# digital energy journal

## January - February 2021

## Cognite's industrial digitalisation conference

BP's Bernard Looney on industrial software

Aker BP and Lundin on digitalisation

Innovation at Maersk Drilling

**Digitalisation at Premier Oil** 

Wintershall - being more practical about digitalisation



Making it easier to use deep learning to identify faults



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**Cover photo:** Bluware's technology makes it much easier to set up machine learning on seismic data, for example to automatically extract faults. Data is stored in a different file format to the usual SEG-Y. See page 10



## Cognite's "Ignite Talks" conference Aker BP and Lundin's Digital transformation

Aker BP and Lundin presented their approach to digital transformation, and how it has been changed by Covid, at a Norway focussed session at Cognite's "Ignite Talks" online event. Also joined by Equinor and Cognite's CEO

"The industry has always talked about VUCA principle (Volatility, Uncertainty, Complexity, and Ambiguity)," said Karl Johnny Hersvik, CEO, Aker BP.

"Now [with Covid] we are actually living it. It is very different to talking and strategizing."

"I promised my team Aker BP would come out stronger after the crisis than we went into the crisis."

"[Covid] has given a new boost in how you think about change, empowerment, which directly impacts how we think about digitalisation."

"We couldn't send people offshore. We were forced to do remote inspections using the tools we already had."

"It has allowed us to test out in real life how a lot of our prototypes are behaving."

"We've gone from 'user case' individual products to end to end business issues. You talk more about the change project and how that builds on the technology base, rather than solving singular problems."

"we have 980m barrels of 2C reservoirs we want to develop. It really forces us to rethink the entire setup."

"In the heart of this is digital. When we started thinking about this in 2016-2017, I never imagined how powerful that backbone would be, and how important it is in shaping your change projects."

#### **GHG** emissions

Mr Hersvik thinks about the challenge of reducing greenhouse gas emissions in three different dimensions.

Firstly, looking for "base reduction", using data to find ways to remove waste from business processes, and iterating.

"There are huge savings to be had. An experiment we did on a field could reduce 8 per cent of power consumption. This field is generating 1 per cent of total Norwegian emissions. Very little input apart from brain power."

Most assets can achieve 4-5 per cent reductions in CO2 emissions, with a relatively small investment, he said.

The second dimension is "more leap based", such as with offshore wind powering offshore platforms. It needs "new investment, new ways of thinking."

The third dimension is "how you think about this as a system - not just a singular event."

"I'm really amazed we are not more focused on energy optimisation as an industry," he said. "We've been focussed on [only] production optimisation for as long as this industry has been around."

#### **Suppliers**

In terms of working with suppliers, Aker BP has been experimenting with an "alliance" model, where it works collaboratively with suppliers to find ways to reduce waste. "We were quite inspired by the early results, significant reductions in cost, time," he said. "95 per cent of CAPEX in Aker BP is going through these alliances."

"We've been experimenting with transferring procurement to 'as a service' basis, such as pumping as a service." There are complications though. "You are impacting that vendor's ability to finance how they run their organisation, set up their business processes."

An important learning is how critical it is to have a trusting relationship between the supplier and customer. Without this, "these won't work independent of structure."

This means that the normal competitive procurement process can make it "very difficult if you want radical change."

Building on this, you need to get the right balance between transaction structures and organisational structures.

"If you just focus on incentives - it will look good on a PowerPoint but won't solve the problem. If you don't have a common identity to solve that problem, in our experience, it doesn't really work."

"There needs to be a development program, developed by these alliances themselves. That means we are, as an oil company, giving up some of the [power in the relationship], giving them a problem, asking them to come up with a solution, usually in several tranches."

"We need to be much better at collaborating, and we can, if we put our heart to it."

"If we can't really transform that industry as a total, I think this will just remain experiments," he said.

#### Lundin

Lundin does not see a need to use the label 'digitisation', said Kristin Færøvik, Managing Director, Lundin Energy Norway. "To us it is all about continuous improvement, embracing new technology to address our business needs, in line with growing our ability to process ever growing data amounts."

"Digital tools certainly do represent the greatest improvement opportunities within our company and within our industry."

"When people ask how 2020 has affected our digitalisation priorities my short answer is, 'not much.""

"We've made huge strides in holding digital meetings. Used correctly, these tools will improve efficiency. We will never go back to business travel habits of the past."

"We can have an impact in improving our own robustness. Low emission, low cost barrels are key."

"We need to make sure we have resilience to low oil price environments. To a moderate extent. our operated activities have changed with the oil price."

#### Individuals

Digital tools are "also about improving efficiency of individuals working for Lundin, empowering those who are out in the trenches to influence and improve their own work process," she said.

"We trust those who see opportunity for efficiency gains to come forward with their own good ideas. We try to make sure they are part of solutions themselves."

For example, "Kristina is creating an app for production and injection planning. Steig is developing an energy management system for cutting power consumption on a rig. Alan is creating a panel with a live link to status off-



Left to right: Karl Johnny Hersvik, CEO, Aker BP; Kristin Færøvik, Managing Director, Lundin Energy Norway; (on screen) Jannicke Nilsson, COO, Equinor; John Markus Lervik, CEO and co-founder of Cognite

shore. Tom is developing visualisation of entire projects, a completely new approach to field development."

"Save 15mins here, a few kg CO2 there. These are the kind of improvements which will help us stay competitive."

"One of the more profound learnings from 2020 is just how precious human interaction is, in creativity, problem solving, individual well-being and just in enjoying working life. For all the digital tools in the world it is still people that make the difference."

"One of the strengths of the Norwegian Continental Shelf is collaboration, we've demonstrated that thoroughly through 2020."

For example, "we have this virtual storehouse of critical spare parts. It doesn't cost an awful lot. There's a significant reduction in waste."

"We are totally reliant on our suppliers, there's lots of things they know better than us," she said. "Our core expertise lies in the subsurface."

#### Equinor

Equinor sees that it is very important to be a resilient company for the future, and strengthen its competitiveness, if it is going to achieve energy transition goals, said Jannicke Nilsson, COO, Equinor.

It is increasing production from its fields, while reducing CAPEX in project construction and drilling, using digital twins and automated drilling controls. It is reducing operating costs by working more efficiently and automating many work processes.

#### Cognite

The important step for digitalisation is making our data availability better, said John Markus Lervik, CEO and co-founder of Cognite, chairing the session.

"Without data there is no digitalisation. The complicated data industrial reality limits our ability to industrialise and scale industrial digitalization."

"We have talked about the power of liberating

IT and operational OT data, contextualising it, and making it all available through one interface and API, so through a common language that people and machines easily understand and use. This means unlocking insights from all different kinds of data."

"Sensor data - temperatures and pressures. Process diagrams. Equipment events and alerts, 3D models, all combined, all instantly available for humans and machines across a multitude of devices."

"This approach is now being established across asset intensive industries as a necessary foundation to operationalise and scale industrial digitalisation."

"True digital transformation can begin only at this stage, not just rethinking how we work but rethinking our busines models."

Data and algorithms can be used to make improvements such as "cutting the time to inspect a factory in half, connecting a renewable energy source to the grid twice as fast, giving your experts access to all the information they need to do their jobs," he said.

An example is an oil company customer in the Middle East, who used better data to improve how it plans its maintenance work, and as a result reduced the number of planned shutdowns. The efficiency gains were valued at \$38m per year.

"Whatever you decide to do with your data it is critical to have a clear focus of creating impact and value," he said.

The company's "Cognite Data Fusion" platform can be used to understand data and learn from it. It puts "raw industrial data" into context, so that people and machines and analyse and build on it. It could be described as the "universal translator of industrial data," he said.

This article is based on the session at Cognite's "Ignite Talks" industrial digitalisation online conference on Oct 27, 2020, "Off to an Early Lead: How NCS Operators Are Embracing Technology and Digital Transformation". The event had over 10,000 registrations.

## BP's CEO, Saudi Aramco's SVP, and Cognite's chairman

Bernard Looney, CEO of BP; Ahmad A. Al-Sa'adi, Senior Vice President of Technical Services, Saudi Aramco; and Øyvind Eriksen, President and CEO, Aker ASA, and chairman of Cognite shared their perspectives on digital in oil and gas at Cognite's "Ignite Talks" industrial digitalisation conference

Bernard Looney, CEO of BP, said that Aker's Øyvind Eriksen had been "a great friend over many years, and a great partner."

"I want to congratulate Paula [Doyle, SVP Sales & Marketing with Cognite), John Markus [Lervik, CEO of Cognite] and Øyvind on incredible progress with Cognite. You have taken something in its infancy just a few years ago, and built an incredible business."

"I'm not surprised, I know who you are, but I'm delighted for you all."

For BP, Covid in 2020 has "had a huge impact on us like everyone, it has been massively disruptive," he said.

But "it hasn't changed our priorities at all. If anything it has accelerated some of the long term plans we've had for the company."

Mr Looney began as CEO in February 2020, and soon after, the company announced a new purpose, to "reimagine energy," and an ambition to be a net zero company by 2050 or sooner.

Coronavirus became a global pandemic one month later. "Our immediate priority became keeping our people safe, working from home, new processes new protocols. Caring for wellbeing, with a large emphasis on mental health, something that I'm very passionate about, something as much a risk and threat in the current scenario as physical health."

The second priority was "supporting the communities that we serve."

The third priority was to strengthen the fi-

nances of the company "in the face of demand falling through the floor."

"We came to the view as a leadership team and a company that the right response was not to park the plans we had, but to accelerate them."

"We want to be leaner, faster moving, lower carbon. That's what society wants and needs, and what we want as well. We've been in action towards that all this year."

BP developed a new strategy in August 2020, building "in large parts on the transformative impact that technology is having, and going to increasingly have on the global energy system."

"We're only just starting to scratch the surface of what is possible."

"We see a huge opportunity for BP in the energy transition. Trillions of dollars will be invested in replumbing and rewriting the world's energy system. It's going to get more complex, more local and more bespoke.

"We like that complexity, that's where we play well in bringing the energy system together."

"We characterise our reinvention from being an international oil company focussed on producing resources, to an integrated energy company focussed on delivering solutions for customers," he said.

"We're taking core capabilities that we've developed over a century, running safe and reliable operations, world class project management, engineering at scale, one of the world's biggest trading houses, we have retail network, marketing expertise. We can integrate it all together enabled by technology."

"This year we've generated \$250m, we think, in revenue from production that would not have flowed without that optimisation."

"More generally, software and other digital tools will transform efficiency, through access to data, standardization, re-use of resources."

"Software platforms are enabling people like us who are non technical to work with data, interfaces, technology to perform tasks, that would have taken masses of time in the past."

"We think this will unlock some huge value for us. We're committed to being at the forefront of this change. We know we don't have all the answers, we don't have all the expertise."

"The two things we love are technology and partnerships. We love to learn and get better."

"I think society needs different solutions, and solutions which we need help to invent today."

"I think competition is on the rise. We used to sort of be able to do our thing and work how we worked. But the world is changing, we are being competed against. There are some incredible companies out there doing things and creeping into our space."

#### Where digital helps

When it comes to what digital technologies can do, Mr Looney sees improving productivity and decision making as big areas. "It



Bernard Looney, CEO of BP and Ahmad A. Al-Sa'adi, Senior Vice President of Technical Services, Saudi Aramco (photo from online event)

takes way too long to get work done, and we have to improve the quality of decision making," he said.

. . . . . . . . . . . .

"I have a fundamental belief which drives where we get to in industrial software. I get lost very quickly, but I deeply believe in the potential here, and I've seen it."

"We've got things taking 80 to 90 per cent of the work out of the system through automation. Not just automation inspection, it is automating process."

"The time which we take moving things through our system - work orders, getting a purchase order, paying the invoice. This stuff is enormously inefficient. It is not good work, it is not fun work, work that people really value."

"I have a huge belief in the power of digital to give society what it wants and give people work that is more fulfilling. Industrial software is at the heart of that."

"Years ago, when we were talking about digital in upstream - people were saying "it is just a fad, something they are trying to talk about because they don't want to talk about their real business". It's not a fad, it's here, and I'm hugely excited about it.'

Digitalisation will also be implemented in the company's consumer business, with retail petrol stations.

"Retail is a big part of our company. In our 3Q results, BP had its highest fuel marketing sales in the last 7 quarters, as a result of the convenience business. BP sells 150m cups of coffee around the world a year and makes quite a lot of money at it."

"I was in Germany a few weeks ago, our first 'mobility hub' in the world. We have a traditional gasoline station, ultra-fast [electric car] charging, electric e-scooter rental, bike rental, parcel drop off."

#### Saudi Aramco

"In an ideal world, energy would be readily available, sufficiently reliable, widely affordable and sustainable," said Ahmad A. Al-Sa'adi, Senior Vice President of Technical Services, Saudi Aramco.

"Most would agree that we need to give climate change the highest priority. While multiple efforts to date have helped reduce carbon emissions, most would agree the progress so far is not meeting expectations."

"At a macro level the world is relying on two major alternative technologies to reduce carbon emissions - electric vehicles and renewables."

"Electric vehicles represent less than one

per cent of the world's vehicle fleet. They face multiple economic and technical challenges. The fuel mix to most electric vehicles is not being sufficiently clean."

"Renewables like solar and wind produce less than 10 per cent of the world's electricity. If we look at the world's total primary energy - it is less than 3 per cent. This is going to double or maybe triple in the next 10-15 years. But it still shows that a significant part of energy will be coming from other sources."

"They still lack large scale storage to address the intermittent nature of renewables."

"We have to [make effort] to further reduce the carbon footprint of existing energy sources. We are [expecting to] supply a major share of global energy for many years to come."

"Across all the research and development that Aramco does, carbon reduction is the highest priority."

The company uses carbon capture and storage technology to collect 30m standard cubic feet (SCF) a day of CO2 from one of its gas plants, and use that for enhanced oil recovery of an oilfield.

Last month, it announced the world's first shipment of high grade blue ammonia in Japan for use in zero carbon power generation.

#### **Digital at Aramco**

Aramco is establishing a "digitalisation program that expands the entire value chain of our operations," he said.

"One of the strategic pillars of this program is to strengthen our leadership position on climate and environmental performance."

"For example we have deployed a greenhouse gas emissions analytical solution that monitors emissions from more than 2000 sources across 170 operating sources, benchmarking the performance of each facility."

It includes using data from low earth orbiting satellites to monitor emissions.

Another interesting use of digitalisation is AI tools provided to geoscientists to help guide drill bits doing drilling.

Mr Al-Sa'adi said this could be partly responsible for the "very low water cut" it has from some its wells, from fields which are over 70 years old.

#### Cognite's chairman

Øyvind Eriksen, President and CEO, Aker

ASA, and chairman of Cognite, said that in many industries, including oil and gas, having data locked in separate systems is a barrier to digitalisation.

"The purpose of Cognite and its Cognite Data Fusion technology (CDF) is to resolve that challenge," he said.

To break down silos, liberate operational data from all relevant sources and enable smart applications that can improve operations in different industries."

"It sounds easy, but the technological task at hand is extremely complex, even for the most brilliant data programmers and scientists. Hence the uniqueness of CDF."

Mr Eriksen said that 2020 may turn out to be a milestone for industrial digitalisation, and converging technologies, in the way that the iPhone in 2007 was a milestone in consumer communications and electronics. also converging technologies.

"In the beginning we became excited by functions like the camera, the mp3 player, the touch screen. The real transformation happened some years after the launch when all these technologies converged, siloes of consumer data were broken."

The oil and gas industry cannot address its "complex paradigm" - with demand for energy rising, an urgent climate crisis, and increasing complexity and unpredictability, while under pressure to produce at lower costs and emissions, "without the power of industrial digitalisation."

"Data driven decision making and automation will help users bring emissions down during a time when society is heavily dependent on oil and gas, while simultaneously playing [towards] an enormous goal in enabling a transition to different sources of green energy."

Industrial digitalisation is a "great white whale for many, enormous, elusive and anxiously hunted," he said. It means "using data to make better decisions today and do prediction analysis to better anticipate the future."

Digitalisation projects are increasingly led by senior management in companies, he said. "When we started Cognite four years ago, most business leaders had some functional expert, like a chief digital officer, to drive digitalisation."

"Today - as demonstrated by Bernard and Ahmed in this discussion, industrial software and automation is on the top of our leadership agenda, used as a tool for transformation and improvement and growth of our respective businesses." digital energy



## Maersk Drilling and Wood – evolving digital approaches

Marika Cecilia Reis, Vice President and Head of Innovation, Maersk Drilling, and Prabu Parthasarathy, VP of Intelligent Operations, Wood, shared perspectives on how the industry is changing its approach to digitalisation

Much of Maersk Drilling's innovation efforts are focused on lowering emissions, including electrification of its rig fleet using shore power and batteries, and installing filters to catch NOx emissions, says Marika Cecilia Reis, Vice President - Head of Innovation, Maersk Drilling.

On the digital side, it is looking at ways to drive down costs, optimise how wells are drilled, improve drilling speed, improve decision making, introduce automation, and reduce waste.

She was speaking at an online session during Cognite's "Ignite Talks" industrial digitalisation conference.

In June 2020, Maersk Drilling joined a new CO2 storage consortium formed by INEOS Oil & Gas Denmark and Wintershall DEA. "If it is successful it would take 15 to 20 per cent of the target for the Danish CO2 for 2030," she said.

Over the coming years, Ms Reis believes the current focus of senior management on digitalisation and sustainability will continue. "We are not thinking of changing any direction at all," she said. "Both of them are going to accelerate."

Digitalisation and sustainability go together. "If we don't get digitalisation right we'll have a hard time making business work, if we don't have sustainability we don't have a business in the long term."

The company is headquartered in Denmark, very focussed on the North Sea but has a fleet all around the world. Ms Reis' department has 25 people working on innovations.

Maersk considers technology adoption as part of the "innovation" process. "Of course the technology is important, it needs to work, we also want to make sure there is adoption. We use different methodologies like design thinking, so you understand what the user wants from this."

It is important to have an innovation process. "We make sure we're not working on everything and nothing, making grand plans that can never come to life," she said. "We have plans but we make sure to make small steps towards a big goal."

"Every single [innovation] project has a user [involved] in the project," she said. "We have multiple offshore workers in the project. We make sure they really like the solutions that we are working out." "The offshore people are selling it to their colleagues. I think that's what you have to do."

Maersk Drilling tries to engage customers, start-up companies and universities in trying to find solutions to problems.

COVID helped deliver the message to companies that they need to keep the ability to change how they do business, having a culture of innovation rather than staying where they are, she said.

Ms Reis formerly worked as head of "business to consumer" innovation at German power company E.ON, and she brings this experience working in the consumer world to Maersk Drilling.

She encouraged Maersk Drilling to bring in more flexibility to the work environment, so it would be more suitable for people who had previously worked in start-ups or "more flexible industries".

This included introducing flexible work spaces and abolishing dress codes. "We make it OK for people to wear whatever they feel comfortable. It is a big deal to people."

"Sitting by a desk all day is often not a good way to do innovation," she said. "And many entrepreneurs don't want to work 8 to 5. You have to adapt to a way that works for you."

Another issue is that "many of these people are very attractive to the job market in general, they do vote with their feet, you have to make sure they stay," she said.

#### Wood

Prabu Parthasarathy, VP of Intelligent Operations with engineering consultancy Wood, said he has seen many clients cut back on capital spending during the Covid period.

Spending on operations has gone up however, as clients look for ways to improve production. But they would like to spend less money on consultants doing so. "We've had to innovate on how we deliver services in a more cost effective way," he said.

Customers are looking for ways they could reduce maintenance without impacting safety, and improving remote working.

The digitalisation focus has changed away from data science, he said. Before Covid, companies were very interested in getting data scientists to "come in and do transformational work." But now, companies are more interested in technologies which allow their engin-



Marika Cecilia Reis, Vice President - Head of Innovation, Maersk Drilling (photo from online event)

eers and domain specialists to deliver results, and do their work in a seamless easy way.

There is increasing interest in using standardised data formats, which give people more flexibility in their choice of technology. There is a corresponding drive towards technology based on open formats.

One of the biggest areas of interest is supporting remote work, avoiding the need for field workers to travel to well sites, or minimising their visits.

Another trend is that companies are involving operational people more in decision making around digital technologies, not driving them from top down.

The days of software companies trying to provide everything a client needs are numbered, he said.

"You still see people who think that they can build their own ecosystem, they just want everything to be part of their platform. The reality is, technologies are changing at such rapid pace, there's always a new innovator doing something better than what you're doing today."

Some software makers are looking for partnerships, because they realise it is not sustainable to try to do it all themselves, he said. "You're not ever going to have all the technologies a client wants."

Mr Parthasarathy anticipates that we will continue to see more cloud adoption. Among other benefits, it is a way for companies to reduce their carbon footprint, with many cloud providers promising to have net zero emissions by 2030.

Perhaps we will also see more digital technologies being developed which can integrate closely with collaborative tools like Zoom, Slack and Microsoft Teams, he said. digital

6

## **How Premier Oil does digital**

Premier Oil's COO talks about how digital is now essential rather than desirable, how it is using technologies to improve production optimisation, 3D surveys and subsea inspection, and how it is joining up the data

Digitalisation "has turned from 'that's nice and looks really interesting, how do we do that' to "people can see it is actually a necessity'," said Stuart Wheaton, COO, Premier Oil.

He was speaking at the "Ignite Talks" industrial digitalisation conference organised by Cognite in late October 2020.

"If we think about work done, we've got to be using things like this [digital technology]. It's simply not practical to not use them."

"If there is a silver lining to the impact on our business [of Covid 19], it is that new ways of working, new techniques and technologies have come out to the fore."

"In terms of managing COVID 19, we wrote apps to do it. There were some immediate technical applications which could help us."

"We've got some examples where we can prove it is no longer necessary to go offshore. They used to go as a habit. By using the right tools it is no longer necessary."

"And we're using all of this data coming in. Because we're sat at home, and we actually have time to do it. Rather than sitting in various other sessions where we had to sift through data using other people."

"We need the tools to do that work for us."

"Some of the crustier naysayers that exist in the oil industry when you bring in something new, suddenly they find they are ac-



Stuart Wheaton, COO, Premier Oil (photo from online event)

tually using it and [saying] 'hmm, wow.'"

#### **Premier's digital ventures**

Premier has a project to optimise production in real time, for a subsea well producing condensate. It is monitoring equipment remotely to check for problems.

The initial focus was "getting the data into people's hands when they were at home or wherever they were in the world," he said.

It is also using digital technology for remote management of subsea inspection. One offshore inspection task in the North Sea, which is normally done with a crew of 12 going offshore, was done in June 2020 with just 6 people going offshore, and everyone else watched by video.

"It was an eye opener that people were able to remotely monitor the job and see the information immediately," he said.

Another project is using laser scans on a 30 year old FPSO in Indonesia. "It is a bit of an integrity challenge. In the South China Sea, it's warm. We have to really look after it."

The company has started using drones to do surveys of the hull, "rather than hang people over the side doing thickness measurements."

All this information goes into a 3D model. It can be stored as a 'baseline' and compared with future surveys.

There has been some effort involved in setting up infrastructure for data transfer, particularly on old assets, such as wells in Indonesia which are over 30 years old.

"We've been spending quite a bit of time in the last year looking at putting the right kind of infrastructure in place, sensors and things," he said.

The next challenge is "how we join all this together" – and use the data to optimise the asset across all the disciplines. "That's really where we are heading."

"We haven't all got endless budgets, but as long as people can demonstrate cash returns and value, why wouldn't you do it.

"We shouldn't take credit to say we are doing a lot (with digital), we are an

independent company, I don't want to overstate it."

#### Bottom up to joined up

The digital strategy started "bottom up", rather than driven by senior management.

Premier Oil is made up of a number of "relatively independent" business units. In each business unit, the company seeks out local enthusiasts for digital technology.

The challenge for a company like Premier is "finding the people who are really keen to start the processes running, then supporting them as best we can," he said. It can involve "finding some of those younger engineers keen to try things out."

"We don't have an overarching big view [from] this information. It has been quite localised in our business units.

"But I think you come to a point where you see the same issues across your operations. That's where some of the leaders [get involved]. We're not doing our job if we start missing opportunities. Production optimisation on one field goes to another. Now we're getting them joined up," he says.

It is not really because we want everything to be the same - that's not our style. But best practise is shared.

#### Choosing digitalisation partners

For picking digitalisation partners, the company goes through a "proof of concept" phase, evaluating available tools. Often business units work with digitalisation companies which are based locally. "I wouldn't say we've gone out to look for a global partner," he said.

"We've done a couple of real time production optimisation programs on a couple of our assets - and picked the one we liked and adopt that in other business units. Similar in condition monitoring."

"We have conversations with people, we set up a trial and give it a go, and assess if it gives us the returns we expected."

The company has "3 or 4 people" with a role of keeping a close eye on trends in the market and what would be suitable for upstream operations.

## Wintershall / Forrester's practical digitalisation advice

Patrick von Pattay, VP of Intelligent Operations, Wintershall DEA, and Paul Miller, Principal Analyst, Forrester, shared practical advice on how to make digitalisation projects work

Patrick von Pattay, VP of Intelligent Operations, with oil and gas operator Wintershall DEA, does not expect the business model of the oil and gas operator to be much changed by digitalisation. But service companies may face disruption, he believes.

He was speaking at an online session during Cognite's "Ignite Talks" industrial digitalisation conference.

"We were looking at how digitisation would change oil and gas, we were looking for this great transformation. But we came to the conclusion that you can't disrupt that business model much, you can't 'Uberise' it."

But, "there will be a huge shift in the oilfield services sector. This is something we saw in 2017 already.

"I get access to alternative companies, startups, young fresh ideas, outside the domain of the typical service sector. That's where I see the biggest disruption."

"Maybe further down the road we'll see new players in the exploration sector. I can imagine data driven companies in exploration playing a niche role.

"Very far down the road I can imagine OPEC providing a token on their reserves. That could be very mind shifting."

#### **Beyond hype**

Discussions about digitalisation in oil and gas companies have got more practical and less hype driven, he said. "We are through the hype with many topics. People understand much better what is actually possible.

"They say, 'I've seen and I experienced it.' [We have] that general level of understanding and acceptance."

"People much quicker recognise what's a digital solution to their problem."

It means that vendors "need to have tangible solutions for real problems."

The Covid pandemic and crisis mean that "it becomes much easier to apply digital solutions," he said.

But there is still much further to go. "Technology today is like mobile banking in 2006," he said.

#### **Product over project**

8

Over 2020, Wintershall made a "dramatic shift from project management to product



Left to right: Petteri Vainikka, VP of Product Marketing, Cognite; Patrick von Pattay, VP of Intelligent Operations, Wintershall DEA; Paul Miller, Principal Analyst, Forrester (photo from online event)

management," in digital technology, he said.

In his terminology, a "project" is a one-off, while a "product" is something permanent.

"You're doing the facelift of the new 911 Porsche. If you deliver that at budget, in time, you've done your job as a project manager. But if nobody buys that car you have failed as a product manager," he explained.

The focus on product rather than project "is something our industry doesn't really have. I haven't been aware of it until I was taught how to do it. We are very project driven. That's a mind shift that was really mind blowing for me."

"Be aware of what you really want, what products you need to develop.

Getting from project to product means having the ability to scale something up to be used through the company. Something to be wary of if you work with external consultants and service companies.

"You have to have scalability in mind from the beginning. No consultant, no service company can ever do that for you. A consultant is going to build you whatever proof of concept you ask for, and they couldn't care less if it is scalable."

"If you have product thinking in mind, a product portfolio in mind, I think you are well off."

The product logic will also push you to make something which is "loveable and shippable", rather than embark on projects which are too large, or which aim to model all of the data you have, he said. "This product logic tells you not to try to eat chunks which are too big."

#### **Biggest value**

Oil and gas companies are interested in improving resilience and saving money.

Interest in "remote operations, augmented reality, robots" will rise, because they help with resilience, particularly in a Covid era, he said.

"When looking at operations, I think digitalisation can help us save 15 to 25 per cent, that's it." "[Examples of] where we make the big jumps [are in the] subsurface domain, where we make new connections, running simulations based on pulling reservoir simulation from seismic interpretation to the final reservoir model."

#### **Data collection**

Wintershall is putting effort into its "data hub", where all the data is brought together. "It's a lot of nitty gritty work that takes a lot of time, to get the infrastructure to provide data straight."

One example is its "production technology workbench", developed together with Eigen, where you can do quick analysis, and use that as a basis for more detailed analysis. The Eigen software "sits on top of" Cognite Data Fusion.

A "truly scalable" solution has been developed, which can be moved from one asset to another, he said.

In terms of data sharing, Mr von Pattay thinks "our industry is at the beginning of understanding this whole data sharing thing. We're not even seeing the opportunities of sharing data."

Other industries have found totally new business models with data, such as a company selling data gathered from the fitness devices it sells.

There are many shades of grey, such as working out how to wisely share data without giving too much away.

In the oil and gas industry, the largest companies may have so much data they don't actually need to share it with anyone. But smaller companies may benefit, such as from two companies operating the same sorts of pumps, sharing data about how the pumps operate, to make better predictive models.

#### Forrester

Paul Miller, Principal Analyst, Forrester,

agreed that the approach to digital in oil and gas companies has become more practical over 2020.

. . . .

"Last year (2019), I had lots of conversations with people about digital transformation as a big all-encompassing grand project, and not necessarily achieving that grand project."

"What I've seen this year (2020) is far more focus on solving immediate tangible problems."

"For example, 'I have a team of workers on an oil field in the North Sea. Because we're restricting movements I can't get an engineer out to them. How can I help them to help themselves? How can I have more visibility in where assets are failing?""

Digitalisation should be seen in the context of a business problem, not a digital or data project. For example, you need greater visibility of why pumps keep failing.

Digital providers should "solve the problems which really need to be solved, working out where to sprinkle a little bit of digital to oil the cogs, smooth the flow."

In contrast, "when people approach it as a technology problem, they say things like, they need an IOT platform or a data lake."

#### Impediments to digital

Before Covid took hold, Forrester did a survey of 160 oil and gas senior decision makers about where they saw the biggest challenges in rolling out digital tools.

"44 per cent talked about a lack of digital skills in their organisation.

39 per cent talk about the fact that these skills were locked up in one small part and not spreading more broadly. 34 per cent talked about lack of integration, disjoint between IT and OT," he said.

"They like the idea of digital and got very enthusiastic, but pragmatically deploying this stuff on the ground is a challenge."

Another impediment is lack of interoperability between systems. "Some of these solutions are deployed for a single vendor's asset, to link through to a single back end software system," he said.

"That lack of interoperability is clearly a challenge. It is getting better."

Another impediment is a lack of support from senior leadership. Projects need "clear buy in and direction from the top, saying, 'this is the direction we're headed in, here is why digital matters. It makes us more agile, it makes us more flexible, it allows us to manage assets more effectively." "Then driving that vision and that mandate through the organisation."

Projects often fail due to lack of understanding of real worker needs by the developers.

"I've seen examples of amazing virtual reality solutions delivered down to the front line, delivered by a digital team, by the IT team or by some external consultant, who never spoke to a real worker about what they are going to do."

"They are given this shiny bit of kit, and its beautiful, immersive and lovely. But it gets in their way, or makes them feel sick, slows them down, or doesn't align with their way of working.

"You need to embed these technologies by involving the people who are going to use them right at the beginning."

"Someone who has been serving an industrial asset for 30 years, they understand that asset inside out. How do you augment them, how do you make their job easier and better? Rather than come from your office and say, 'I know best, I know what's going to fix your pain.""

When decisions are being made about which digital projects to develop, the ultimate decider is still "clearly dollars," he said.

Some companies need to be advised to be less ambitious in their plans.

"The CIO of one rail company in Europe decided that the solution was to have a digital twin of the entire rail network. My advice was, think about the problem a bit differently - break it up into manageable chunks."

Some of the biggest benefits sound quite mundane. Forrester did an interesting project with the Paris Metro, to use analytics to work out the best way to invest money.

The most useful learning from the project was that every time they send an engineer to a train, they should spend a few minutes checking the door mechanism – because if one of the trains has a door mechanism that is a bit slow, it means the stops are few seconds longer, and over time that compounds into significant delays.

#### **Resilient supply chains**

After COVID, companies understand the value of having a resilient supply chain, rather than seeking the lowest cost provider, he said.

"[There were] very long, fragile, fixed supply chains which broke as soon as pandemic level pressure hit them. As those supply chains are reconstituted, [cost] is no longer the overriding driver. Understanding how you can re-route around choke points becomes more important." "All those things carry a cost that people a year ago weren't prepared to pay. They'd say, we can just have a single provider in China, a single tanker provider bringing the goods, a single port in Europe. That makes total sense until [somewhere] locks down."

"Understanding that is becoming a much more important part of the conversation."

#### **Data sharing**

The development of digital "ecosystems", sharing data between companies, may be going slower during Covid. "It requires you to get so many stakeholders into a room. That's too difficult a logistics challenge at the moment."

All the talk over the past few years "data is the new oil" does not help encourage sharing – it can encourage people to treasure their data and keep it to themselves, he said.

There's a knee jerk response, 'if data is where we're going to build our new company, we should keep it close and use it as a competitive weapon to beat our competitors with.'"

But, "there's clear interest and value in recognising that some pieces of your data are not the crown jewels you thought they were. There may be value to you in sharing with a competitor."

"There's a lot of work to work out where the data really is differentiating. For most companies that will be 2, 3 per cent of your data. Most of it will be more valuable let out to other people."

In the airline industry, Airbus has a data sharing platform called "Skywise", with information about how their planes are flying around the world, operated by airlines in competition. There is a challenge to define granularity of data, showing what is only for Airbus, or only for Airbus and the airline that provided it, or for airlines and partner airlines, or what can be shared with direct competitor airlines. "There's a lot of tensions to work through there," he said.

It can be very helpful if there is a player within the 'ecosystem' with some clout, such as with the Airbus example, or with Volkswagen and its 'industrial cloud'. They may say they want to open it up to other people, but it does not look that attractive to their direct competitors.

This article is based on a session at Cognite's "Ignite Talks" industrial digitalisation conference on October 29, 2020, "Operationalize and Scale Models and Applications with Trusted Industrial Data". The moderator was Petteri Vainikka, VP of Product Marketing, Cognite. Video available at www.cogniteignite.com

## Integrating subsurface data with Cognite

For the subsurface and drilling domain, Cognite is developing tools to help find, integrate and work with data, together with Aker BP

The original business model for Cognite was to integrate real time data from oil and gas operations. Its data integration business model is also useful with subsurface and drilling data, which is not real time but still has big search and integration challenges.

Here, the company's main aim is to help domain experts find data, something they often have to spend a lot of time doing, before they get to their main work.

Data is often only accessible through the software used to create it, such as with subsurface models.

And sometimes people have challenges knowing where to find it. "In order to even start your workflows you need to understand what data is stored, which applications [created it], who is responsible for the project," says Dr Carlo Caso, Senior Director of Product Management, Cognite, a former oil and gas exploration geoscientist.

He was speaking at an online conference session during Cognite's "Ignite Talks" industrial digitalisation event.

"We are using the capabilities of Cognite to liberate this data and information from legacy applications and make them available in the cloud to a modern application program."

This includes both seismic and other exploration survey data, and subsurface models.

With data 'liberated' and integrated, it is possible to offer very useful functionality for geoscientists, he said.

For example, they can find what documents

a company has related to their area of interest using "polygon search". They search by drawing a box on a digital map to define this area, rather than from looking through folders and databases.

It would also be useful for geoscientists to be immediately informed if there is new information on the company's archives relating to this search area. They would like to know where the data they are working with has come from.

Integrating in the other direction with Cognite's platform, it is possible to connect the subsurface data directly to data science or low code tools, for example running a Python script on it. You can develop new workflows. "There's no friction or barriers between one step and the other," he says.

#### **Aker BP**

Kjartan Nesse, Vice President of Digitalization, Aker BP, and head of the subsurface hub (including drilling and wells), said that when the company had internal discussions about what they would most like to see improved, the biggest area of interest was data and data quality.

The biggest challenge is "figuring out what data we have, without spending tons of time on it," he said. So much time is spent looking for data, and some work gets done more than once.

The company had originally planned to focus on blockchain and machine learning. "Suddenly we had to shift," he said.

"We see that when data is available, a lot of

creativity from very skilled engineers and G+G people comes to play, in a much better way," he said.

Engineering teams from Cognite are working together with domain experts from Aker BP to try to get there. At the time of the discussion in October 2020, the tool had been released in "early stage" to 100 users.

Improvements had already been seen in the understanding of data quality. It also leads to an increase in the level of interest people are taking in data, including data from domains other than the one they usually work in.

"I think that's all about having ease of access and availability," he said. "It is so interesting when you 'surface' the data - the understanding of what quality of data you have and don't have."

For future technology purchasing decisions, the company will have a preference for open platforms and open standards, such as data formats in the Open Subsurface Data Universe(OSDU), he said.

Aker BP will preferentially buy software with APIs which work well, he said. "We see a lot of applications have APIs but they are not really used because they are not made for having this kind of ecosystem working."

"I'm envisioning an ecosystem where we [connect] different major components," he said. For example it could bring software components from Schlumberger's Delphi cloud environment together with components from a small technology company.

## Bluware VDS – a data environment making seismic AI easier

Bluware VDS is a cloud-native data format for storing seismic data, which makes it easier to run AI on it

Bluware, a seismic technology company headquartered in Houston, developed a data storage environment for storing seismic data, which makes it much easier to run AI algorithms when streaming data from the cloud, says Dan Piette, CEO of Bluware.

The format, called VDS (Volume Data Store), is a modern alternative to the SEG-Y seismic data format.

VDS has been developed and improvised since 2003, when Bluware developed a software platform for a major international oil company to use in desktop geoscience applications.

Bluware's founders previously worked in the computer game industry, who had different

expectations than other oil and gas software companies about how fast software should run.

Bluware's founders worked hard on developing a technology which could provide rapid access to all seismic data regardless of the size.

Other companies at the time were all using SEG-Y format, a standard originally designed for storing data on tape.

Software using SEG-Y data had to ensure that the file sizes were not so large that they crashed or slowed down the platform. The SEG-Y data resolution was reduced or set to a maximum project size. This was a time when 3D visualization was becoming the



Dan Piette, CEO of Bluware

## Subsurface



Fault surfaces from deep learning

norm and applications required access to data in all directions instantly.

Rather than reduce quality or the size of the volume being viewed, Bluware instead, developed its own VDS format to overcome these limitations.

Later, when geoscience software started moving to the cloud around 2018, VDS turned out to be a much better format, as being "object orientated", given that SEG-Y data was much more difficult to use directly with cloud software, Mr. Piette said.

#### **Bluware today**

To develop the software further, venture capital has been raised from EV Private Equity, a company that invests in innovative technology companies within the oil and gas industry.

Shell, as Bluware's main client, also wanted involvement, so provided investment through Shell Ventures.

According to Bluware's website, clients include Equinor, Shell, BP, Polarcus, Lundin Petroleum, and Aker BP.

According to a Bluware press release in June 2020, they announced an agreement with BP to provide its technology to help BP improve 'quality and speed when delivering seismic interpretation products.'

BP said it would implement Bluware's InteractivAI deep learning technology, to support geoscientists' ability to interpret subsurface data.

The data storage and software are on Microsoft Azure cloud hosting platform. Bluware has a partnership with both Microsoft and AWS.

#### How it works

Here is an explanation of how the VDS file format enables Bluware to deliver an interactive experience with their InteractivAI deep learning solution.

Using deep learning to identify geo-bodies in seismic data requires the seismic volume to be output as millions of small image blocks, that are then randomly sequenced before being organized into a 1D 'stack' file for import into a machine learning platform like TensorFlow. This is time consuming and costly.

The data needs to be brought into the deep learning algorithms randomly, not sequentially, because a sequential data flow will mean that the training will only work on the section of data it is receiving at that time, not the whole of it.

The randomisation of seismic data in a SEG-Y file is a challenge, Mr. Piette says. "You can do it, people are doing it, but about 80 per cent of your time is consumed with preparing the data."

As a separate step, you manually extract lines and crosslines from the SEG-Y, which are saved as images and exported into the machine learning platform.

But once data is in VDS format, it can be streamed directly and completely randomly into the machine learning platform. There is no need to copy, crop, or decimate any data thereby eliminating preparation time.

The computer system can be running deep learning algorithms as soon as a geoscientist begins training the network and can immediately infer similar patterns within the seismic data.

#### Working with Al

The result is the geoscientist is much more productive when using deep learning workflows on seismic data in VDS.

The geoscientist starts by labelling a geologic feature on the seismic data. Since the data is stored in VDS format, InteractivAI can pass the native data and labels directly into a deep neural network to begin training. The trained network can then stream a live inference on top of the VDS seismic volume instantaneously allowing the geoscientist to work interactively with the network.

As the interpreter adds more examples, the network becomes more accurate in delivering live inferences. Once the accuracy is sufficient to meet the interpreters needs, the trained network can be used to create an entire feature volume identifying all occurrences of the feature in 3D. The workflow is the same for any number of geologic features, be it faults, salt, channels, incised valleys, or even igneous intrusions.

By blending the expertise of a seasoned interpreter with the rapid pattern recognition of a neural network, you can deliver 'human-like' interpretations across entire datasets in hours, instead of weeks.

Geoscientists will begin to see the inferences from deep learning appear on the screen in real-time as they work, "something that noone has been able to do until now," says Mr. Piette.

The geoscientist can then decide whether or not the computer's assessment is correct or if more training is required. This is all done interactively in minutes.

"It is like an empirical [experience based] analytics of what's going on in the subsurface," Mr. Piette says.

"You end up with a processing of seismic data that is orders of magnitude faster," he said. "One client told us - their interpretation went from a three-month cycle to a three-day cycle."

Geoscientists can also work proficiently.

Ultimately it means that geoscientists are spending more time on core concepts of trying to make geological sense of what they see, rather than "picking wiggles". It is allowing them to work more efficiently, rather than replacing them, he says.

#### **Open Source**

In June 2020, Bluware contributed Open-VDS Version 1.0 to The Open Group Open Subsurface Data Universe (OSDU) Forum.

The Open Group OSDU Forum aims to develop a standard structure for storing subsurface data, including seismic data and well data. The OSDU consists of more than 195 companies including oil companies, infrastructure providers, and independent software vendors.

Bluware now also provides OpenVDS+, a free-to-use library that adds Bluware's industry-leading wavelet compression technology to OpenVDS.

#### Integration

The Bluware platform has APIs, enabling

## Subsurface

seismic data in VDS format to be accessible to other geoscience tools and machine learning algorithms.

If you want to get the benefits from VDS without changing your existing interpretation applications, you can use its data streaming and transcoding tool namely Bluware FAST. Data in VDS format is streamed from the cloud, transcoded, and presented as a virtual file in any seismic format including SEG-Y, SEP, or ZGY file to your seismic interpretation system without duplicating data.

"Companies can often read seismic data faster from a remote cloud server in VDS format, than they can if the data is stored on their local hard drive in SEG-Y format," Mr. Piette says.

Customers like this because they may have concerns about "stranded applications", ending up with software and formats which are obsolete. Or they want to get more return from the investment in the software they already have.

"You have applications going to the data, rather than data going to the applications," he says. "That's a fundamental shift.

#### Background

Bluware was formed from the merging with two other companies in 2017, Hue AS and Headwave Inc.

Before that, Bluware had been an IT services company. Bluware started working with Shell providing IT services and built up a broader client base in the years up to the oil price collapse in 2014. Headwave and Hue provided geoscience services and software.

Hue had been in business since 2001. Bluware and Headwave had been in business since 1996. As an IT services company, Bluware would deliver IT that clients asked for, such as a wavelet extraction routine, and the client would own the intellectual property of it. "We had a big group of people very experienced in oil and gas," Mr. Piette says.

Dan Piette, CEO, has been involved in subsurface digital technologies since 1988, when he joined Landmark. Since then, he has seen oil prices drop 50 per cent at least five times.

Every time it happens, "it seems like innovation comes," he says. "Every time we go through these cycles, someone has another brilliant idea."

Mr. Piette has a strong background in subsurface data integration projects. He is the former CEO of OpenSpirit, a company which aimed to help companies integrate subsurface data from multiple sources.



## Where geoscience goes next – opening session at EAGE Dec 2020

Senior exploration leaders from Shell, CGG, Rystad Energy and University of Texas shared their perspectives on where geoscience, and work for geoscientists, is going next, in the opening session of the EAGE 2020 annual event (online) in December

#### Marc Gerrits, executive vice president for exploration with Shell, sees geoscience as "the custodian of technical excellence in the subsurface."

"That has served the oil and gas industry very well," he said.

He was speaking at an online opening session of EAGE (European Association of Geoscientists and Engineers) annual event, held in December 2020 (see link to video below).

The value of geoscience will continue beyond oil and gas. "Any aspect of the energy transition that involves subsurface and subsurface technology will include expertise that comes from geoscientists," he said.

"CCUS, hydrogen storage, geothermal energy, all require an understanding of the subsurface. And an understanding of how to use the subsurface for the benefit of those future technologies as and when needed."



Marc Gerrits, executive vice president for exploration with Shell (photo from online event)

Meanwhile, "we will need geoscientists to continue to work with the oil and gas industry, which has multiple decades to go."

The oil and gas exploration market dynamics are changing to an orientation around "value" rather than "volume", Mr Gerrits said. In other words, it is no longer mainly about the number of barrels.

When considering a project, companies are comparing the financial breakeven of producing the newly found barrels, with the breakeven for producing barrels Shell already has in its reserves, he said.

Companies are also considering the "carbon resilience" of the barrels, such as the CO2 emitted when producing them, such as in pumping, transport or construction.

For any exploration projects, shooting new seismic, and more advanced seismic will be needed. "The seismic industry is an absolute partner in creating that value for oil and gas companies," he said.

#### Sophie Zurquiyah, CGG

At the moment, "clients are stopping and delaying significant investments that are required to maintain [oil and gas] production," said Sophie Zurquiyah, CEO of geoscience services giant CGG.

"I look at the number of studies that point to the need for oil and gas for the foreseeable future. In any scenario it is required as part of the energy transition."



Sophie Zurquiyah, CEO of geoscience services giant CGG (photo from online event)

"I believe the delays in investment that we're seeing now will result in shortages down the road - 2023, 2024."

Asked whether we are likely to see further consolidation in the geoscience services business, she replied, "there's a text book [answer] which says, 'when times are tough everybody is shrinking, the only solution is consolidation.' I'm not convinced, I think it depends on [the] individual situation. I see forks in the road. Depending on where your starting point is, the course forward might be different."

When companies are not seeing the growth they expected, or no growth at all, there are two pathways. One is to try to do more for existing clients, for example helping them do more with the "energy transition". The other direction is to look at new industry sectors where the company's competences would have value, she said. For example CGG is developing structural health monitoring sensors for buildings under

## Subsurface

its Sercel brand, using technology developed for seismic surveys.

The mining sector may be increasing its demand for subsurface technologies. "It is the same story as oil and gas 30-40 years ago, where the easy deposits have been found. Now mining companies are going to deeper, perhaps offshore, more complex 'reservoirs', so those skill sets of geoscience are going to be needed."

When asked about gender diversity in the subsurface industry, she said that with 30 per cent of employees in the company female, CGG has a similar gender split to most oilfield services companies. CGG has 60 per cent women on its board, which is unusual.

The difficulty in recruiting more women extends back to the universities. "If you look at hard science, mathematics, physics, many [courses] of the world don't even have 30 per cent women."

"Where we're not doing such a good job is making sure these women can evolve and take leadership positions in the company."



Jarand Rystad, founder of energy analysis firm Rystad Energy (photo from online event)

#### Jarand Rystad, Rystad Energy

Overall demand from energy will continue to grow at around 2 per cent a year, predicted Jarand Rystad, founder of energy analysis firm Rystad Energy.

As energy efficiency improves, we may see demand from the outputs of energy (such as power and transport) increasing, while the primary energy demand is decreasing, he said.

In terms of demand for oil for road transportation, we saw a comeback to almost pre-pandemic traffic levels during the summer, although we are seeing a big drop again in winter in the second wave of Covid-19. "In 2021 we will have a gradual recovery of road traffic. Aviation will lag another year, we think."

Mr Rystad believes that new energy technologies (renewables) are "so competitive" we will see a transition to them, but how fast we shift will depend on government policies. With no change of policies we may be zero carbon in the 2060s-2070s, but with strong policy support, "we might see zero carbon society more in the 2040s, 2050s," he said.

With very few new infill wells being drilled at the moment, there is a risk of oil supply shortage in 2022-2023 as demand returns. "So we might get a new upcycle. However it will not last for very long because we have an extremely strong comeback expected in shale. We might have a new downcycle after 12 months, in 2024."

"Then after 2024, we see more of the structural shift happening with increased sale of electric vehicles, also a switch in many other sectors currently consuming oil and gas. We will see a very quick switch towards renewables."

"The battery technologies are developing so fast they represent a credible backup capacity to deal with the intermittency of solar and wind," he said. "So you can take the risk of deploying those [renewables] technologies."

"Towards the end of the decade we will really feel the effect of this energy transition, all the new energy forms."

When asked about work prospects for a new generation of geoscientists, Mr Rystad sees a lot of emerging areas onshore and offshore. One area of interest is seabed mining for minerals like cobalt, zinc and copper, including "hot water ridges in the middle of the Atlantic."

"Renewables in general are requiring a lot of these new metals. This could be a new business area."

#### **Redefining "energy transition"**

"The [energy] transition isn't one fuel to another, it is minimizing the environmental impact of all forms of energy," said Scott Tinker, geoscience professor at the University of Texas at Austin, and director of the Bureau of Economic Geology at the university.

"There's a misplaced understanding that we're leaving one kind of fuel and going to another one."

"In fact, we're not leaving oil and gas, and we're not leaving coal behind, we're adding other kinds of energy. The energy demand is so great in the world. China is building 120 GW of new coal today."

"To me, energy transition means lifting the world from poverty, and reducing the environmental impacts of all forms of energy on all forms of the environment. Not just the atmosphere, that's very important for sure, but so are land, water and local air. Those are the four pillars of the environment."

"Different forms of energy at scale impact [these four pillars] differently. Burning fossil fuels puts out CO2 emissions. Capturing sun and wind with non-renewable solar panels, wind turbines and batteries is going to devastate, through mining, manufacturing and landfill disposal at scale."

"Any form of energy we move to, solar, batteries, geothermal, hydrogen economy, nuclear, uranium, they all involve the subsurface. They all involve extensive mining of earth resources,



Scott Tinker, geoscience professor at the University of Texas at Austin, and director of the Bureau of Economic Geology at the university (photo from online event)

manufacturing and then disposal of those products back into the earth, hopefully not the rivers and oceans."

The definition of the term geoscience is becoming broader, Mr Tinker added. It is not just subsurface - now the term is used to include studies of the atmosphere, the environment, the surface and subsurface. "So the geosciences are well placed to embrace the broad energy spectrum."

The negative impression that many in Western Europe and the US have of the oil and gas industry should not be presumed to apply to the rest of the world, he said.

"Most places in the world actually bus students to oil and gas industry events, because they are good jobs. China has a university of petroleum with 60,000 students. Globally the reputation of the oil and gas industry is actually not so poor, it is quite healthy.

"Western Europe and the [part of the] US with a lower perception of the oil and gas industry that's 520m people, less than 7 per cent of the world's population."

"That's understandable, the energy industry broadly needs to clean up its waste, for sure. That includes solar panels, wind turbines, batteries, nuclear, all other forms of energy at scale."

"The world's is growing, it is industrializing, it is just getting started."

Around the world, "energy poverty is a major issue. We see about a billion people without access to electricity, and another 2.5m cooking indoors with wood."

"These major issues, rights and freedom of women, access to clean water, immigration / migration, health, education, they are all affected by energy poverty, and we don't shine enough light on it.

## The EAGE opening session is on YouTube at https://youtu.be/a3In46nC0Bg

The article is based the "Cross Talk Conversation" segment starting at 24.48

## Making asset performance management more straightforward

Using asset performance and risk management tools for managing oil and gas assets is very appealing to oil and gas companies - but it gets very complex. LR is developing software tools to make it easier to manage

Risk based inspection, where items are inspected when they are at higher risk, rather than according to a traditional periodic schedule, is an idea which many people in industry agree with. Particularly with Covid travel restrictions, the idea of not doing unnecessary inspections is very appealing.

And asset performance management, where you optimise the maintenance schedule, so work is only done when it is necessary, is also appealing. It means reducing both cost and risk.

The logic behind asset performance and risk management is straightforward – something is only inspected when it is likely to have a problem, and maintained when it needs to be. But it gets very complex to manage when you have thousands of items, it becomes impossible for people to understand them all, and individuals do not want to take responsibility for making decisions about something they do not understand very well.

Any asset management system needs to be fully understood by the people with the responsibility for the assets as it is they who will be accountable should an accident or failure occur because something wasn't inspected or maintained.

There are many other complex factors to consider. If an inspection is not done according to the recommended schedule for a specific item, the increase to the overall risk will vary, depending on what equipment it is. If you have a certain number of overdue maintenance tasks, you want to know which of them is most problematic.

Also, the risk of equipment failing will often depend on how close its operations are to the safe working windows. Equipment is often specified with fixed limits about what is safe and what isn't. But actually there should be two separate limits. A 'real' safe operations limit where you are taking a risk of an immediate incident if you go beyond it, and another limit, closer to normal operations, where you cause the equipment to wear out faster if you go beyond it. This may be acceptable, depending on the circumstances.

A company will typically have separate teams involved in managing production and managing the equipment – and the production team's goal is to get as much product through the system as possible. So you can imagine a scenario where there is an alarm saying that operations are within the safety limit but outside the integrity limit, which may confuse people as to how to respond. Or the maintenance staff are saying to operations staff 'slow down you are going to damage my pipe', although it is not an immediate hazard.

The risks also need to be thought about both at an equipment level and at a system level.

Victor Borges, Head of Digital Engineering Content, Lloyd's Register, explains this with the example of a bucket hanging on a hook. If you know the bucket contains sulphuric acid, you care a lot more about the strength of the hook.



Victor Borges, Head of Digital Engineering Content, Lloyd's Register

#### LR's AllAssets

AllAssets, an asset performance and risk management software package developed by engineering and technology consultancy Lloyd's Register (LR), is designed to provide a foundation for all of this, for both fixed and rotating equipment.

The AllAssets software grew from a number of acquisitions. LR America acquired Capstone Engineering in 2005, a specialist in risk based inspection. In 2016 it acquired RTAMO Ltd, a software enabled consultancy based in Aberdeen focused on reducing maintenance costs for asset owners.

AllAssets customers today include upstream oil and gas, FPSOs, refining, petrochemical, pharmaceutical and agricultural chemical. Clients will typically have thousands of pieces of equipment to manage, some of which moves or rotates, and some of which is fixed.

The latest release of AllAssets, v2.8, announced in December 2020, has an emphasis on the "low code" and on "enhanced user journeys". The aim of these is to make it easier to set up a risk based inspection program and administrate the system.

LR uses the term "low code" to indicate the building block tools it provides to make it easier to set up a risk based maintenance system, such as its pre-built templates, explained further below.

#### Usability

Making a usable computer system is always a tricky balance between adding in features which people might want, but then seeing performance decline as the software becomes too complex to use, Mr Borges says.

With the version 2.8, LR says it has improved the user "journey" by "over 30 per cent in some areas through simplified navigation and load time".

The new system has hyperlinks giving fast access to popular parts of the platform, and making it easier to dive into data.

Individuals can set up their own views and dashboards for what they need to see. AllAssets links to Microsoft's Power BI software, so that all the data in the database is made available to the analytics tool, for different people to use as they need to.

Different people have access to different parts of the application, they can all contribute their own knowledge, to help identify the right interval for the right equipment.

#### Templates

The software is built with a number of templates which can be used as a basis for planning a risk based inspection program, providing something to start off with. The models can be thought of as similar to inspection templates many companies use. It provides a useful starting point, which a company can take and then make changes for the inspections they do and don't want to make.

As of February 2021, the last time data was published, it had 77 maintenance strategy and optimisation models for the most common and high priority equipment types, including pumps, motors and compressors, as well as 37 risk-based models, and 143 templates and admin lookups.

Customers can easily configure these models

to replicate specific operating conditions for all equipment types without any software coding.

The library is being continually extended, with more Failure Mode Effect Analysis templates and Preventative Maintenance recommendations.

Mr Borges is responsible for all the "digital engineering content" models which go into the software, and as "product manager" is responsible for technical aspects of the platform itself.

The templates are made available to all customers, and include "everything we know about managing risk and inspections", Mr Borges says.

Companies may find that the templates give them everything they need, and they can use it without any changes.

Some companies may want to modify the templates to their needs, or design their own template, which they can then adapt to different situations.

One company, which operates 11 industrial plants, had its own way of summarising its turnaround data (a "turnaround" is when a plant is shut down for major maintenance work), and made its own template.

Companies using the software need to define an internal process for how they manage the templates, such as giving an individual responsibility for deciding which template should be used.

#### **Aker BP case study**

One client, E&P company Aker BP, wanted to see if LR could identify ways to use its equipment data to reduce maintenance workloads and spending, with a pilot project on the Skarv FPSO.

The pilot looked at 100 centrifugal pumps and 1,700 fire/gas detectors, with a 60 month maintenance history.

This included pumps for hydrocarbons, utility, seawater, firewater and "jockey firewater" (which keeps pressure in the system at a specific level when it is not being used).

The cost of production loss from a faulty pump could be up to 50 million NOK (USD 5.9m).

For the detectors, a target minimum reliability was set at 99.3 per cent, except 99.9 per cent

for smoke detectors. This was in accordance with Aker BP's existing safety requirements.

LR combined the use of its AllAssets Maintenance Optimisation software with its own data and engineering expertise.

The project had 3 stages – gathering data, including maintenance history, maintenance procedures, and making a criticality ranking of equipment under investigation; analysing and reviewing information using various strategies; then identifying if the test intervals could be improved.

The optimisation work brought together data from the facility with LR's industry-standard reference files.

The most effective maintenance strategies were identified using a mixture of algorithms and engineering expertise.

The result of the project was that Aker BP had full transparency for its maintenance costs, and could see ways to save 400K NOK a year on pump maintenance (USD \$47k), and reduce annual maintenance hours of fire and gas detectors by 50 per cent, by optimising test intervals and reducing inspection activities. digital

## LR – machine learning on safety incident reports

Lloyd's Register has a Severity Scanner project with the Health and Safety Executive to use machine learning on safety incident reports, identifying trends from analysing free text using Natural Language Processing, a sub-field of AI

Spotting trends in safety data, such as a small rise in incidents with certain characteristics, is enormously valuable, because it can show where management attention can be best focussed to reduce accidents.

These trends can be hard to spot by analysing the data in safety reporting forms, unless you were lucky enough to put exactly the right question on the form.

Companies try to solve the problem by making comprehensive questionnaires with pre-defined categories which capture lots of data. The result is that people spend a lot of time filling in forms, but may still feel they cannot choose an appropriate category for a particular event or they can choose only one word category such as 'other'. You may have had this experience yourself.

Written text, meanwhile, can be a better way to report what happened in an incident, if someone is asked to just tell the story of the incident including the most pertinent facts. But written text is harder to analyse digitally.

LR is developing AI tools which can analyse written text (incident descriptions, audit reports and insurance claims descriptions), parsing it for themes / topics, hazards, and now also the se-

verity of an accident and prevalent root causes. This can then be used for further analysis. The AI is basically turning the natural language text into rich mathematical data. With data analytics techniques, similar incidents can be clustered.

The system's ability to spot patterns across different names and phrasing used in the text enables the user to easily cluster, filter and visualise what is really going on around the organisation, no matter the variety of units inputting it or the formats.

One success story example was when the tool was used to analyse accident reports from a "major UK hospitality chain". The computer analysis identified that it had a large number of burn incidents connected to a specific type of oven and specific type of dish. It also identified a specific group of customers, and a specific geographic location, which was most prone to accidents.

Another great example from one of the major port terminal operators was finding a substantial number of incidents that related to two certain pieces of equipment. This was an occurrence the HSE manager never expected to have surface in the reports. One of the pieces of equipment (appearing in 100s of reports), was not even in its correct location on site to begin with.

This information was only available in an accident report as part of narrative text, it was not entered specifically into any form, or with any tags.

A strength of the system is that the analysis can be applied directly to the source reports, not an intermediate layer of data extracted from it, which may miss out some of the most important information.

Assessing "severity" from text is proving harder than analysing the topic and hazard.

Currently LR has a "SafetyScanner" product, which can analyse safety reports for hazards and topics, available for a number of industries, including oil and gas. The "Severity Scanner" engine is being further developed on top of the SafetyScanner technology.

To get the most out of the system, LR recommends that companies ask employees to report incidents in their own words (typed not handwritten of course), providing as much relevant information as they can.

The advanced computer training to develop the tool has been combining LR's own vast data-



The LR Safety Scanner Dashboard

base with the HSE database holding 40 years of safety reports, from the oil and gas and maritime sectors.

Companies can also use the analysis to develop a knowledge library of safety information, which they can use to compare safety performance with peers.

As part of the project, LR is developing new tools which make it easier to report injuries and dangerous occurrences.

LR is now using the tool to develop a set of health and safety "leading indicators" for the process safety and construction sectors, which can be used to help customers understand what they should be measuring to improve health and safety outcomes.

For the construction sector, it is developing a "Knowledge Risk Library", integrated with Building Information Management (BIM) models.

Severity Scanner forms part of Lloyd's Register Foundation and the Health and Safety Executive's "Discovering Safety" an ambitious £10 million, 5-year research programme which aims to substantially improve health and safety and ultimately save lives, particularly in poorer or developing nations, supported by the Thomas Ashton Institute. Learn more via the programme's Knowledge Library and website.

digital energy

## A robust IT infrastructure

Robust IT infrastructure is a subject which does not get much attention in a technology world focussed on novelty – but it is essential in getting your applications running guickly and reliably, says ISN Solutions

The digital technology world spends a lot of time chasing the wow factor. So IT infrastructure perhaps does not get the attention it deserves, except when things go wrong.

A robust IT infrastructure is essential for making applications run quickly, keep data communications flowing easily, and cybersecurity problems avoided. And there are ways that it can be better done, says David Greenwood, CEO of ISN Solutions, a UK company spe-



David Greenwood, CEO of ISN Solutions

cialising in IT infrastructure for upstream oil and gas.

Over the past decade, there has been a big switch to using IT infrastructure on the cloud. That changes the nature of IT infrastructure support, but it does not eliminate the need for it, he says.

Oil and gas companies have many challenges making cloud systems work the way they want, getting new applications running, and connecting data stores together. They also have challenges connecting data from process control systems into the business environment.

Not so long ago, companies would not even consider connecting control systems and sensors to the business networks for security reasons, Mr Greenwood says. But now, although the cybersecurity concerns still exist, people are hungry for the business benefits of doing this.

Companies are looking for the ability to better

analyse what is happening at their production facilities remotely. "All business units can see the benefits of being able to ship telemetry data from an operating platform offshore to onshore, for others to benefit from," he says.

"We've been involved with facilitating data capture and export from process control systems and ICS systems, and pressure and temperature data from wells, onto onshore systems for further analysis, getting sensor data out to third parties."

#### IT infrastructure support

ISN Solutions' business is largely supporting and advising oil and gas companies with their IT infrastructure. While much of the company's work is about the challenges with connecting offshore to onshore, ISN also has a number of contracts for ongoing service, where it provides day to day IT support and monitoring of the IT infrastructure, and support for new IT projects.

"Our approach is to develop and work with the client to provide a strategic roadmap of capable infrastructure, whether it would be cloud service or on-premises service, how to budget accordingly, and if they need any enhancements, particularly with cyber security threats."

"We're after long relationships, this is why managed services is the heartbeat of what we do," Mr Greenwood says.

Often clients ask for advice about the best way to connect a certain technical application to the workforce and external contractors in a secure and reliable way. "We facilitate bringing all of that together."

It can also give advice about how difficult the cybersecurity issues will be to handle.

Sometimes companies may get too ambitious in what they are looking for. ISN is able to advise people on what would and wouldn't be viable.

ISN has a unique market position, being larger than a small local IT support company, but much more personal than the big IT organisations with hundreds of thousands of employees, who "may be inflexible and less personable with their service," Mr Greenwood says.

#### **Network analysis**

There are digital tools available which can help companies, or external consultants like ISN, understand how well networks are operating, or where they need to make further investment in data communications capacity.

It does not see the actual data through the net-

works (which would mean security or legal complexities). But it can install devices on the network which transmit data describing how the network is operating.

The network monitoring covers onshore as well as offshore. "Even if they have a server in their office, we put a monitoring agent on it," he says.

"It is really understanding the volumes of data, and the communications resources that we need, to be able to shift data within a time level that the client is looking for," he says.

"Our analysis dictates what our recommended approach and architecture would be."

Where communications are limited, such as where the only option is satellite communications, the advice can be used to help companies better manage the "pipe" to ensure that it is available for their most important communications.

"We have an understanding of how to get those applications out to those areas where communications can be limited."

"Our support team have a single pane of glass where they can see all the clients, all the different networks, all the different systems, including cloud based systems."

"We can set up alerts if we see traffic levels reach a certain threshold. We have the ability to look at the traffic and see what kind of traffic it is. We can tell how much is YouTube traffic streamed by a particular user, and see if that's the cause of any network saturation."

"We provide the platform that these things run on, and oversee the whole thing."

#### Thin client out of fashion

One interesting change which has happened over the past few years is a move away from 'thin client'.

The thin client was a favoured technology around 2010, where somebody would work on a remote computer system. Mouse and keyboard movements would be sent to the central computer, and the screen display would be sent back.

This meant that no software or data files were required on the remote computer, But it could also be a frustrating experience if there was latency while data was transferred.

Today, it is more common for people to have software applications on their local computers, and send data files to and from a central server as needed, Mr Greenwood says.

This is equivalent to using Microsoft Office with remote file storage, vs Google Docs, where everything is remote. "Everyone seems to have MS Office on their machines these days," he says.

The change is possible "because network bandwidth is more abundant." It becomes more plausible to send large software application files and data files over the communications link. And it means a more comfortable experience for the customer.

"The applications can tolerate a little bit of latency and network congestion," he said.

There can be hybrid models, where some data is held on people's laptops but sent back to the cloud as soon as it is updated, and other data is held only on laptops for much longer, sent back to the cloud periodically.



## Salesforce – a platform for building oil and gas applications

Salesforce is best known for its CRM systems, but it also provides a platform which can be used to build software applications, such as for oil and gas field ticketing. We heard about some examples

Salesforce is best known for its customer relationship management systems – but it also provides a platform which can be used to build software applications which can make use of some of the features of the platform.

Liquid Frameworks, a Texas oil and gas technology consulting company, has built a field ticketing solution using the Salesforce platform.

The company developed its first field ticketing solution in the 2000s, built in-house using the .NET framework, said Matt Danna, senior director product strategy, speaking at the PIDX Virtual Autumn Forum.

It decided to move to the Salesforce platform in 2010-2011, because it realised there were some things it wanted in the product which were hard to build on .NET but available by other cloud providers, including APIs and multicurrency support.

A number of modules were released between 2013 and 2019, including for field tickets, invoicing and price quoting. The most recent is an enterprise asset management module.

80 per cent of the company's business is in oil field services, with the rest being industrial and environmental services.

Building software using a platform, rather than from scratch using code, means that the company can focus more attention on solving its customers' business problems, rather than worry about digital infrastructure issues, such as where data is going to be stored, said Matt White, senior solutions engineer with Liquid Frameworks.

In this case, it makes it easier to build software tools which keeping pricing consistent through the different tools.

This resolves problems which often happen in field services, where there is inconsistent pricing. One person might set up a contract with a price book, another sales person offers discounts from it, and the person doing the work might not be aware of what has been quoted or put in the price book, "so pricing is made up on the fly." So invoicing ends up a very manual process, Mr White said.

Companies have accounting administrators compiling large amounts of data, adjusting pricing, sending tickets back out to the field, it all takes a lot of time, so people wait longer to be paid.

Oilfield services pricing can be very complex, including a mix of data rates, cost per foot of a well, or cost for a trip.

With the software, a job is set up in the system using the same calculation method, which was in the quote, so the consistent pricing "travels" through the process and errors are eliminated.

An example customer is Stallion Oilfield Services, a US equipment rental and services company with 400 locations and a remote workforce.

The company uses PIDX standards and protocols to keep price books synchronised between buyers and suppliers.

The mobile software can automatically add "geostamps", a reference of where the person holding the mobile device is situated when the data was entered, even if he is not connected to the internet at the time.

#### Saleforce perspective

Jason Olbekson, global industry "go to market" director oil and gas with Sales Force, said in the PIDX forum that the energy practise is currently one of Salesforce's fastest growing business sectors wither over 1000 customers (although this includes upstream, midstream, refining and retail).

Some themes it sees when talking to its customers are investing in digital business strategies which build "trust and transparency," moving towards "agile platforms" to help deploy new business models, developing digital tools to empower the workforce (such as with mobile and safety devices), adding sensors and analytics to operations, and looking for ways to reduce carbon emissions.

Salesforce provides tools which give companies involved a "single source of the truth," covering customers, suppliers and business partners.

Salesforce acquired a company called MuleSoft in May 2018, described as a "platform for building application networks". It aims to "make the spaghetti easier", in the communications between different people, processes and data.

One way to do that is to make it faster to "onboard" different trading partners onto your system, including setting up and mapping what they need to see.

It also acquired analytics software company Tableau in August 2019.

Its Salesforce 360 for oil and gas product was developed following the acquisition of Tableau and MuleSoft. It can be used to connect together old (legacy) software systems, and integrate their data together, said Dejim Juang, senior manager solutions engineering with MuleSoft.

The MuleSoft product "Anypoint Partner Manager" provides a web interface for managing your trading partners, including mapping the communications, whether by XML, JSON or some other method. There are 200 different connectors and APIs which can help you connect to different systems, including SAP.

It can be used to set up trading partners, including their transmission protocols and security certificates, and what the message flows should be.

Salesforce 360 for oil and gas provides an intelligence engagement layer across your ecosystem," he said. "A model simplified approach brings order to the chaos."

digital energy

## How Talos provides cyber threat intelligence

Talos, the "threat intelligence" division of CISCO, keeps abreast of changing cybersecurity threats, including for industrial control systems and devices, and helps companies if they ever get hacked. Joe Marshall from Talos explained how it worked at a special Engenious session

Talos, the "threat intelligence" division of CISCO, claims to have one of the largest commercial cyber threat intelligent teams in the world, with about 400 staff including researchers, analysts and engineers, supported by telemetry and other systems, to provide actionable threat intelligence.

analysing it and doing something about it," said Joe Marshall, Industrial Control Systems Security Research Manager with Talos.

He was speaking at a special session at Engenious, "Introduction to Cisco Talos and Operational Technology (OT) security."

Threats can include any kind of hacking, in-

cluding malware, financially related attacks, and worse.

It has clients in utility (power generation) and manufacturing sectors, as well as oil and gas.

With people based all around the world, research can continue 24 hours a day, as teams working in different time zones work together,

"Threat intelligence is seeing a lot of bad stuff,

18

for example to analyse a new piece of malware.

#### Areas of focus

The organisation is structured into areas of focus

There are people looking for vulnerabilities in open source software, people looking for vulnerabilities in hardware, and people developing new ways to prevent attacks from happening.

Other staff are developing software tools which can search for certain pieces of malware, without taking up too much system resources. About 50 staff members are involved in incident response.

There is a threat hunting team. They might be looking on the "dark web" (the hidden part of the internet) for people selling credentials (login details) which can be used to access company networks

Talos employs a number of analysts who also speak languages which can be relevant to cybersecurity, such as Russian, Ukrainian, Portuguese, Korean and Japanese.

Talos also shares information with other cybersecurity researchers. There is too much going on for any one company to see it all, he said. It is a founding member of an organisation called Cyber Threat Alliance, also including competitors like Palo Alto Networks and McAfee.

The biggest team in TALOS is detection research. It does more than just analyse the malware, it develops ways to quickly visualise what is going on, and enable people to respond to what they see.

It is easy to get an enormous amount of data, the bigger challenge is being able to find something within it.

Talos does a lot of "open source intelligence", looking in publicly available places, such as Twitter and Instagram, where "you can find bad guys advertising their malware, sometimes they brag about things."

In the operational technology / control system world, Talos works closely with a number of automation companies, including Schneider Electric and Rockwell Automation.

It has researched many devices, including routers, hubs, cameras and virtual private network devices. "This is not easy work - it takes 3-6 months to find one vulnerability with these products."

#### NotPetya example

Mr Marshall illustrated how it can all work, with the example of NotPetya, "the costliest cyber-attack in history".

A state actor, "Russia in this case", managed to hack into the development system for a small accounts software company in Ukraine. When an update to the accounts software was released, NotPetya was released. This was the hack which did major damage to shipping line Maersk.

"There are amazing stories you can catch of companies barely surviving and more than a few that didn't. I encourage everyone to go to the Wired magazine article," he said. "We were the first boots on the ground to analyse this."

The first call was made to Talos about 3am in the US. "In 12 hours we had incident responders."

Talos was able to see that this was a "supply chain attack" - spread through suppliers, rather than spread through clicking on e-mails.

To begin with, "we had a lot of detection, but not a lot of context," he said.

The virus was "incredibly vicious", as it flowed from company to company. "A lot of these networks were connected, it could flow so easily, it was just incredibly prolific and destructive."

The virus appeared on people's computers as ransomware, but Mr Marshall believes that the real goal was just to cause destruction. It didn't even make it easy to pay the ransom.

#### The hacking business

Many "threat actors" are seeking financial gain, such as with ransomware which demand that companies pay to get access to their computer systems.

Not all hackers write their own malware. There are services online where you can access malware written by someone else for a weekly fee, and use it for your own hacks.

Mr Marshall gave an example of one hacker who was specifically targeting companies working in building automation. It found five target companies - a German shipping company which also provided building control systems, a large US building automation company, a large US manufacturer of HVAC (heating, ventilation, air conditioning), an integrated HVAC company and an Eastern European HVAC reseller.

The hacker had discovered that all of these companies were selling products provided Trane, a HVAC software and hardware company.

There are some HVAC systems exposed directly on the internet, and they can be found with a "internet of things" search engine called Shodan.

On this site, you can access the hydration system for a number of gardens and golf courses in California, and a similar system for water purification on a building. "These are all things you wouldn't want to expose to the internet, but I can find them. The inadvertent exposer is typically oblivious."

Accessing HVAC systems can give you a way in to bigger systems.

US grocery chain Target had given its HVAC contractor direct access to its network, so it could monitor its refrigeration units. So the hacker might have been trying to first gain access to the HVAC software and hardware, then access the contractor, and use that as a way to access Target's network. "That is a heck of a thing," he said.

All companies should think about their "attack footprint". And if they provide vendors with access to their networks, they should ask their vendors, "what are you doing to protect me".

Ultimately it is about reducing risk - which is a business issue, not a technical one, and something business people can understand. "Business and risk go together hand in hand", he said.

#### **IOT threats**

In terms of threats, the control system threats can be considered "micro" where IT threats are considered "macro". With macro threats, a hacker tries to attack millions of people at once. But with micro threats, it is worthwhile for a hacker to make considerable effort trying to access one system.

Note that control systems today use a lot of the same equipment we find in the "macro" world, such as Windows computers, domain controllers, and so share the same vulnerabilities.

#### **Maturity program**

To get to the first step of a cyber security program, there are "bare minimum things you have to get your arms around," such as keeping software patched, knowing what is on your network, making segmentation so something nasty cannot spread through the whole network, basic visibility. "If you are able to do [these] things reasonably well you are ahead of the game," he said.

Further up the maturity chart we have data flow mapping, and the most mature companies are doing threat hunting and Security information and event management (SIEM). "Larger customers and vendors are able to do that because they have the budget."

#### Cybervision

To help customers better understand what is on their network, Cisco has a product called "Cisco Cyber Vision" which scans everything, building up a map of everything it detects, and determining whether each device has the latest patches.

"This is invaluable," he said. There may be reasons you decide not to install latest patches, but at least you can be aware of the risks.

It will also generate information about the IP address, MAC addresses of each device, what model of equipment it is, and what firmware it has.

#### People

Good cybersecurity people in the operations technology world need to understand three separate domains - how the operations technology works, how IT works, and also the processes it is controlling. "It is not investments in technology, it is investments in people that matter," digital energy he said.









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