, "the strategy of Total has been fundamentally the strategy of a supplier, to be available and spread out around the world," said Patrick Pouyanné, chairman and CEO, Total, in an interview during Baker Hughes' Annual Meeting in February.

"Today, with [the] energy transition, we must think to what customers are requiring. The level of green energy and the level of price. It changes the paradigm for us."

"Transition for me means a journey, a journey where we have to adapt.

With a clear target (carbon neutrality by 2050), but not thinking it can be done in black and white, and not forgetting the affordability of this transition."

"If we want to go to carbon neutrality, we will have to do it with our customers."

"Some corporate customers are deciding themselves to green their electricity and themselves produce their energy. The relationship is fundamentally changing.

"That's the reason why Total is transforming its strategy, going to customers to propose different products."

People's desire for energy is different in different places of the world, he said. "When you are in emerging countries, obviously you want to have clean energy but also an affordable one."

Patrick Pouyanné, chairman and CEO, Total. Photo credit © École polytechnique - J.Barande

To get to carbon neutrality, this public sector [government] are very important, they will set some policies. If we don't have some policies in place it will be very difficult to go to carbon neutrality," he said.

"We have seen that Europe is committing itself to carbon neutrality, which will have an impact to the cost of energy in Europe."

Investors

Mr Pouyanné was asked if Total's investors are ready to accept that profitability will be lower going forward, because of the costs of the energy transition. They should see it as an investment in the future, he replied.

"When I joined the industry (20 years ago) we were speaking 20 per cent [returns]," he said. "Today the real interest rate is zero rate. To have 15 per cent [today] means the risk premium is much higher than it was before."

"We need to invest in order to deliver future cash flows by 2030 and beyond."

"When we have decided in Total, ten, twelve years ago to engage in a LNG adventure in Russia, there was no profitability. In 2020 we believe to have strong dividends from these investments."

"When you invest in a new field of energy, you know it will take time before you will be able to deliver some cashflow out."

Total needs to maintain a profitable business at the same time. "We have [the] lowest cost among producers of $5 / barrel. I need this to invest in [the] future cashflows of the company."

"We are trying to find the right balance between businesses fundamental to the world today, because it relies on oil and gas, and to reinvest a large part of it in new energies."

Asked about why Total pulled out of the American Petroleum Institute, he said, "At a certain point we need to be consistent between what we want to address as a strategy, and membership to some organisations.

"We will review the consistency between these memberships and our own climate ambitions. We consider some of the organisations to which we are a member are not aligned with the objectives we think of the world."

Bob Dudley – how the industry should decarbonise

Bob Dudley, Former CEO of BP and current chair of the Oil and Gas Climate Initiative, shared his thoughts on how the industry should approach decarbonisation, speaking at the Baker Hughes Annual Meeting in February

The Oil and Gas Climate Initiative (OGCI) is a group of 13 oil and gas companies, aiming to collaborate to support the Paris agreement and transition to low carbon.

Members include the big European international oil companies, national oil companies Saudi Aramco, Petrobras and CNPC, and US companies Occidental, Chevron and Exxon. Together they account for 30 per cent of the world's oil and gas production.

Bob Dudley, chair of OGCI, and a former CEO of BP, shared his thoughts on how the industry should approach decarbonisation, speaking at the Baker Hughes Annual Meeting in February.

"2020 was a very difficult year," Mr Dudley said. "I was concerned .. [OGCI} might lose focus. But in fact the companies stepped up and upped their [carbon] commitments."

The member companies have different investors, governments and customers, and so they are under different pressures. "They have to pick what we focus on. A group like this can't do everything," he said.

OGCI has set a collective target for reduction of methane and energy intensity across the membership. "We've passed the [first] targets, we're about to set more aggressive targets," he said.

New business models

This is not the first time the oil and gas industry has been told it needs to change its business model. But it may be the first time that it really does need to change, he said.

"In my 40+ years in energy, every time there's a crisis, someone says, 'it's different this time,' but the world bounces back. This time it really is different."

"It is the art of management of these big companies, how fast they can move, what new business models they can move to. Sometimes [they have to move to] investment models which may have lower returns, but they have to do this to survive and thrive."

"The climate challenge we have goes way beyond any one company, or any industry, or any country," he said. "Governments have set targets for net zero for 2050.

"It looks like US is going in that direction. It is good to see the US re-engage on the climate stage. The change in administration in the US puts a lot more emphasis and urgency on it. That sends a big signal to the world, it re-ignites the goals.

Bob Dudley, chair of OGCI, and a former CEO of BP

Even China has set a net zero goal. All these things help build the momentum as well as investor concerns."

But also, "between 2040 and 2050 we're going to have 2bn more people on the planet. 95 per cent of that energy growth will come in Asia and Africa, which has particular challenges."

"We're going to need investors to have a little patience with the oil and gas industry," he said. "There's clearly a role for the oil and gas industry [in future]."

"IOCs [International Oil Companies] can move a little bit faster. Getting that balance right is critically important. Many industries will have to do the same thing to reduce and clean up."

Further out we might see investment put into things like hydrogen "which people call the wonder fuel."

Although natural gas itself, "which is a carbon atom and 4 hydrogen atoms, can become a great energy carrier," he said.

"I've seen no scenario that's credible to hit the aims of Paris without things like CCUS [Carbon Capture, Utilisation and Storage] and natural gas as part of that great transition," he said.

In terms of the negative perception of the industry held by much of the public, Mr Dudley said it is something the industry has learned to live with. "The industry has had a negative view [from others] in the US going back to the breakup of the Standard Oil Trust."

"I don't think you get there by companies or industries saying 'trust us', you actually have to act."

"Maybe we don't tell our story very well, but I know how many people are committed, working inside the industry and these companies," he said. "I think we need to keep working, invest, and tell our story a bit better."

The industry is working together in other ways, such as on methane alliances, and companies are doing many of their own projects.

On the question of whether we need a carbon price, he replied, "I don't know how we get there without putting a price on carbon and having markets work. It is one of the things that seems to be missing. It can be an actual price, [or] a tax. 200 years of economic history tell us that without a price on something, it is very hard to change people's behaviours."

"We see it in Europe, there's a carbon market. China is setting up six different carbon markets.

"I am an optimist that it will happen. But this is year for some of these things to come more in focus."

Mr Dudley was asked about what he has learned about leadership in a time of crisis. He replied, "People want to see you're on it, but that you're calm and there's a plan. You may need options. I think you have to develop a great group of people around you."

Baker Hughes strategy – energy transition, digital, neurodiversity

Baker Hughes executives outlined aspects of the company's strategy, including energy transition, cutting its own emissions, digital technology, and staff neurodiversity

For the energy transition, Baker Hughes' business strategy is based around three 'pillars'. These are transforming the core business to improve competitiveness, investing for organic and inorganic growth as they build a more diversified energy and industrial business, improving efficiency of the existing business, developing products for gas, and positioning for new energy frontiers like hydrogen and CCUS, explained Michele Fiorentino, Executive Vice President of Strategy & Business Development at Baker Hughes.

For improving efficiency of the existing business, part of their strategy is expanding use of remote operations, he said.

For gas, it wants to develop products to build the gas 'value chain', including compression and other gas handling technologies.

Services for new frontiers can include technologies like hydrogen, CCUS, energy storage and geothermal, he said.

Baker Hughes also offers consultancy services which cover the transition, through a company "io oil and gas consulting", a joint venture with Baker Hughes and McDermott.

One service it offers is pre-FEED (early stage planning) for oil and gas energy transition projects. It has a customer in Trinidad and Tobago considering a green hydrogen project, said Uwem Ukpong, Executive Vice President, Regions, Alliances & Enterprise Sales for Baker Hughes.

Carbon capture is already opening up new markets for Baker Hughes beyond oil and gas, Mr Ukpong said. "Last week I was speaking to a fertiliser company [discussing] how we can help them decarbonise. We are seeing some small start-up companies ready to set up a blue ammonia plant with carbon capture."

Mr Fiorentino said it is very hard to predict how hydrogen will be rolled out, because it depends on the market situation.

"It is often the case that people fall in love with specific solutions. But it will be very difficult for any low emission technology to take off until there is a higher cost of pollution."

"As far as hydrogen specifically, even with that incentive, you are probably talking about 10 years before it becomes really mass market."

Baker Hughes own emissions

Baker Hughes has been working to quantify emissions for products and services, a long and complex task, said Allyson Book, vice president of energy transition for Baker Hughes.

"When you understand the full lifecycle, it gives you more insights."

"As a manufacturer, scope 3 [supply chain emissions] becomes very material," she said. "We work with suppliers, customers and employees."

Digital strategy

In the realm of digital technology, Mr Ukpong believes that Baker Hughes has a unique advantage in its ability to combine digital capability with oil and gas and engineering domain expertise.

And this domain expertise gives the company a differentiation from the purely digital technology companies who are aiming to build their oil and gas market.

Although it can be useful for Baker Hughes to work together with companies like Microsoft. "Microsoft is very well connected to a lot of major customers," he said.

Working with Microsoft can help, for example, when oil and gas engineers want to install a new AI application.

"Going together with Microsoft allows us to explain to the business what we're trying to do, and say it won't disrupt the CIO's ecosystem."

Often you need domain expertise to work out if the output from an AI system makes sense, or if a domain expert would make a similar recommendation to the one the computer is making, he said. And domain expertise is also required when building the digital tool.

The main advantage digital technology can offer domain experts is the ability to scale up what they can do, said Mr Ukpong, himself a reservoir engineer.

"I've got to look at data and see if that validates with well-established physics models."

"We've got a customer who is trying to predict when ESPs are going to fail based on physics based models. I can only look at 20 ESPs at one time. When we brought in AI and looked at past behaviours - and built a statistical model, we can look at 800 ESPs a day. That's the beauty of AI where you're bringing in a much higher level of efficiency."

If people in the industry believe computers can replace the experts, it may lose its experts, Mr Fiorentino added. "You don't create those experts at the flip of a finger, it takes training, dedication, time. Once they are gone they are gone. You can't go on the street and say, 'I need a turbomachinery expert'".

Staff diversity

Baker Hughes is also looking to hire more neurodivergent people. This is a term Oxford Dictionary says is "frequently used with reference to autistic spectrum disorders."

"Neuro-diversity I think provides a cool competitive advantage, when you can embrace that and have a really inclusive workforce," Ms Book said.

"We're going to try to build an internship program, so people can get a feel for jobs where we may not have placed neurodivergent people before."

The company has identified "individuals that are on the spectrum who are uniquely positioned to work in our digital technology teams," says Deanna Jones, chief human resources officer with Baker Hughes.

"The way they think about these complex problems, a system approach to the work that we're doing, I think it is a fantastic partnership."

"Not only identify the neutral diverse talent, but prepare the leaders to work with the different talent."

Ms Jones adds that 75 per cent of the company's employees live and work outside the US, and 35 per cent of the US employees come from "diverse, under represented minority groups."

Baker Hughes executives on the future of industry

We heard perspectives on what the future of the oil and gas industry will look like at a Baker Hughes panel organised for the media, with the VP drilling, the VP digital and the VP technology

A big learning from 2020 is that remote operations is not just about enabling business continuity at a time when people cannot get to the rig. It can also deliver better outcomes, said Paul Madero, VP drilling services with Baker Hughes.

He was speaking at a panel organised for media during the Baker Hughes Annual Meeting in February.

"The majority of drilling records we set in 2020 were accomplished with remote operations," he said. For example, drilling 2 miles in a 24 hour period. This record was then broken again 7 days later.

People used to believe that by having a physical presence on site, you get improved capacity to control what is going on. But experience shows "that's not the case."

As of February 2021, remote operations are used for nearly 90 per cent of its drilling around the world, an increase from around 50 per cent a year ago. "We had 50 customers adopt remote operations for the first time in 2020. In 2019 I was calling customers [to ask if they wanted to do it]. In 2020 they were calling us."

"We're controlling more aspects remotely - chemicals, completions and cementing."

Remote operations is not something a company can do easily. "We didn't just wake up and turn on this capability overnight, we've been developing this ecosystem for over 20 years. It requires a robust digital infrastructure, systems and workflows. Flawless, reliable and consistent execution."

"Remote operations is a gate into implementing more advanced AI and predictive analytics," he said.

"There is a cultural change which goes alongside the remote operations, which is always hard to do, if people have the choice of not doing it," he said. It means people need to collaborate digitally at a level not seen before.

With remote operations, field engineers are able to monitor five times more wells than they did before, when they had to travel to well sites personally. That gives them much more ability to optimise.

There have been many developments in predictive analytics on drilling.

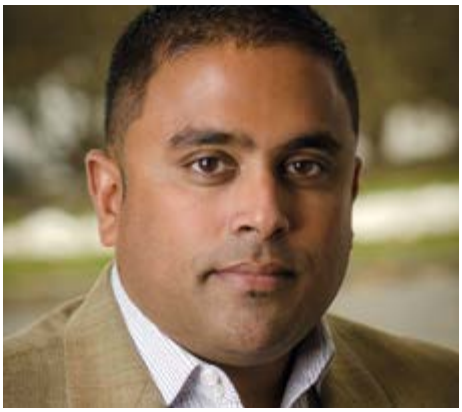
"I'm optimising on a foot by foot basis," he said. "We're going to unlock a whole new area of what we believe is left to optimise."

"Is it possible that 10-15 years from today there may not be any humans onboard a rig? Potentially."

One of the challenges with remote operations is integrating with legacy equipment. "We need to pass through others' equipment. This is something that we've approached with a lot of discipline."

VP Digital

Shan Jegatheeswaran, VP digital with Baker Hughes, says that as the company closed offices due to Covid-19, it saw almost twice as much use of digital tools immediately.



Shan Jegatheeswaran, VP digital with Baker Hughes

An important theme behind digital investment is "digital is a means [to do something], not an end [in itself]," he said. I think that's a first quality threshold."

The software team needs to be continuously asking itself, "why do we want to build this software," to ensure it is driven by business needs, not a desire for exciting tools.

"We've all been through thousands of pilots and proof of concepts that go on forever. Some work and some don't. You get tied up in PowerPoint meetings. That needs to change."

"I think digital does have a credibility issue," he said. But the best way to build credibility is to focus on the most important elements – data, design and change management, and do that over a period of time.

The first question is whether you are able to capture the data you need, where it comes from, and if you are creating another data silo. "You've got to really lock that down."

Design and user experience "feels like a forgotten science. That's important. It's not enough to [expect someone to] use software because your boss said so - you have to like it."

An important theme is to make use of cloud computing. "We've bought into that concept. We think that's going to drive productivity in the future," he said.

Another theme is that "artificial intelligence is two parts domain expertise and one part digital," he said. "The limiting factor is things like data clean up, curation, streamlining. The way we think about it is first mile, last mile. How do you even get the data ready, clean it up, make sure AI algorithms can use it?"

There is increasing emphasis on interoperability of software, and avoiding being "locked in" to a certain software product.

"We have to retool and rebuild a lot of our software so it is friendly for integration," he says. "That ecosystem approach is here to stay and we're serious about it.

People

The changes in how Baker Hughes approaches digital is not just about technology, it is also about the choices of people the company hires, in particular making sure that they are good collaborators within the company.

"The key thing to recognise, when you think digital and software, the ingredients to build something is almost 100 per cent people. You see a ton of ways that people are building out software."

"We looked at our software talent around the world, and said, if we want an integrated digital experience [for customers] we have to apply some rigour. We have a global organisation. We dictated standardisation.

"We have teams talking to teams. We don't want data silos anymore."

"We stood up a few centres of excellence around design, user experience."

"You get that starting point right, slip on some operating rigour, attach a 'return on investment' [calculation] to it, and make it something an end user has put in their workflow."

"Setting up the environment so the people you hire can do their job is important."

"We have to question how we do business with our suppliers, partners and customers," he says. "It is going to drive a co-operative mindset. Those are things we're living through right now."

Big tech competition

Mr Jegatheeswaran said he is not concerned about big tech companies coming into the oil and gas sector. "The emerging space is one of the few trilling dollar markets. I don't think it is going to be winner take all. We don't view the tech guys as competition. They are rising tide and we should rise with them."

"As Baker Hughes we are really good at the first mile and the last mile. We are in the trenches with our customers. The middle part should be standardised - it should be as off the shelf as possible."

"Imagine having to maintain a maintenance ecosystem. We know what that feels like, we've lived with that with other enterprise software over the last few decades. The advent of the big giants coming in is great."

"The best thing we can do to be successful is innovate the metabolism of how you run the organisation, and it starts with how decisions are made, he said.

"You need software to maintain the machine as it runs today. Then you've got to invest in medium term innovation which is within reach. Then you want to take some bets and optionality which is a little longer out. The decisions we make today will have impact 6-12 months from now."

Scott Parent, VP technology

The energy transition itself can be enabled by digital transformation, says Scott Parent, vice president of technology at Baker Hughes. "There would be no way [to do it] other than to take what we know today and layer on digital capabilities."

Mr Parent has a background in aerospace engineering before joining Baker Hughes, so, as he puts it, he is now making machines which work 2 miles down instead of 2 miles up. But there is a difference in the subsurface challenges, in that every problem is unique.

Baker Hughes is developing a lot of sensors, including emission sensors for methane and acoustic scanners looking for leaks. The business sells 800,000 sensors a year. "All of that infrastructure is going to be needed at a pace that we haven't seen before," he says.

Baker Hughes does not plan to monitor every piece of equipment. For example the security elevator is one piece of equipment which doesn't necessarily need monitoring, although some companies do.

Additive manufacturing

Additive manufacturing [3D printing] is an interesting technology which "allows us to use bespoke metal recipes, bespoke designs, do that at very low volumes," Mr Parent says.

"The opportunity of faster manufacturing, also the opportunity to do incredibly different things in design.

One example is making unique drill bits. "When we get a call from Saudi in basalt, or bedrock in Pennsylvania, we can use computer vision to look at the worn topography of a bit down hole, and do a regenerative design pattern to repair that bit. We do this in hours not weeks. It is a truly business transformation - especially if we can move the printers out to the point of use."

Interesting innovations

Mr Parent thinks that one of the most interesting areas of innovation happening at the moment is in edge computing, computer systems which operate actually on remote assets. "Bespoke edge computing", software written just for one piece of equipment, offers particular promise.

There are "things at the edge" you want to communicate and work with, monitor and control, he said.

Specialist domain companies like Baker Hughes could develop the edge computing software, and the software which domain experts use to work with the data. Big tech companies could provide the cloud infrastructure in between.

"There's an efficiency to using some standardised tools - working with some player in the industry."

Another area of interesting technology development is around digital imagery. "I think it is something we're going to see more and more of. Someone remote can see what people in dangerous places are seeing."

Bringing robotic tools and replacing people can help a lot to make a process more efficient. "When you want to look for efficiency, you have to lean out the [whole] process. Human beings are not the leanest things in the process. Many times you have to remove the human element and redesign the process for automation."

"I am not talking about fully autonomous systems - but [autonomous] subsystems and subsystems of systems." For example, a Formula 1 Car has a lot of automation, generating 4TB of data per car per day. But it is not an autonomous car.

STRYDE – making 1m channel seismic affordable

STRYDE, a company providing wireless seismic devices, has a mission to make a 1 million channel high density wireless seismic survey affordable. We spoke to CEO Mike Popham

STRYDE, a company with technology originally developed at BP, has a mission to make a one million channel, high density wireless seismic survey affordable, with its low cost devices.

This would enable companies with onshore oil and gas fields to have much better information about the subsurface for an affordable cost. It can also be used for onshore CO2 sequestration and geothermal projects.

STRYDE claims that its seismic receiver is the smallest, lightest and lowest priced on the market, compared to other wireless receivers.

The node is just 41mm wide, 129mm tall. It can store 4GB of data, enough for 28 days of continuous (24h) recording.

The receivers are light enough (150g) that one person can carry 90 to 100, depending on the regulations, with a total weight of 13.5kg to 15kg.

It has a fifth of the weight of the "next smallest node" available on the market while having equivalent recording capability, according to STRYDE.

With other wireless seismic receivers on the market, it is normally possible to carry only about 20, says Mike Popham, CEO.

"The light weight and small form factor means it needs a fifth of the vehicles to transport, and a fifth of the people to carry it to location. There are knock-on benefits for reduced safety risks, environmental impact and speed of deployment."

It has been used in challenging environments such as sand dunes, forests and deep snow.

There is no limit to how many nodes the system can have, but it has been designed with a million nodes in mind.

The recording has higher fidelity than geophones, and it is better than most other systems at lower frequencies.

The company

The technology has been developed over 8 years, initially beginning life in BP's labs in 2013. The technology was further developed in collaboration with Schlumberger and Rosneft. The first field trial was completed in 2013, with 10 nodes. The first system integration test was in Norway in 2017, with 100 nodes.

The initial hypothesis was that focussing only on what operators consider to be critical

components of the receiver would make it possible to have a lighter weight, lower cost receiver, thus allowing much denser surveys, Mr Popham says.

Mr Popham is a former technology commercialisation and project management lead with BP, but left BP to become the founder of STRYDE in late 2019.

The company sells the device directly to operators and to seismic contractors. STRYDE has capability to do processing but is currently not focussed on providing seismic processing services. "We're a technology provider," Mr Popham says.

The company now employs 50 people, with domain specialists, hardware and software experts, field support experts and a commercial team. The devices are available for sale or lease.

Other equipment provided by STRYDE includes a specially designed rucksack for someone to carry receivers in an ergonomic way as they walk; a fast charging and data download unit which allows one person on shift to turnaround up to 20,000 fully depleted nodes every 24 hours; and a handheld device which can be used to record where receivers are planted, so they can be later retrieved.

The company is supported by the BP "Launchpad" scheme, which has an ambition to "build and scale a progressive portfolio of digitally-led businesses which re-imagine energy."

Projects and clients

STRYDE's markets for the device include oil and gas, geothermal, CO2 sequestration, mining, passive seismic, and even archaeology around protected buildings.

In 2019, the STRYDE technology was used to record the highest trace density land seismic acquisition ever in the world in the UAE, achieving 184m traces per square kilometre. The survey had 50,800 nodes, using a 12.5x12.5m carpet of receivers, covering 81km2, in an area covered in sand dunes and oilfield infrastructure.

In December 2020 STRYDE announced an agreement to supply 80,000 STRYDE nodes to an unnamed land seismic contractor in the Far East.

This followed two field trials done by the same seismic contractor with 1620 STRYDE nodes, in mountainous regions of Southern China, comparing the STRYDE system to other nodal and cable systems.

During the year 2020, clients leased or purchased over 170,000 STRYDE nodes, for use in oil and gas, also geothermal, mining, archaeology, Microseismic and seismic risk.

Another experimental "super dense" 2D field trial was held in 2020, in partnership with Gallego Technic Geophysics (GTG) and Real Time Seismic (RTS) with a node placed every 20 cm, to demonstrate the capability of the system to acquire bespoke and extreme density surveys without the operational constraints of bulkier systems.

GTG used the nodes on four commercial geothermal exploration projects in Belgium, Switzerland and France over 2020.

"We plan to use the devices on onshore CO2 storage projects during 2021," Mr Popham says. High density surveys are useful in CO2 sequestration, to help better understand rock properties, work out the best place to drill, monitor where CO2 is actually being stored, and check for any changes in the subsurface.

The device

An interesting technical innovation inside the device is having a battery which is itself part of the sensor. A simplified explanation is that the battery pushes against a piezo sensor. When the node moves, the battery presses on the piezo sensor which generates a signal. This is an alternative to the geophones which most other devices use. The generated signal is a measure of acceleration with a high fidelity response, yet with a very low power requirement. "A lot of engineering went into getting this sensor right," Mr Popham says.

"The sensor itself is a piezo electric disc, the same type of electronic component which is used in speaker technology. To the touch and weight, our node feels similar to holding a snooker ball, with coloured, rounded, tough plastic – albeit slightly lighter."

Devices are usually set to start recording as soon as they are planted, and they record for up to 28 days.

Deployment workers carry a device which can be used to record the GPS co-ordinates of the nodes, maintaining a record of where all the devices are. The device also has its own GPS system, so the position can be recorded together with the data.

STRYDE is continuing to invest in R&D, both on the node itself and the other parts of the system. One focus area is to further extend the recording life of the node.

Cables vs wireless

One of the biggest issues for customers in some regions is still persuading them that they should switch from cabled systems, which they have used for decades in some cases, to wireless nodes, Mr Popham says.

Cables do have some advantageous features. The data can all be stored centrally, rather than on the devices themselves, and it is possible to monitor what all of the devices are recording in real time. With wireless nodes, in order to check for any recording issues, you would have to download the data or physically walk to the node to check its status.

"At STRYDE, we take the view that the convenience of wireless devices far outweighs this extra assurance. We see less than 0.1 per cent of nodes malfunctioning in the field, and when you've got a high channel count system, that live quality control isn't something you need."

Many potential customers ask to do a trial with STRYDE nodes, and often they compare it to cabled systems in the trial, he says.

These trials show that compared to cabled systems, the receiver side of a survey is at least twice as fast, when using half the people he says. "You are paying a big premium to use cables without any real upside."

There is also a whole business process of "line checking" required for cables, which is not needed for nodal surveys.

Line preparation, whether involving cutting trees through forested areas or bulldozing tracks, is an expensive, high risk, time consuming activity often necessary to move cable systems around the surveys area. STRYDE nodes eliminate the need of such activity for the receivers as they can be deployed anywhere a person can walk.

Theft and safety

One concern that companies might have is that the devices could be stolen or just picked up by someone curious.

The devices are cheap enough, and there are enough of them, that one or two missing devices should not make a material difference to the dataset or the economics of a survey, Mr Popham says. Additionally, the small size of the node makes them far easier to conceal than with other competing products.

A bigger concern might be safety risks related to the battery inside. STRYDE has done a large amount of testing to make sure the device will not easily open. "They are very safe and are in a completely sealed unit. We've done a lot of testing and accordingly, have gained safety certifications around the globe."

Supply chain emissions data – PIDX's work on a new standard

The oil and gas industry's customers and investors want data about how much CO2 is emitted producing hydrocarbons, including from the operators' suppliers. Standards organisation PIDX has started designing a data exchange system

The oil and gas industry's customers and investors are increasingly asking for "ESG reporting" – data about environmental, social and governance factors involved in producing hydrocarbons – particularly the greenhouse gas emissions.

Calculating this is a complex task for oil and gas companies. Calculating emissions from your own operations can be easy enough if you know your fuel consumption. But gathering data from your suppliers, and suppliers of suppliers, gets much more complicated.

There are already many efforts around the world to standardise how emissions data should be collected from specific sources, perhaps too many. And there are many efforts looking at emissions data reporting, such as to authorities.

But the challenge being addressed here is of what goes between. How the emissions data from suppliers should be gathered by customers so it can be put together into its emissions reports.

This gets very complicated, when you consider that data is needed as part of the process of deciding which supplier to work with, and the actual emissions made in fulfilling the contract may be something different.

E-commerce standards organisation PIDX has started work developing standards for how emissions data can be shared between suppliers and customers, so it is credible, trusted, reliable, and accurate.

PIDX already makes standards and digital infrastructure for e-commerce transactions between buyers and suppliers, which include a lot of data transfer, such of the specifications of equipment, price, what is needed, invoices and payments. One idea is that emissions data could be added to this infrastructure.

The PIDX workgroup tacking the problem, which it calls "Emissions Transparency Data Exchange", has representation from Chevron, BP, Baker Hughes, Microsoft, OFS Portal, Sellexis and IDS.

PIDX has a memorandum of understanding with the Shell sponsored "Open Footprint" project, which is developing standard ways to gather and describe data. This includes ways to digitally describe a facility, emissions type, uncertainty levels, reporting periods, and non-productive time.

The Open Footprint standard could be used together with the PIDX data exchange standards, so the Open Footprint standard would describe how data should be gathered, and the PIDX standard describe how data is exchanged.

Chevron perspective

"From an operator perspective - we want to do something incredibly quickly, there's a need and a desire to make this real," said Mary Sailors, sub chapter head for data science, Chevron, who is working on the project.

She was speaking at PIDX's virtual conference about ETDX, Managing Emissions Data in the Supply Chain, on Feb 24.

For an operator, calculating "scope 1" emissions from assets you own and operate is proving "easier to calculate, not super simple."

The important factor is that "you are the data source. This information should already be readily available to you.

"Scope 2" emissions, from power generation, or if you purchase heat and steam, are also fairly straightforward.

But the complexity is in "Scope 3", which means "all the other emissions associated with products and services."

Much of the information which relies on outside companies is "not readily shared and often just estimated. The total emission story may not be entirely accurate," she said.

"We also don't know exactly how to do this, what data do we capture, what level of granularity. This is not something that's been historically done."

One of the hurdles to getting more data transparency, ironically, is the multiple efforts to gather data, she said. "Many efforts sound like a great thing - all hands on deck. But resources are really spread thin."

And also, companies may be unwilling to commit enough staff members to the problem, which means that people are often managing data in their 'spare' time.

PIDX workgroup

A first project from PIDX is making a one-off implementation, which will explore how the existing PIDX schemas (for managing data communication about transactions with suppliers) can be extended to support transfer of emission data.

It will also look at how the PIDX schema can be incorporated together with other schemas, such as the Open Footprint standard.

This data element can then be incorporated into PIDX invoicing and purchasing order standards, which already exist and are widely used, and also use PIDX's reference data, such as a standard language for describing oil and gas activities which is machine readable.

The hard part is defining a methodology for what needs to be captured and how it will be measured. That is turning out to be the bottleneck in the process, she said. "What we're trying to get crystal clear is: what are the components that make up those emissions. This will enable 'apples to apples' comparison between options."

If operators are adding external (scope 3) data to their own (scope 1) data, "we need to be sure it is consistent, there's a trust."

Andrew Mercer

Andrew Mercer, a consultant who was formerly CIO of BP for Middle East and Africa, explained one of the wider purposes of the scheme, to help oil and gas companies

Andrew Mercer, a consultant who was formerly CIO of BP for Middle East and Africa (image from webinar)

make more informed choices of what they buy, from knowing the carbon emissions.

For example, two cargoes of LNG could have a very different carbon footprint, depending on how the offshore platform which produced the gas was powered, where the energy for the liquefaction came from, and the length of the sea voyage.

For hydrogen, there is a different carbon footprint depending on if it is green (from renewable), blue (from gas with carbon capture) or grey (from gas without carbon capture).

"In order to calculate the carbon footprint we have to look right along the supply chain, asking suppliers what carbon footprint is associated with services or goods they've provided."

"Gathering data from lots of different sources is cumbersome, it takes time and costs money. The trick is to make the data exchange as smooth as possible. That's why this PIDX emission standard is so important."

Greg Coleman

Greg Coleman, CEO of consultancy Future Energy Partners, talked about the early days of counting emissions at BP and the enormity of the challenge today.

Mr Coleman formerly held roles at BP both of VP and head of investor relations (2000 to 2002) and Group Vice President HSE and Security (2002 to 2006).

In these roles, "I used to get a lot of questions about carbon issues," he said. "That was still in the early days, we didn't have the Paris accord, it was a voluntary effort."

"I spent a few years with the environmental part of BP developing reporting protocols. Looking back, we probably didn't understand what we were doing. This whole notion of Scope 3 was very foreign to me."

But do companies have much idea about how to measure emissions today?

Mr Coleman says he knows of a project to estimate the greenhouse gas emissions from a pipeline network of a country in Asia, and it has estimates of between 200,000 tonnes a year and 1.1m tonnes a year. "My observation is they are not able to measure their emissions," he said.

This country is calculating emissions based on various accepted methods for valves and flanges. "When we get to measuring directly, we'll find the emission numbers are very different."

"There's a lot of pressure on boards of companies to be much more fluent on what exactly they are reporting. This is going to be a shock to the system, when we find the range of uncertainty [makes it] open to a lot of interpretation."

Investor demands

Meanwhile, companies and their investors are changing how they think companies should behave.

The US Business Round Table, an association of CEOs of US companies, changed its definition of the purpose of a company in August 2019, to promote 'An Economy That Serves All Americans', rather than having a purpose of serving shareholders.

Blackrock, which manages $7.4bn in a number of funds, is asking companies it invests in what they are doing for the climate, and also mandating a single global standard for reporting. "I recommend that everyone look at Blackrock's prescription for what they expect companies to report."

"There may be 300 different organisations trying to come up with reporting protocols," Mr Coleman said.

There are $14tn of investment funds reported to be unavailable to fossil fuel companies, and $490bn debt raised in 2020 for "ESG bonds" (although still only a small percentage of a $100tn fundraising business), Mr Coleman said.

ESG has gone from "essentially nothing when I started working in the finance sector to this level now. People are starting to put money to work in these kinds of funds. My children, my pension plan, they are all much more focussed on this issue."

The oil and gas industry is pointed to as "the culprit", although a lot of emissions also come from agriculture.

All of this highlights the need to develop much better information about where emissions are coming from, he said.

In 2019, only 71 companies tied executive renumeration to ESG targets, according to FT analysis, and now that has grown to 604 companies.

Mark Carney, as the Bank of England governor, "took a very unusual stance," he said, encouraging companies to take climate into account in financial decision making.

"He's taken a number of roles in industry where he's putting his thoughts into financial action. People like him are very influential, they will drive the industries to be much more focussed on these issues. It is good to see that he's doing that."

Reporting standards

More and more companies are setting targets for emissions, and once that has been done in a transparent way, a failure to hit targets, or gather precise enough data, leads to a discussion about why.

But at the same time, "It is a long game. Many companies don't accept they are accountable for scope 3 emissions, particularly pure upstream oil and gas companies. I think that's going to change," he said.

"They can do offsets for a little while. Offsets are only a temporary measure in my view."

It will take much longer if all companies "do their own thing", rather than agree on standard ways to report data, he said. "ESG reporting is very opaque and varies by company."

There are strict reporting standards for financial reporting, regulated by bodies such as the International Financial Reporting Standards Foundation (IFRS)", he said. "I expect we need to get to that same place on ESG type reporting."

As with financial reporting, ESG audits are likely to require some third party verification of what's being reported. Without this, "it's very difficult to see why people are going to trust us. We're always in the bottom quartile of most trusted industries."

"Auditors are a potential third party that can validate what's been said and not been said. But auditors are hired by the company, they need to be clear about their role in this."

Whether Sarbanes-Oxley rules covers environmental issues "depends on how you interpret the regulation", he said.

But fundamentally, "if we leave it to regulation I think we will all wish we had done more to get reporting and performance agreements more transparent. If we're not careful that's where we're going to end up.

"Sarbanes Oxley created a lot of sleepless nights for me when I was involved in that."

Another issue is possible double counting. Car manufacturer GM has announced that it will eliminate tailpipe emissions from all new light duty vehicles by 2035. Oil and gas companies would be counting those emissions as part of their "scope 3" emissions. So are they being counted twice?

To summarise, developing standards "sounds like an open-ended task. At some point this needs to be narrowed down to something the industry can get behind," Mr Coleman said.

Microsoft

Kadri Umay, principal program manager global energy for Microsoft Azure (image from webinar)

Kadri Umay, principal program manager global energy for Microsoft Azure, described what a digital infrastructure could look like to handle emissions data.

The standard way of working with emissions data involves lots of silos, he said. The source data is first imported into software like Excel. The data is put through a complex calculation and modelling process, perhaps with the results in another spreadsheet. Data from different sources will be aggregated, which requires ensuring it all uses the same measurement units. Many companies use proprietary or in house developed schemas.

So a first step to improving the situation would be to automate this process as much as possible, with real time data and automated calculations.

A second step is making the calculation methods much more auditable and transparent. They should also be immutable (not possible to change).

A third useful step would be to focus on standard output formats. This is important if the data is going to be ever used in machine learning or analytics applications, such as to predict emissions, or correlate emissions with the industrial processes which caused them.

When it comes to supply chain emissions, these are often today just estimated from the invoicing data, as a record of what companies have bought, he said.

It would be useful to have more "edge devices" – computing systems connected directly to the sensors which measure emissions. These could be programmed to send only the data which is needed, rather than sending all the data generated by the sensor and leaving it to be sorted out downstream. For example, it might be programmed to send data just when some anomaly is detected, or a change happens.

You need an online platform which can take in the data. "You can find that in any cloud platform," he said. For example, Microsoft has a service Azure IoT Central.

Then you need applications which can process the data and make calculations, running on the cloud. Finally the calculated emissions data needs to be stored in some sort of open repository.

One example data structure is OSDU (Open Subsurface Data Universe), which was originally developed for subsurface data, but can be extended to include emissions data. "We're adding features like real time data ingestion, new energy use cases," he said.

"An open data platform provides the capability to exchange this data with other entities openly and freely."

Microsoft is also working with the Open Footprint project, "to leverage their schemas for open emission reporting and exchange."

"If you have the right data in place you have the luxury of thinking about new ways of solving the problem," he said. "Until today, we haven't had any way of looking at the emission of a process control plant, trying to correlate those with [operating] parameters, to reduce emissions."

Microsoft has an example of its own, where its customers can freely download data of Scope 1, 2, and 3 footprints of their workloads on Azure. So customers can see what emissions they are causing by using Microsoft services, based on Microsoft's operations other than electricity (scope 1), electricity purchases (scope 2) and other purchases (scope 3). They can use this to work out how they might reduce the emissions. The data is fully audited by outside auditors.

Emissions data in e-commerce

Chris Welsh, chairman of PIDX board and CEO of OFS Portal, explained how emissions data might be shared with other standard digital communications between buyer and supplier. The normal cycle has standard stages of sourcing, ordering, fulfilment and payment.

PIDX makes digital tools for all of the substeps here, including "master data management" (managing the data which describes items which might be purchased), managing catalogue data (a list of items a supplier sells), "contract management" (when a supplier and buyer agree long term contracts with a specific price list), sending "request for quote" documents, responding to bids and sending quotes.

Then issuing purchase orders, confirming purchase orders, goods receipts, issuing 'field tickets' (for services provided at a well site), invoices, responses to invoices, payment remittances.

When emissions become part of this, it means a vendor might specify the "emission rating" of their product as part of the sourcing. The emission rating system could be similar to the energy rating systems we have for some buildings and household goods.

The "bill of materials," a list of materials used to manufacture a product, could also include a specification of the emissions data which needs to be reported together with those materials.

A company might report emissions made on their invoices, such as the fuel used in providing a service like water collection.

Going together with this emissions data, we are likely to need a standard machine readable language. For example PIDX has a "Petroleum Industry Data Dictionary". It enables documents to contain descriptions of complex items and attributes which are standardised and machine -readable. There could be environmental attributes added to this.

"This is one of the most exciting projects we've had since putting together the PIDX project from scratch," he said.

IDS

One data service provider quick to see a business opportunity here is IDS, an oil and gas data reporting company with offices in Aberdeen, Kuala Lumpur and Calgary. IDS will use whatever the ETDX project group generates, said David Shackleton, Head of carbon data management with IDS.

For example, a service can be provided for drilling rigs, gathering data about volumes of diesel delivered to the rigs, volumes used, volumes left over, which can be used to calculate and verify the emissions made every day.

One ''use case' is a carbon emitting company, which wants to submit emission data for a year to a central depository, with the idea that emissions data can be anonymised, aggregated together with competitors, so that people can see how they compare with the average. "We'll be helping to facilitate this data flow," he said.

How Deloitte helped oil majors improve chartering

Deloitte presented case studies of how it helped two oil majors improve their chartering processes with digital tools, speaking at a Digital Ship webinar. It may indicate how the roles of shipping intermediaries will be changing

Consultancy Deloitte presented two case studies of how it had helped two (name undisclosed) oil and gas majors improve their tanker chartering with new digital tools, with a presentation at a Digital Ship webinar in January, by Patrick Boles, supply chain consultant with Deloitte, based in Dallas.

Deloitte's port and shipping group provides professional services, including technology implementation, to the deep sea and broader maritime industry, including ports. Deloitte has 200,000 employees, with over 500 dedicated solely to maritime. Its staff include specialists in specific digital tools.

Mr Boles formerly worked as an owner and operator of inland barges and coastal barges in liquid trade on the US Gulf Coast.

In the webinar, he presented two case studies of projects he has worked on over the past two years with oil and gas companies, to improve how they manage their marine logistics, address pain points and capture value with the help of digital technology.

The goals of the projects were slightly different (described below) although both related to tanker scheduling, chartering, voyage management, demurrage and financial settlement.

Role of intermediaries

The software project indicates that we may be able to see changes in the working process between vessel owners, charterers, brokers, bunker delivery providers and other service providers, he said.

"I do see a push towards bringing them all in one workspace or platform to allow them to collaborate in a more efficient manner than they are today."

This does not necessarily mean removing any intermediaries. Shipbrokers are still used by both of Deloitte's oil major clients described here, and an important part of the process, he said.

But it is possible that some intermediaries in shipping are benefitting from the lack of transparency, having more of a value themselves because they are the only people who know what is going on.

"That's counter to many of the objectives that we're trying to achieve here," he said.

"There are new busines models for them that are appearing as a result of this technology. I suspect they'll adapt to that going forward."

"I don't think they are going away, but I think they'll look different in the next 5 years."

"There's only one direction this thing is going, it is becoming more digital. That is borne out in demand we are seeing from our clients. They are accelerating their desired pace of increasing digital maturity."

Case study 1

Case study 1 was an oil and gas company which spends over $2bn annually on marine freight.

It has two separate business units responsible for managing the cargoes.

Before Deloitte helped implement a new system, the work was done on spreadsheets developed by individual users, which were e-mailed between people. There was much e-mail and much redundant data entry. This led to suboptimal vessel planning and execution.

High reliance on e-mail and personal spreadsheets for moving data are "tell tale signs of an organisation that is not digitally mature," Mr Boles believes.

Deloitte started with an "Agile" process to work out how to design a better system, forming four "scrum teams" with a brief to make a 'minimum viable product' in under 14 weeks.

The Agile process emphasises developing tools which you can directly try out with customers to see how well it works. Sometimes people need to be persuaded to share unfinished tools with customers. But "that's how you learn," he said.

The 14 weeks of work began with a "interview and assessment phase," where Deloitte staff talked to people in different roles, in both business units, working with different commodities, and in different parts of the world. The aim was to assess the existing processes and technology, and to assess the specific pain points and opportunities for improvement.

The next phase was to run design workshops. This was the most important phase in the program. It involved a "pain point prioritisation" – assessing which pain points were most useful or important to address.

It enabled the project team to get an idea of what the ideal future state would be.

The project team had to turn these descriptions of pain points into "user stories", something which the software developers could understand, and use to build the system.

Low code

The software itself was built on the Salesforce low code platform.

The software development involved the creation of shared workspaces, where people in different roles can enter data, see what they need to see from data entered by others, see what they need to do, and collaborate. The workspace then replaces Excel spreadsheets.

For example, one workspace was for marine scheduling, where everyone involved could

Patrick Boles, supply chain consultant with Deloitte

see what they needed to know in one digital place.

As a result of the project, the company has identified $40m in savings it can make.

The biggest financial benefit came from making it much easier for people to see details of commodity trades and cargoes.

The Salesforce platform has many tools to help automate workflows, and provides access to a number of apps made by other companies. Salesforce also has a suite of collaboration tools to support people in different roles working together.

Salesforce also has document storage capabilities. Previously the main document management system was folders in Microsoft Outlook, he said.

"In marine cargo transportation, there's a large amount of documentation that has to get managed, so that was a big thing," he said.

The first client thought using Salesforce's low code environment would be a good digital foundation which they could build on. "They felt it was about choosing an innovation platform for the future," he said.

In contrast, if they went for a pre-built software, it might mean choosing a system which you are then stuck with, as your "legacy" system, the client thought.

This project had a high emphasis on collaboration and communication, which a flexible low code tool was thought best able to support.

Mr Boles recommends that low code tools should be evaluated as an option any time you are considering new software, particularly if you cannot find an off the shelf tool which addresses all your needs. "Every business case is unique," he said.

Case study 2

The second case study was for the chemicals group of an oil and gas major, managing "hundreds of millions of dollars" of freight spend, with many spreadsheets, e-mails and phone calls.

The company thought they would be able to improve their planning, optimisation, contract management and spend visibility, with better digital tools.

The software was implemented in a more traditional "waterfall" or sequential way, with 3 months of design, including a business requirements review and a detailed design and build phase, mapping process flows.

This was followed by 9 months of build and implementation, including change management and user acceptance testing, to roll out the application. "We did a lot of training sessions, which are crucial," he said.

There is a fourth phase, called "sustain and improve," which comes after the software has been rolled out.

Working with Deloitte, they evaluated four different software vendors, including SAP and Oracle, and eventually chose Veson Nautical's "IMOS" platform.

The client considered Veson to be the market leader for management software for dry bulk and liquid shipping. Veson also provides professional services to help customers use the software. "The developers are familiar with the industry, they understand all the inherent challenges," Mr Boles said.

The software was needed to "address capability gaps in the organisation. Contact management, demurrage, settlement," he said. "They were doing demurrage calculations in spreadsheets for millions of dollars."

Other software companies said that their tools could be modified or configured to be used for shipping. "Ultimately we didn't feel confident in that," he said.

The client anticipated benefits of around $15m as a result of the digital technology implementation, largely from reducing spending on base freight and bunkers, and reducing spend on demurrage, by reducing vessel delays.

They would also be able to reduce spend on outside companies, such as inspectors. "There's a tremendous amount of waste in the inspector hiring process," Mr Boles said.

They would benefit from better spend visibility. "They had millions upon millions of spend where they didn't really know where it was going," he said.

Avoiding repetitive work

A goal of both of the projects was to automate repetitive tasks, so that people can focus more attention on exceptional events.

Examples of repetitive tasks which can be automated are updating the "Statement of Facts" (a detailed chronological description of the activities of the vessel during the stay in a port), or sending out "cargo nominations" (instructions to a shipping company).

But for a digital system to do this, it needs to be set up to support all of the complex activities involved in a tanker charter, with many internal and external people co-ordinating their activities in a certain way. "There's a lot of business processes that need to be understood there," he said.

Advice for success

Mr Boles shared some tips on successful digital project implementation.

It is good advice to start as early as possible with the training, perhaps as soon as you have selected which software tool to use. And test out the software as much as possible. "There's no such thing as too much training or too much testing in these projects," he said.

It is important to "take a holistic view of your relationship with a [software] vendor," he said. You need to evaluate whether you will end up being 'locked-in' to the software company you choose, and what the implications would be.

Also, whether the vendor would do any custom development for you, and how much influence you would have on the vendor's plans. There may be ways to increase your influence, for example by joining their supplier relations board.

When you finally release the software, it can be useful to "wow" people with something magic, which keeps them enticed in the project, he said.

For example, if you can show a demurrage analyst, who has previously been making demurrage calculations in a spreadsheet, that the system can now do the calculation automatically based on data already in the system, this can be a "wow" moment, he said.

"All these sorts of things make their job more enjoyable, and let them better realise the value that they're going to deliver to the organisation," he said. "It gets everybody committed to the project and the endeavour as a whole."

This article is based on a Digital Ship webinar on January 12 chaired by Digital Energy Journal's editor. The webinar is online at **https://youtu.be/S_puDn4mP98**

Oracle – the same data platform over project lifecycle

Software and data platforms for oil and gas construction projects have evolved to the point where companies can use the same platform for the entire lifecycle, says Geoff Roberts of Oracle Construction and Engineering

Oil and gas construction projects today typically use a wide range of different software packages through their lifecycle, including for design, construction project management, purchasing and operations.

Software tools are evolving to the point where it is possible to use the same platform across the entire lifecycle, says Geoff Roberts, director of energy industry strategy for Oracle Construction and Engineering.

If you use different 'point tools' [separate software products] for each stage of construction, "it becomes an integration nightmare and a spider's web," he says. Particularly if, as we see now, "organisations are changing literally on a 6 monthly basis."

Geoff Roberts, director of energy industry strategy for Oracle Construction and Engineering

It has to be a "high code" approach, with a lot of custom programming. And it cannot be done by people in the customer company. "It becomes a very complex IT delivery."

Some companies spend large amounts of money on "system integrators", which integrate the various systems together.

By sticking with a single underlying platform, you have a 'digital data thread' through the life of a project.

"You could throw up a new business process in half a day, and start controlling or managing your supply chain, your internal people, you can very quickly change direction," he says.

And the digital tools to support the new business process can be put together with your existing staff and domain experts, built on the underlying platform, so there is no need to bring in more external IT consultants, he says.

The software tool can support people in following the company's standard operating procedures, showing who should do what, when they should do it, what the delegation powers are, and what the escalation routes are. All of this can be incorporated into the platform.

Not every work process is suitable for being organised using digital technology. But "there's areas - which just naturally fit." This includes "anything around governance and control," he says.

You can also make a digitally supported structure for anything where people have to collaborate to create something specific.

Integrated platforms can also help companies manage and reduce carbon emissions. Their work processes to decarbonise need to be embedded in the projects and management systems. "We have built functionality and tools to do these things," he says.

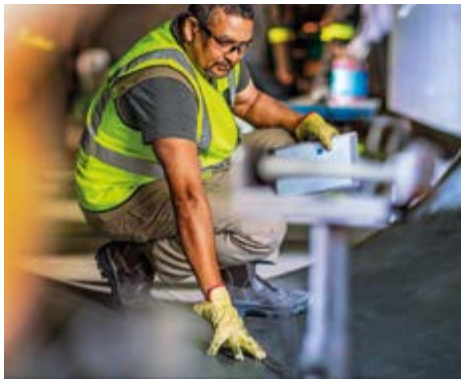
Suppliers

Many oil and gas companies are seeking to work with a wider base of suppliers, Mr Roberts says.

Working with a small number of "tier 1" service providers can make life simpler, but you sometimes find these service providers are just re-contracting the work to a second tier of smaller suppliers, while creaming off 15 per cent.

But when working with more suppliers, it gets more complicated making sure they are all giving you what you want, and also that the supplier companies are well managed, Mr Roberts says.

Digital tools can support the necessary governance and control. If you have a single underlying platform for the whole project, these tools



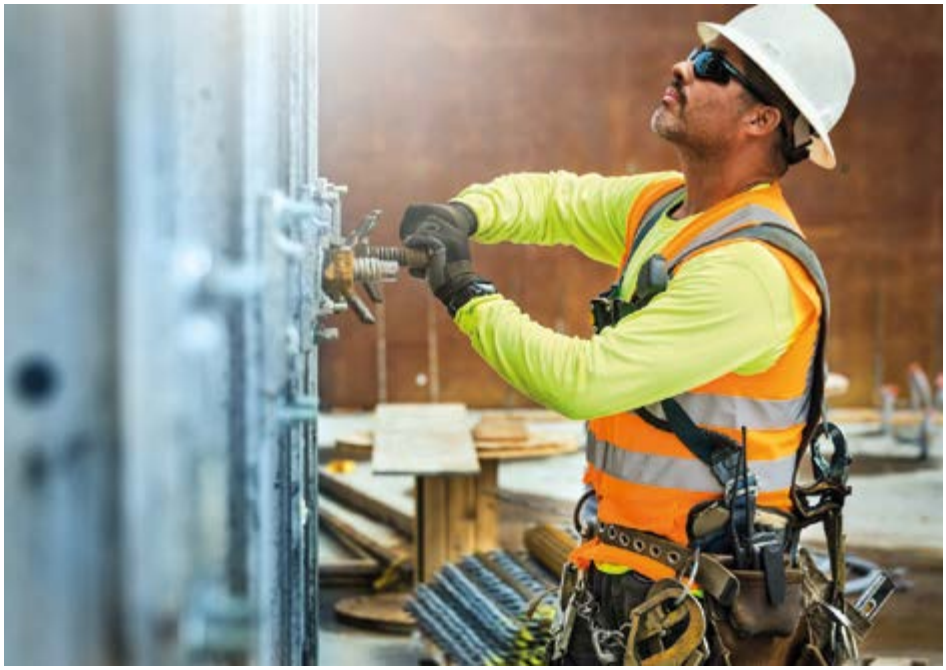
are much easier to put together and change, he says.

The data connectivity can work "vertically" and "horizontally".

Vertically can mean feeding information from different suppliers to company executives in the "host" organisation, and in the other direction, sending data from company executives to multiple suppliers.

Horizontally can mean sharing data between silos within the company, and enabling suppliers to co-ordinate with each other, rather than everything going via the host organisation, he says.

Digital tools can be developed to support automated workflows involved in working with suppliers. For example, you might want to have a structure for a 'design review' with a supplier. They have to happen collaboratively – and often with people in different locations.



Using data science to check flow meters

TÜV SÜD National Engineering Laboratory (UK) is developing ways to use data science methods to determine whether flowmeters are losing their accuracy, based on changes in patterns in the data they generate

Flowmeters are critical equipment in the oil and gas industry, because the flow measurements drive the calculation of how much money is paid for hydrocarbons when they are sold. But they can lose their accuracy over time. Some have been installed incorrectly without anyone knowing about it for years.

TÜV SÜD [UK] National Engineering Laboratory in Glasgow, UK is developing ways to use data science to determine whether or not this is happening.

Reasons for inaccurate data can include incorrect installation, instrument damage, particle deposition, the presence of an unexpected second fluid phase, and upstream or downstream flow disturbance. They also slowly lose calibration over time.

Having a better understanding of the condition of a flowmeter's calibration means that the re-calibration can be done only when it needs to be. Flowmeters are typically calibrated after fixed time intervals. The cost of calibrating an offshore flow meter is estimated to be around $50,000 when all costs are considered, with operations stopped while it is done.

Oil and gas flowmeters are either subsea or on offshore platforms, not easy locations to access.

Flowmeters output a lot of data. The question is whether you can use that data to find out more about how the instrument itself is performing based on mathematical modelling and statistical techniques.

"A lot of companies are just storing the data, they are not doing anything with it," says Dr Yanfeng Liang, Mathematician at TÜV SÜD National Engineering Laboratory.

Because the modelling process is looking at patterns in the data, the same process can be used on any kind of flowmeter, and for any fluid.

For years, flow measurement was typically performed by using mechanical device, such as a spinning turbine or even measuring the pressure before and after an intentional restriction in the pipe to infer a flow rate. However, as the technology has advanced more complex and data rich devices have emerged, such as ultrasonic meters.

Ultrasonic flowmeters send an ultrasonic wave into the pipe. They detect how fast the fluid is moving from the frequency of the reflected sound, due to the Doppler effect (the same phenomenon which changes the pitch of a police car siren as it drives past).

There are also "transit time" ultrasonic flowmeters which measure the time to travel between two transmitter / receivers. Under flowing conditions, a wave going upstream of the transmitter will take longer, because it is fighting against flow in the opposite direction.

Data output by the flowmeter can include the measured flowrate, ultrasonic signal strength, the time it was measured, and temperature.

Data models

The model looks for correlations in how different variables change. The modelling looks at the entire data set at once. The modelling can be done from data over any period of time depending on the nature of the problem.

TÜV SÜD National Engineering Laboratory develops an understanding of the typical patterns in how the variables change in data from a healthy meter. They compare this to the patterns in the data from the flowmeter being evaluated, to see if it looks abnormal.

When they can see a pattern changing slowly over time, and have an understanding of what is causing it, they can make prediction models. For example, if they think a certain pattern is caused by a small amount of wax build up, and that pattern is changing slowly, they can extrapolate to see what point in time in the future the wax is likely to cause the flowmeter to be inoperable. So maintenance can be planned before then.

A human being could do the same work, but data modelling can look at much more data variables much faster as well as extracting additional and hidden insights in variables. There are errors which induce the same drifts in the same variables, therefore without using advanced data-driven models, it would be challenging in distinguishing between errors. Consequently, delaying the fault diagnosis process.

The more data which is recorded, and shorter the interval between recording, the more accurate the final prediction result, and the more resolution you get. For example being able to pinpoint the exact location of wax build-up within the flowmeter, or the percentage of gas present in the flowmeter, or its remaining useful life when exposed to sand.

Dr Yanfeng Liang, Mathematician at TÜV SÜD National Engineering Laboratory

The modelling includes "diagnostic variables", where it has been shown that errors will cause them to drift from their baseline values. Through the use of data-driven models, you can say that you are 99 per cent sure the drift is because of a specific error.

The 'diagnostic' variables can drift both due to errors in the measurement, and changes in the process conditions.

"It can give a greater certainty on pinpointing the right error," Dr Liang says. "The end users don't spend time solving the wrong error. It is helping them speed up their fault diagnostic process."

About NEL

TÜV SÜD National Engineering Laboratory (NEL) in Glasgow, UK, is the Designated Institute for Flow and Density Metrology with responsibility for providing the UK's physical flow and density measurement standards

It offers services to upstream oil and gas companies to better understand how their flowmeters are working.

In February, it announced the launch of its flowmeter data analytics service, to help minimise flowmeter downtime and maintenance.

eyeGauge – digitalising legacy equipment

eyeGauge of Paris is developing technology to automatically take data from legacy equipment into a digital network

eyeGauge, a 1 year old start-up in Paris, is developing technology to gather data from analogue meters and other non networked devices, and incorporate it into a digital network.

Oil and gas installations, ships, and other industrial sites, often have equipment with analogue meters and numerical displays designed to be checked by a person standing next to them.

They were installed in a time when people did not expect sensor systems to be connected into a network. Workers read the sensors by walking around the plant with a pen and paper.

eyeGauge does not reveal publicly how its technology works, because it has a patent application pending, but we can say that it is a non-invasive system for automated data collection from equipment of any age and any manufacturer.

The company was founded by Rodion Denisyuk, a former R+D senior manager with industrial software giant Dassault Systèmes.

Rodion Denisyuk of eyeGauge

Mr Denisyuk believes the cost and complexity of installing networked digital sensors is one of the major obstacles to digitalising industrial plants altogether. And we can make this task a lot easier if we can find better ways to work with what we already have, he says.

Companies are increasingly seeing the benefit of being able to automatically get readings from devices remotely. Automatically gathered data has less errors than data manually entered into a computer or mobile device. There can be risks associated with sending a worker to the site to take the reading.

And also companies are coming up with better ways to get value from the data, such as to reduce consumption or improve equipment uptime. They are increasingly recognising the importance of having all possible data, not just some of it.

Companies find that even ships and plant built in the past few years, equipped with digital networked sensors, can still have one or two analogue, non network connected devices on it, such as a flowmeter. “You need an engineer to go in there and write the readings of fuel consumption down twice a day,” he says.

One industrial networked sensor can cost as much as Eur 2000, and people might want 20 of them.

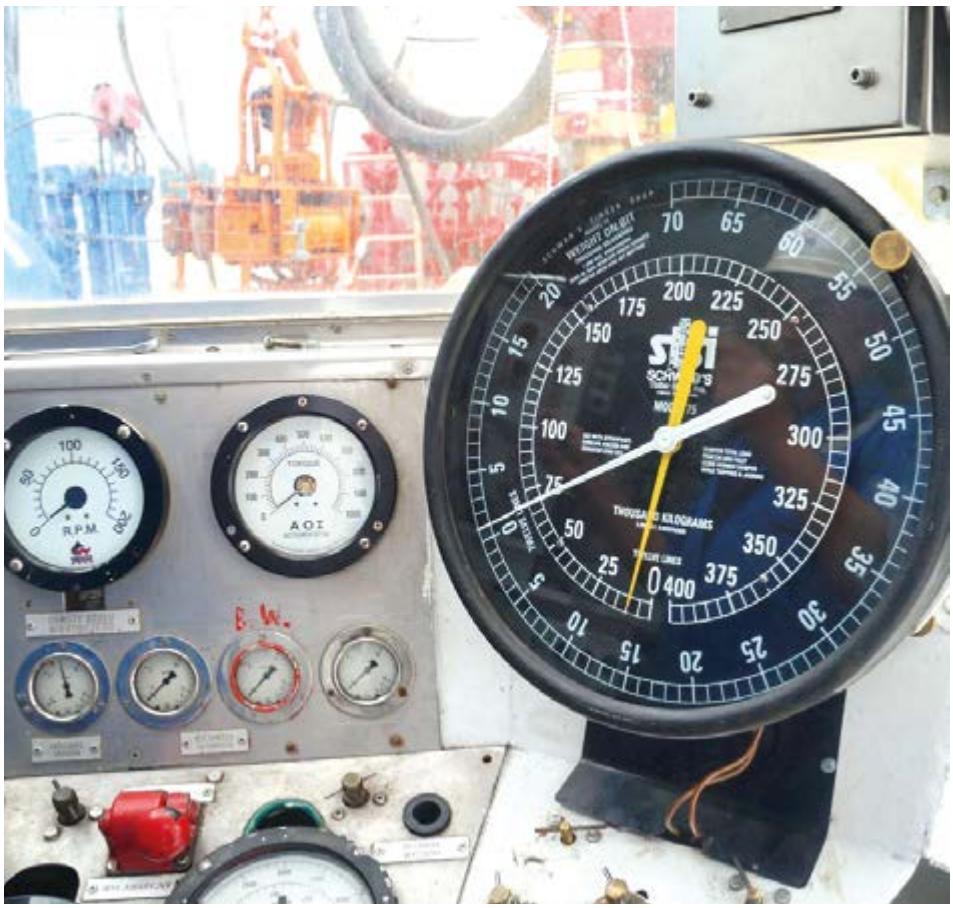
Companies sometimes decide they will only use the information which can be automatically transferred to the network, and ignore everything else. But then they find they have an incomplete picture, he says.

The EyeGauge solution does not involve replacing any equipment, just adding something. It can be installed by crew members / onsite engineers, without specialist skill, he says.

EyeGauge is working together with industrial infrastructure giant Mitsubishi Corporation, following a “decarbonisation challenge” organised by venture capital company Rainmaking, which involved matching start-ups to big corporates.

It is running a pilot project with Wilson Ship Management to install the system on a small general cargo vessel.

It is working with SKF Aeroengines company which makes ball bearings for aviation. Their main production line is fully automated, but they also have old equipment providing compressed air and lubricating oil, which has a lot of equipment still monitored manually, Mr Denisyuk says.



What a lot of oil and gas equipment still looks like

Keeping physical infrastructure cybersecure

Some tips to keep physical infrastructure cybersecure are to embrace remote access but ensure that connections are monitored, minimise the 'attack surface', understand your network and maintain secure authentication.

By Joe Slowik, Threat Researcher at DomainTools

Analysis of infrastructure-targeting cyber events indicates a steadily increasing cadence (frequency) over time. The threat landscape, particularly for Industrial Control Systems, has changed dramatically over the past five years.

There have been no known, deliberate, physically disruptive events since the 2017 'Triton' incident. But reporting from governments, security firms, and industrial organizations emphasises a significant increase in detected threats from likely state-sponsored actor initial access operations to targeted ransomware operations.

Meanwhile asset owners and operators find themselves in a rapidly changing operational environment.

Increasing vendor adoption of cloud-based or remote telemetry solutions, COVID-19 related protocols requiring increased remote access, and even simple efficiencies have all dramatically changed operations and their defensibility.

Infrastructure asset owners and operators find themselves in an increasingly contested and more connected environment.

Yet with some awareness, adaptation, and investment, defenders can meet these challenges and place potential adversaries at a disadvantage.

The first step in this process is understanding the environment—both operationally and in terms of threats—as it currently exists, and the next is adapting security controls to meet these challenges.

While this is only a brief overview of possible controls and adaptations, taking this guidance as a starting point will set infrastructure operators on the path to increasingly secure and reliable network operations.

The following ideas can help asset owners and network defenders secure their environments and ensure operational integrity.

Embrace remote

Whether due to COVID restrictions or increasing efficiencies through centralized operations centres over multiple physical sites, remote access and control over operations is here to stay.

We can express discontent about the security risk this posture raises as much as we may like, but fundamental business logic and technical evolution mean we cannot turn the clock back to some earlier period of network isolation.

So rather than fight a losing battle against an entrenched trend, asset owners, operators need to embrace this development and work with it instead.

Accepting this trend of remote connectivity means defenders and engineers can divert energy (and resources) in a more positive direction, towards ensuring such links are secure and monitored.

Attack surface analysis

Building on the previous observation, while asset owners and operators must accept increased remote accessibility and operations, this does not imply that such operations need to be insecure.

Rather, proper network design and remote operations implementation mean organizations can control and potentially reduce their attack surface relative to adversaries.

Understanding business requirements and operational needs first, and engineering solutions to meet these needs while maintaining baseline security requirements, will be critical in architecting networks for increased remote administration activity.

Failure to adopt this posture means putting an organization in the unenviable position of dealing with both the business requirements of remote access and an implementation that is impossible to secure.

Monitoring

Once operators and defenders embrace operational realities and limit exposure to the necessary minimum to support business use-cases, focus can shift to ensuring that ingress and egress points to the network are appropriately monitored.

Technologies from default traffic encryption to emerging trends such as DNS over HTTPS can limit network visibility.

But ICS environments should still remain relatively accessible to network security monitoring techniques.

Identifying, and if possible, enriching network observables can allow for rapid detection of suspicious activities of various kinds.

Such items can range from strange source IP addresses trying to remotely authenticate to odd domain names referenced in traffic from control system networks.

In either event, operations start with capturing and looking at relevant traffic, DNS lookups, and netflow data.

Understand the network

Understanding the network is critical to building out meaningful, sustainable network defence against adversaries.

For organizations responsible for securing systems ranging from point of sale terminals to standard IT workstations to programmable logic controllers (PLCs), the ability to rapidly identify and determine where a potential intrusion is taking place can be incredibly valuable.

Not all networked resources are equal in value or importance, and being able to differentiate between them as part of incident investigation and response can enable powerful, focused incident response activity.

Asset identification and tagging can reveal not just what a given adversary might be after, but allow for rapid triage and decision making as to what follow-on steps are required.

Secure authentication

Embracing multiple aspects of the previous four observations, secure authentication is perhaps the most significant security control for improving resilience and reducing the likelihood of a serious incident.

Multiple adversaries, from state-sponsored actors to ransomware operators, thrive on their ability to capture and replay credentials in a victim environment to move laterally and potentially distribute disruptive capabilities.

When the above controls fail, having a robust authentication schema in place, including a secure Multi-Factor Authentication (MFA) solution, can ensure follow-on adversary operations are limited or generate sufficient noise that defenders can rapidly detect their presence.

Joe Slowik, threat researcher at DomainTools, worked in security for the US Navy, spent three years threat hunting at Dragos, where he was able to look into the 2016 Saudi Arabian safety system attack, the Ukrainian power events of 2015-6, as well as a series of (likely state-directed) incidents targeting Western European and North American critical national infrastructure

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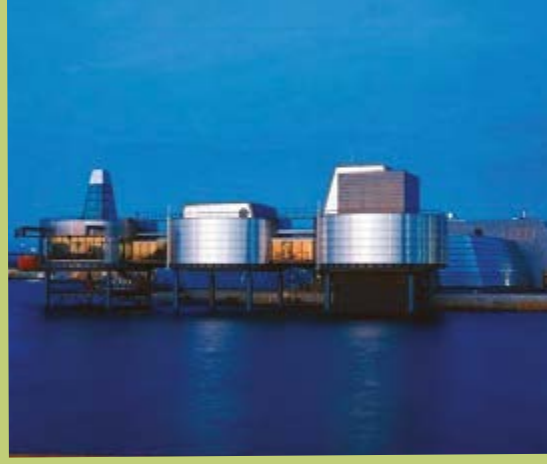

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