

# digital energy journal

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June- July 2020



***A 45-vibrator survey  
in Saudi Arabia***

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## Digital Energy Journal

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### Cover image -

45 Sercel Nomad "65 Neo" all terrain vibrator trucks being used on a "mega crew" survey conducted by Sinopec Geophysical, covering large areas of Saudi Arabia, which began in late 2019.

The survey also used 60,000 channels of Sercel's 508XT seismic acquisition system. Data can be recorded at frequencies down to 1 Hz.

"Its revolutionary cross-technology architecture (X-Tech™) optimizes productivity and makes it the ideal choice for such mega-crew configurations," Sercel says.

## Chevron and PIDX plan for GHG standards

Oil and gas digital business association PIDX is planning to develop standards for greenhouse gas emissions, under the leadership of Chevron's head of digital transformation strategy

PIDX, an association for digital business standards in oil and gas, is planning to develop data standards for greenhouse gas emissions from oil and gas production.

The project is being led within PIDX by Chevron's global head of digital transformation strategy, Sebastian Gass, and has the support of the full board of PIDX. This includes Andrew Mercer, who leads low carbon and sustainability within the information technology and digital teams at BP, Shawn Green, R2P [request to pay] Project Implementation Manager, Lower 48 at ConocoPhillips, and Amit Sethi, global digital customer experience leader at BHGE.

Or to describe Mr Gass' title and role in full, he is the general manager of the Technology, Strategy and Services division within Chevron's IT Company (ITC). He is responsible for Chevron's Digital Transformation Strategy, Data Science, Enterprise Architecture, Project Management, Operational Excellence, Supplier Management, Services Definition and Business Planning groups.

The challenge, as Mr Gass describes it, is that gathering emissions data for internal and external reporting is becoming a major administrative and data management challenge, involving much tedious and time consuming manual work.

Each business unit in Chevron has a multitude of agencies they are required to report to, including local, state and national, as well as internal reporting, he says. The data is required to be submitted in a variety of formats and submission modes. "Some agencies may ask for a spreadsheet, some ask for PDF files. Some bigger and more sophisticated agencies have web based forms."

Chevron has to collect the data from the various operations and laboratory systems which each business unit uses. The data must be gathered locally, assimilated, and prepared for reporting.

Mr Gass envisages a standard digital process for gathering and sharing emission data. This would enable the process to be more automated, and also to better support analytics on the data, which may identify

ways to make better decisions on how to produce oil and gas with lower greenhouse gas emissions.

"The value proposition was transparency, not just within the company but externally," he said.

Companies currently publish a range of "energy intensity" measures in their annual reports. "They are all over the place – there is no standard," he said. "You can't compare apples to apples – on who is more energy intense and efficient. It is incredibly error prone."

For example, some people issue numbers about how much CO2 is released by people watching Netflix. "Do you believe it? I don't know. There are lots of different studies, government bodies, academic bodies that have a point of view."

"We have a unique opportunity as PIDX to bring clarity into this space, to really influence and more importantly shape the dialogue around energy transition and emissions.

### Within Chevron

Mr Gass says that Chevron increasingly sees "energy transition" as core business, rather than something separate. "The energy transition is a major topic within Chevron, a major initiative," he says.

"Whether you see it as OPEX reduction, power management, ESG, the way we position ourselves, it is all really within one topic."

Chevron has its own projects to try to find better ways to manage emission data and to see what it can do with the data.

For data gathering, it is starting with two projects – the Gorgon natural gas plant in Australia (which is also a large scale carbon capture and storage project), and the El Segundo refinery in Los Angeles. "We're working with them to try to improve their current process of recording emissions," he said.

In both sites, it wants to find ways to streamline the data collection and 'curation' process, to make data better available on a daily basis, so it can be incorporated

into production meetings, supporting “process change” decisions.

It is seeking to develop an architecture to automate the collection and curation of data, including adding in trusted external data.

It uses a greenhouse gas emission reporting and analysis software from Sphera.

Separately, Chevron has a project called “Lighthouse” to “use both internal and trusted external emissions data to better inform Chevron’s operational and business decisions”.

The goal of the projects are to meet regulatory reporting requirements, and provide real time views of data through a Power BI dashboard, enabling the fine tuning of operations.

It should also be able to support prediction of greenhouse gas emissions for the future, and fill in gaps in emission data with other data sources, perhaps from space.

Finally, Chevron wants to be able to reduce the cost of compliance, he said.

But this is not just a reporting scheme – Mr Gass is keen to look at the whole data architecture around it, and perhaps find ways to apply data science and AI.

Chevron has a team of data scientists and data engineers, working with partners at IBM and Microsoft, to explore ways that data science and AI can “help Chevron improve environment performance,” said Franz Helin, IT Project Manager at Chevron.

The ultimate goal is to make “every business and operational decision that Chevron makes to be informed by the environmental impact.”

It could be centralised, bringing all data into a single place, and then shared widely around the company.

“If we have centralised and commonly hosted emission data that we can share, Chevron can make better decisions,” Mr Helin said.

Chevron wants its staff to be as aware as possible about the environmental impact of their decisions, he says. The environmental impact of a project or purchase would be considered alongside the usual factors of cost, safety, and oil and gas production.

People may then find ways to optimise decision making taking into account where the environmental impact would be reduced.

The data might also be shared with the petroleum industry’s customers.

### PIDX standard proposal

The proposal for PIDX is that it develops standards for data exchange related to carbon emissions, and any other needs related to the “energy transition.”

At PIDX, where Mr Gass sits on the board, there have already been “several board discussions and strategy meetings [looking at] what is the next generation, the next natural evolution for PIDX,” he says.

The proposal is that it would leverage the PIDX “framework” to develop clear data standards and understand data exchange needs, covering suppliers, operators and networks.

PIDX would create a forum which would review how the data can be better collected and reported, and develop standards.

The system would improve clarity about the energy standards for different parts of the world. The reporting would be more trans-

parent. There would be better alignment between operators and suppliers about what data is needed.

Chevron has appointed Franz Helin, IT Project Manager at Chevron, to “help with the energy transition working group within PIDX, drive that forward, bring in whatever we can bring from Chevron.”

Stephanie Waters, president of PIDX, who also serves as Procurement/Supply Chain Enablement Manager at Chevron, said that the initiative came out of a PIDX “Innovation Day” held in February this year, where there was discussion about how PIDX should fit with the energy transition, and other ways PIDX should move forward.

PIDX could also define data models and definitions, and support technical integrations.

The development process could follow agile methodology, looking to develop a “minimum viable product” by August 2020, Ms Waters said.

The project team will have a remit to review other reporting schemes developed for CO2, and see how the PIDX project would fit with that. “Obviously we don’t want to have a competing standard, or a different standard – that would not make a lot of sense,” Mr Gass said.

“The OGCI standards are definitely something we need to take a look at. There’s plenty of other standard bodies out there.”

“But most of these are on the reporting side, templates and formats and things of that nature. Our focus should be more on the data integration side. Very few of them, as far as I know, are down to the level of how do you integrate systems.”

## SpotLight – “point” seismic to detect changes in the subsurface

SpotLight, a company based in Massy, France, is developing technology to monitor changes in the subsurface using seismic focussed on small volume or “spot”

SpotLight, a company based in Massy, a suburb of Paris, is developing technology to monitor changes in the subsurface affected by oil and gas production, with seismic focussed on a small volume of the subsurface, or “spot”.

The company claims that a number of “spots” on a field can be permanently monitored for a “few hundred US dollars”

– compared to millions of dollars for a full field seismic survey.

In February 2020, SpotLight began work on a pilot with Petroleum Development Oman (PDO) in the Qarn Alam area of Oman, expecting to complete Phase 1 of the work in May 2020.

The project team identified 12 “spots” where it wanted to make repeat seismic

measurement. The size of the spots range from 5 to 30m vertically, and 50 to 300m laterally, depending on the geology.

Ten of the spots were used to track steam flood performance (or break through), and two to monitor cap rock integrity, to ensure that steam injected into a field did not damage the cap rock.

The data acquisition was carried out by

PDO using its own standard equipment.

SpotLight is also doing a project with OMV of Austria, which should lead to a peer reviewed technical paper.

## How it works

The idea is that reservoir engineers do not need to monitor change in the entire subsurface to check their models of what is going on, they can just look at a small part of it,

For example, the reservoir engineer might want to know if a subsurface fault is permeable. Two “spots” can monitor for changes on both sides of the fault. If there are changes on only one side of the fault, it is not permeable, says Habib Al Khatib, founder of Spotlight, and a former innovation portfolio manager with CGG.

Another example – the reservoir engineer may want to know if an injection is hom-

ogenous (happening the same in all directions). This can be checked for monitoring for change in four spots around the injection point (North South East West).

To make it easier to compare one reading with another, SpotLight advocates installing its sources and receivers in a permanent way where possible.

This is easier to do when you are only doing subsurface analysis of a small part of the subsurface, compared to an entire reservoir section, which may need millions of receivers and thousands of shot points.

Analysis of the data can show changes in pressure, fluid substitution, temperature, and rock properties.

It may be possible to locate critical zones, where sub-surface activity is not well understood, and which might compromise production or the overall integrity or safety of a reservoir.

Making the survey successful relies on good survey design and data processing, rather than extensive deployment of equipment.

## Phaze Ventures

The company received investment from Phaze Ventures in early 2019, a venture capital company based in Oman.

Phaze Ventures thought that the technology could be used in geothermal energy, CO2 sequestration and volcanology, as well as oil and gas production.

Phaze also arranged further seed investment from M. Robert Brunck, former CEO of geosciences company CGG, and the French investment bank BPI France.

# Microsoft perspectives on oil and digital

Kadri Umay, principal program manager energy industry with Microsoft shared his perspectives on how the oil and gas industry can make better use of digital technology, and what Microsoft is doing

Kadri Umay, principal program manager, energy industry, with Microsoft, shared his perspectives on how the oil and gas sector can make better use of digital technology, speaking at the PIDX International Virtual Spring Conference in April.

Mr Umay is part of the energy industry team for Microsoft’s Azure cloud computing service, and leads some of its data initiatives.

Mr Umay remarked that the Covid-19 means that industry is effectively having a “digital transformation enforced on us”.

Digital transformation “is no longer a project run by the office of the chief digital officer (CDO),” he said. “We have to do it today. It has become a survivability thing.”

The oil and gas industry is also being pushed by both financial pressures and demands of the energy transition to digitise faster.

The drive to reduce emissions, and need to work with lower margins, is likely to push companies to be making much more real time decisions, he said. For example, if emissions somewhere are higher than anticipated, changes need to be made much faster, not after waiting a year for an emissions report.

“If you have a new service, or new software or new hardware that can provide you competitive advantage or an opportunity to reduce cost, you should be able to use it tomorrow,” he said.

## Data quality

Data quality continues to be a big problem – and also only a small percentage of data is used in decision making. We can still consider ourselves “wildcatters” in the data arena, he said.

Mr Umay cited a study from EMC saying that “only 3 per cent of the potentially useful data is tagged.” If data is not tagged, it can’t be found, and “we can’t run our digital workflows on that data,” he said.

Mr Umay has been looking at “patterns of inefficiencies in data management.”

“Finding [data] is the first inefficiency that we see,” he said. People in oil and gas companies might need to use 60 different search engines to find data they need, because the data is all stored in different places, or made from different applications.

Then the second problem is making the data available for your project. “Some of it is sitting in Joe’s desktop, some in a data centre in Australia, some in cloud servers in Singapore. You need to copy all this data in your cloud storage area before you start to process,” he said.

Then data can need a lot of processing and exporting before it can be used in for example a subsurface interpretation workflow. “On a good day – it takes half of usable time of a geoscientist,” he said.

These problems were mentioned in a book written back in 1992, “Enterprise Architecture Planning” by Steven Spewak.

## Structuring data

For one client, Microsoft decided to look for a way to structure well data. It defined some data types (about the well and wellbore, well trajectory, well logs and documents), a set of data schemas defined in JSON, and released a demo.

“After the demo we had a lot of people interested in working with us and committing resources,” he said. “We took all these schemas and operationalised them, professionalised them.”

It has a similar project with seismic data.

## OSDU

Microsoft is involved in the Open Subsurface Data Universe (OSDU) project, which aims to develop a standard data “platform” or structure for all subsurface and wells data, so it can all be easily searched. There are over 200 members.

The OSDU defined a number of standard application programming interfaces (API) using REST (Representational state transfer) constraints, which define how software should be structured for ingesting, searching and delivering data from this depositor.

It has also defined JSON (human readable text) based schemas for metadata.

So you can have different data formats but with the same metadata schemas.

Anyone can build applications with these APIs, so it can connect with data stored in an OSDU structure. Some software companies are already doing this, he said. There could be something of an ‘app store’ where people can buy different apps which work with OSDU.

There can also be a role for Systems Integrator companies, which offer services to connect systems together.

Many customers are using “power apps”, such as dashboarding and data visualisation applications, such as Power BI and Spotfire, or analytics platforms like Azure Synapse.

It should be possible to plug in data in OSDU format into all of these applications. Data scientists and geoscientists need spend much less time on the “plumbing”, or “data janitorial work”.

### Technologies

Companies might want to look at what he calls “cloud native architectures” – software designed initially for the cloud, rather than software moved to the cloud.

They might want to explore managing data in data ‘objects’ rather than in proprietary file formats, known as “object storage”.

“We can store any size of data in object storage,” he says. “It’s very low cost and very scalable. It makes life super easy.”

No SQL databases can be used to store and read data “any way we want”, in a way which can be scaled to any size.

Having “serverless architecture”, where data storage is managed by the cloud, rather than by using specific server machines, makes it easy to be scalable to any size. You can use gRPC (remote procedure call) to connect services between different data centres.

A “microservices” based architecture can “provides tremendous simplicity.” It is resilient and easy to upgrade he said.

Companies can be looking at better ways to gather data from sensors and developing ‘edge’ services (with computation done next to the sensor, so it does not have to send all of its data to the cloud).

An interesting emerging technology is “secure multi-party computation”, where data can be

shared with others but kept encrypted the whole time. So you can run the same machine learning algorithm on different data sets owned by different people, encrypted with different keys. The algorithm can ‘see’ all the data, but no human can. “Machine learning algorithms get better and better when you share data,” he said.

The Graph QL standard, a query language for APIs, could be useful. “Being able to access data with an API that makes sense for your use case is important,” he said. “I think Graph QL will gain popularity in the next few years.”

Technologies like Secure multi-party computation might be useful in optimising scheduling, if it enables companies to share their requirements to a scheduling algorithm working across multiple companies, but without revealing secrets to their competitors.

Mr Umay mentioned Microsoft’s Project Silica, which enables data to be “written” onto a piece of glass, enabling data storage for 10,000 years. He showed a picture of a piece of glass a few inches square, which held a 76 GB movie. “This technology is virtually impossible to destroy,” he said.



## Getting more sophisticated with spares

Oil and gas companies are getting much more sophisticated about how they manage spares, including maintaining optionality to buy a similar product from another supplier, rather than being constrained to only buying a spare with the part number in their systems, says Peter Hardy from Sphera



Peter Hardy, director, of MRO (maintenance, repair, and operations) delivery with Sphera.

In the boom times of the oil and gas industry, the approach to spare part management often boiled down to keeping as much spares

as you could in stock, keeping simple databases of part numbers, and hoping you had the parts you needed when something broke, says Peter Hardy, director, of MRO (maintenance, repair, and operations) delivery with Sphera.

People had an incentive to hold as many spare parts as they could because the critical issue was not the money tied up in storing spares, but avoiding getting in a situation of having to explain why a certain part was not available. “We would find whole warehouses full of stock which had never been touched.”

But now companies are getting much more demanding, aiming to reduce the parts they keep in stock without getting caught without something they urgently need, and also maintaining flexibility to switch supplier.

Sphera, based in Chicago, specialises in data and consulting services for heavy industries.

### More nuanced strategy

To keep maximum optionality with minimum cost, you need a far more nuanced

and integrated strategy with spares data, Mr Hardy says.

People are saying that if they are not using the parts in stock at least once or twice a year, they should not be holding them. Storage and capital costs can amount to about 20 per cent of the value of the materials per year.

But to be able to safely reduce stocks, they need predictions of which spare parts might be urgently needed, classifying spare parts for criticality, having skilled people who understand what parts are right for the task, and making it easier for engineers to find the parts they need.

Maintenance staff need to know about the function of the item. Inventory management departments need to know how they can store or transport it, and if there are any storage requirements.

Sometimes optimisation strategies solve one problem but create problems elsewhere, such as reducing spares in stock but being more reliant on fast deliveries, or having engineers spending more

time trying to source the exact right part. In order to better predict demand, companies are using techniques like Montecarlo simulation or actuarial science.

A further issue with spares is that much older equipment requires expertise to fix which is no longer available. So companies may choose to replace equipment rather than fix it, even if the spares are available.

Developing a spares strategy requires both data management and subject matter expertise, Mr Hardy says.

## Master data

The underlying challenge is getting the “master data” right, he says. That includes cleaning the data, ensuring it is accurate, and standardising it.

Wrong master data can lead to extra costs in multiple ways. For example, if you can’t find the part you are looking for in the company stores, because the location shown in the computer system is not correct, you have to pay to buy stock which you already own, and there are delays waiting for deliveries.

If you have duplicate items, so more items in storage than you thought, that increases the cost further.

If you fit the wrong parts, there can be unexpected machinery failures, possible safety and liability issues.

Too much information or data floating in the system can also be a problem. An Accenture study found that the cost of each redundant piece of material in an ERP system can be about \$30, in terms of making it harder for people to find what they are looking for, and then cleaning up the data.

High quality master data is also needed to negotiate contracts and determine the lowest cost suppliers.

Consistency of data is very important in helping people find the right parts – if you know how items are described, you know how to find them.

And not all spare parts are equal. A problem with a valve can stop operations, but a crack in the bezel of your monitor won’t stop anyone doing anything. Data can convey the criticality of each component.

“The whole point around master data is around consistency, completeness and accuracy of information you are pulling in,” he says.

## Functional specification

Different suppliers making equivalent spare parts are unlikely to agree to use the same part number. So in order to have choices

about which supplier to use, a spare part needs to be described by its function, not just a manufacturer’s part number. But there is not usually any standard way to describe items.

As an oil and gas real life example, you have five different pieces of equipment which all have what looks like the same valve. But the first valve is certified for a liquid up to a certain temperature – which makes it fine to use in plant A, but not on Plant B and C.

A company which supplied a complex piece of equipment, such as a pump, may try to steer customers to buying all spare parts from itself, although the spare parts themselves may be made by other companies, such as bearings. Sometimes, equipment suppliers will just cover the original manufacturer’s part number with a paper label.

But there could be other issues involved – perhaps the machinery supplier does its own quality checks on the bearings and rejects 50 per cent of them. If you buy the bearings direct, you won’t know.

Another reason to have a functional specification is in case a supplier goes bust. This is the only supplier who will be able to provide a part with its specific part number. Other suppliers may be able to provide an equivalent replacement part, but you need to know the part’s specification to do that.

Mr Hardy used the example of work gloves to illustrate functional specifications further. These are available in a number of different materials, types, sizes, colours, construction methods. There are standards for factors like “cut resistance”. They have lengths and sizes. Different specifications make gloves appropriate for different jobs. But there is no standard way to describe them.

Companies need to ensure that people have the right gloves for the right jobs, when doing machinery or maintenance work, but want to avoid spending more for gloves if they can. Oil companies purchase enormous quantities of gloves, so a few dollars saving on each pair mounts up.

Companies often want to have corporate purchase systems, where individuals in the company are able to buy what they need from a catalogue, restricted to purchasing items which have been approved by the company as suitable in both specification and price.

But commercial companies don’t necessarily support the idea of a standard functional specification system, because they want to strongly encourage buyers to use their products. Some vendors in particular have a reputation for never providing any specification or

information about their parts. “The last thing any supplier any wants to put is any information on interchangeability. It has always been a fight,” he says.

## Semantic web

Mr Hardy is very enthusiastic about the idea of a “semantic web” for item functional specifications – which basically means items are tagged in a way that can be read by computers. It means a specific way to describe something – with nothing supplier-specific. A standard language for machines to read the web.

People can give items multiple names, but the computer only has one definition. “I can call it one thing, you can give it a different name, we know how those things fit together,” he says.

There is an ISO standard for functional specifications, ISO 8000, which could be confusingly described as a “standard for a standard”. Suppliers can provide a standard system for describing the functions of their products, which can be approved to see if it meets ISO 8000.

The ISO standards can be a tool for buyers, if they stipulate to suppliers as a condition of contract that data must be in ISO 8000. “That’s what will drive this,” he says.

If no standard exists, the supplier creates a metadata standard and submits it themselves into an approved ISO 8000 depository operated by another company.

Like all ISO standards, it doesn’t tell you specifically how to do something, it says how it should be done. So it can describe how a metadata standard can be put together – then a standards organisation like PIDX, or anyone, can put it together.

## About Sphera

Sphera specialises in data and consulting services for heavy industries, and acquired SparesFinder, a UK company focussed on improving quality of spares data, in 2018. The spares management work is within the ‘operational risk’ department of Sphera, reflecting that managing spares is perhaps best seen as a risk issue. It may be dangerous to issue someone with a “permit to work” if they don’t have the spares they need to do their work.

Sphera seeks to bring all elements together into one integrated environment, so its spares management tools are integrated with its permit to work management tools and barrier management tools, as well as master data management.

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## PIDX goals – transition, modernisation, adoption

The goals for oil and gas e-commerce standards association PIDX, over the next 5 years, are around the energy transition, modernisation of the standards, and encouraging adoption, say board members Chris Welsh and Amit Sethi

The strategic goals of oil and gas e-commerce standards association PIDX over the next 5 years are around the energy transition, technology modernisation and adoption councils, said Chris Welsh, CEO of OFS Portal, and Amit Sethi, global digital customer experience leader at Baker Hughes GE. Both are board members of PIDX.

### Modernising standards

PIDX is also keen to find ways to modernise its standards. With so much software being cloud hosted, e-commerce can increasingly mean connecting together different cloud software systems, rather than finding a way to communicate electronically, said Chris Welsh, CEO of OFS Portal.

“We need to make sure PIDX is helping organisations talk to each other across the internet from cloud to cloud in a secure way.”

PIDX is looking at getting involved with cloud to cloud API integration.

It could set up standard data sharing agreements between PIDX members.

There are ways software can be developed to make data sharing easier between systems, including using JSON (JavaScript Object Notation), a data interchange format using human readable text, and RESTful Web Services, a software architectural style that defines a set of constraints to be used for creating Web services.

If companies increasingly use blockchain for managing data about transactions, PIDX could play a role in “tokenisation”, where secret data is converted to a token by a trusted third party, so it can be passed through the chain without revealing the data.

PIDX could also make the XML structures of its standards more flexible, by moving to dynamic XML schemas. Many requirements of the standards have changed over the past 2 decades since they were introduced, including different tax jurisdictions, governments doing electronic invoicing in different ways, tax reporting requirements and fiscal compliance requirements.

The standards could also be posted on GitHub, rather than just on the PIDX website.

### Adoption

PIDX is keen to see more adoption of its standards. The standards are adopted by 80 per cent of companies in North America, but only 8 per cent in Europe and South America, and only 2 per cent in Asia, India and Australia, Mr Sethi said.

And in North America, not all of the standards have been adopted.

Many organisations make a decision to adopt the standard, but struggle to get it adopted in their company.

It might be useful if companies were encouraged to report on the business outcomes they gained from adoption, such as improvements in productivity or cash.

PIDX is considering setting up a “Standards Adoption Council,” he said.

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# Making field tickets easier to manage

The “field ticket” process, paying suppliers for work done at well sites, still involves much manual work. Dave Savelle, General Manager, Field Ticket at Enverus, based in Austin Texas, explained the issues

US wellsite service providers typically issue paper documents, known as “field tickets”, after they have done work, documenting what has been done, and what needs to be paid for.

These field tickets go through a process of getting approved by oil companies, so invoices can be issued and payments made.

The process is still very manual, which means it has higher costs, time and inaccuracy rates than if it was all digitised.

In a pre-internet era, when everything was done on paper, it could take 8-10 weeks for the whole process of the field ticket being sent to the oil company, pricing checked, invoice approved, invoice coded / routed, and loaded to a payment system to be paid, says Dave Savelle, General Manager, Field Ticket at Enverus, a company providing electronic solutions for field ticket management, based in Austin, Texas.

By 2010, companies were using digital technology to make and route invoices, but the paper field ticket system persisted, Mr Savelle said. But electronic field tickets would mean customers could have a single step for approval, invoicing, and payment.

One of the reasons for reluctance to move to electronic field tickets is that supplier administration departments wanted to have an intermediate approval step, so did not want an electronic system which would automatically transmit the field ticket data from the worksite, as the “document of record”.

“Suppliers don’t trust their field hands to be the ‘source of truth’ related to cost, scope and quantity related to a field ticket,” he said. “They want to check the pricing, was the right discount used, does scope align with work done, was the right catalogue item selected.

Some suppliers issue field tickets within a day of the task being done. But other suppliers route the tickets through to a head office, and may not issue them for a week.

Some companies have developed automated tools which could create field tickets with less error – for example using GPS data to make sure that the field ticket connects with the right well, and so the right customer. But this proved difficult to make work. GPS systems are often not

high enough resolution, particularly when there many different objects in a small space for the computer to identify, he said.

Geotracking systems rely on handheld devices to track the movements of drivers, but it “relies on drivers and crews to use it properly,” he said.

### Integrating with production software

Meanwhile, oil companies want to be ever more sophisticated in how they predict and track spending for different projects, which means they need good field ticket data.

They would also like an integrated system for approving purchasing, which means integrating all the purchasing data into their ‘morning reports’ to be approved.

This means that all of the costs need to be entered manually into their systems from the field tickets, including descriptions of the costs, cost codes, vendor names. There can be inaccuracies.

Sometimes there are multiple types of ticket in use, such as “general ticket”, “materials ticket” and “hauling ticket”. Customers don’t necessarily have the same labels as a supplier.

Companies want to be able to split up costs for drilling and completing wells, and production operations. This can be challenging when (for example) both fracturing and production mean water flowing to the surface, which will be collected by one truck issuing a single bill.

Consider a situation where 8 wells are connected to one storage tank for produced water. 6 of the wells are in production, 2 were recently completed.

The company has to decide how much of the costs of water collection should be allocated to “flowback” (water which flows to the surface after hydraulic fracturing), and how much should be allocated to operating expenses. Then these costs need to be broken down and assigned to the individual wells to work out the costs of each well.

“One operator was doing this manually with a series of spreadsheets. It was awful, they had a small army of people. In this environment there’s no way they can afford to support that small army,” he said.

What typically happens is that the costs of a well in the software is only aligned with the actual costs after the invoices have been received.

### About Enverus

Enverus, formerly known as Drilling info, provides “Data, information, and actionable insights to make critical business decisions across the energy value chain”. It acquired Oildex in September 2018, an oil and gas financial automation company.

Over the 12 months April 2019 to March 2020, its system handled over 2 million field tickets, with total spend of \$6.18bn, with 4000 suppliers.

Enverus provides an online portal which can be used to generate field tickets. “We’ve taken an end to end process and made it completely digital,” says Mr Savelle.

Most of its field tickets are generated through its online portal. Only small percentages are generated by other means as “true B2B transactions”, including direct integrations with supplier software (JSON/API), going through 3rd party integrators, or PIDX electronic commerce standards.

Mr Savelle thinks there could be an opportunity for PIDX, as a standards body, in “providing leadership in enhancing standards for data and transport layers for field ticket information”.

PIDX already has a field ticket standard, but there are “certain quantities and data elements currently not managed,” he said.

# How can we assess a digital twin?

Many asset and equipment companies are producing “digital twins” – digital models of a real physical thing. But the value you get from the twin varies, partly because the digital twins are not consistently updated when the asset changes in operational use. DNV GL has a project to find a way to assess them

Many asset and equipment companies are offering “digital twins” today – digital versions of a real life physical asset. But the value you get from the twin varies.

A particular concern is that many digital twins are created at the point of construction / completion of a new asset, and don’t reflect developments in the physical object as it matures, says the technical advisor to the oil and gas industry, DNV GL.

DNV GL’s methodology for assessing digital twins is based around three building blocks.

The “functional assurance” - how it is designed, developed and tested, verified, and put into operation. The “operational assurance” - updating, periodic assessment, data quality, model quality, sensor system, condition. The digital “platform” it runs on – the asset model, data, sensors, architecture.

The methodology was developed together with Technip FMC, and already discussed with a number of operators. “We are ready to take it out in the market and start working with the industry,” says Kjell Eriksson, Vice President, Digital Partnering, DNV GL - Oil & Gas.



Kjell Eriksson, Vice President, Digital Partnering, DNV GL - Oil & Gas.

“Our methodology is a process of providing evidence that a digital twin will provide valid information, predict system performance within well-defined limits and to a stated level of confidence over time,” he says.

DNV GL has issued a “call” to oil and gas companies and suppliers, who would like

to pilot its methodology. If its methodology is successful, it would be able to prove that the data generated by digital twins can be trusted, and the technology is useful.

“We want to run a series of pilot projects in the industry to get a final test before we publish it as a recommended practise. These are planned for the second quarter of 2020,” he says.

DNV provides similar services for physical items, for example “65 per cent of subsea pipelines are designed to DNV GL rules or standards,” he says. “We have helped the industry to set the standard. All suppliers and sub suppliers have agreed on a common set of terms.”

## Benefits to vendors

The digital twin assessment can also make life easier for vendors, giving them an independent assessment of what their twin is suggesting, Mr Eriksson said.

There is a potential liability on a vendor if it makes a twin which gives poor advice on what to do. For example, it may start predicting incorrect maintenance intervals or state an incorrect requirement to replace parts.

Another benefit to vendors is that DNV GL’s approach could be adopted as an industry standard, so there is only one way which digital twins are assessed everywhere.

Otherwise, “the vendors have to comply with a range of different qualification schemes, which is not driving efficiency,” he says.

The more standardised digital technology can be, the easier it is for people to learn how to build or use it, he says, because they are not constantly adjusting to a different scheme.

And “in the times we have now, efficiency is key to becoming a viable industry.”

Ultimately this should be a way for the technology to generate more trust, which will lead to people using it more.

## Background

Digital twins are being widely discussed today, and not just in oil and gas – also sectors like healthcare, defence, automotive.

The term digital twin was first used for a 3D model of an offshore oil platform, and the

term evolved to mean a digital representation of anything, without specifying how rich this should be.

But typically, a digital twin is something supplied by an asset manufacturer to the asset owner, as a digital representation of a physical asset and its behaviour.

They will only be widely used if people find it possible to trust the data that they are providing.

All suppliers of hardware are required to do a quality assurance process, but there is no such requirement for digital twins, says DNV GL’s Mr Eriksson

## Domain and digital skills

Qualifying a digital twin design requires both domain skills and digital skills. Domain skills are defined here as having a knowledge of what the equipment is doing – such as a production engineer who understands production equipment.

“If you are digital skilled only, and don’t understand pump performance, valves, actuators, seals, and all the mechanical nitty gritty, you can easily go wrong,” Mr Eriksson says.

But domain experts without digital skills will also struggle to get value from a digital twin. Digital skills might include understanding the various parameters of data quality – accuracy, signal timeliness, and lack of duplicates.

## Universal methodology

DNV GL’s methodology for assessing digital twins can apply whatever the digital twin is, Mr Eriksson says. It could cover just a single piece of equipment, such as a pump, or an entire installation, subsea or topside.

“We’ve made a methodology which is not too cumbersome for the simple ones but not too simple for the more advanced ones. The methodology will scale,” he says.

But the more complex the twin, the more work will be required to make it useful.

## Maturity scale

Most digital twins developed so far are purely descriptive – a static digital version of the asset. But there is a lot of talk about making them more ‘intelligent’ such as being

able to diagnose a problem or suggest what to do about it.

Efforts are being made to increase their sophistication, including real time updating based on live sensor data, and combining analytics and other simulation technologies.

Digital twins can also be looked at in terms of their “maturity” along a scale, DNV GL says.

It starts with a static digital model, and then one with more detailed description. Then you could add more live sensor data to it and then use it to diagnose a problem.

As you develop this capability more, you could use it to predict problems, prescribe what to do about problems, and finally fix its own problem (autonomy).

The more advanced it gets, the more thorough the quality assurance process needs to be, so you know it is actually telling you something useful, or doing something useful, Mr Eriksson says.

It is very difficult to have a digital twin that will predict or prescribe what to do if you don't have a thorough description in place. Like an autonomous car which does not understand the car or the road.

## Functional assurance

The “functional assurance” part of the test addresses whether the digital twin is capable of achieving its function.

To make the assessment, you need to understand what it is designed to solve, what opportunity it is built to exploit, or what decision it is designed to help make. And whether you want information which will diagnose a problem, or predict what will happen, or tell you what to do.

Then you can ask whether it has the necessary data and information to do this. If you find you can't get hold of data in the quality you need to solve the problem, then it can't work.

Another aspect of functional assurance is whether the twin is designed to be suitable for whoever is going to use it. It means looking at how easy they will find it to use, and what level of disruption they will see to their normal working process in order to get benefit from it.

“That is part of this qualification process that we are developing,” he says.

## Keeping it up to date

The “operational assurance” part of the assessment addresses ways to keep the twin up to date.

A digital twin is usually supplied together with a new machine or offshore installation, and reflects how a new item will behave. But over time, the object degrades, and a digital twin needs to reflect the degradation.

The digital twin needs to reflect any repairs or modifications which are made.

## Digital platform

The digital platform which is running the digital twin also needs to be assessed.

You need a continuous process of monitoring the quality of data and sensors which feed into the digital twin to know if you can trust it.

The digital platform has issues of cybersecurity, consistency of asset models and architecture to consider.

Data can be transferred from remote sensors, through a remote IT environment, to an on-shore installation, then processed through some analytics, with some data storage along the way. There are plenty of opportunities for the signal to pick up ‘noise’.

There could be automated services which continuously monitor the quality of a data signal, and flags when the data appears to be so far outside the expected range it should be considered untrustable or needing further checks.

“You really need to understand the flow of that signal before you do analytics,” he said.

Sometimes data models are being used as a basis for artificial intelligence type analysis. But “AI is no good if you don't have control over the quality of the data,” he says. “Sometimes that is forgotten.”

# DevOps at Kongsberg Digital

Kongsberg Digital, a Norwegian provider of oil & gas, maritime and utilities software and digital solutions, is a pioneer in “DevOps”, the collaborative process of “developing” software tools in tune with “IT operations” hand in hand. DevOps is the pioneering approach to develop and deliver software hosted in the cloud.



Anshul Lalit, director of DevOps and Quality Management

Kongsberg Digital has numerous applications across the business areas, including in digital platform, maritime simulation, oil & gas, digital twin etc.

Anshul Lalit, director of DevOps and Quality Management, Kongsberg Digital, says he sees DevOps as more of a culture than any technology. It is a culture “that inclines towards growth, communication, and fast response.”

The move to DevOps also meant a change in how the company serves its customers, moving from being product based to service based, and making as many products as possible cloud hosted, and moving to an “app store” model, where customers can

buy different applications or services online.

“DevOps is not a product,” he refers. “You cannot buy DevOps and install it. DevOps is people following a process enabled by products to deliver value to our end users.”

Getting DevOps working at the company involved a number of changes to how the company worked, including changes to “legacy workflows, silos, bureaucratic gates, geo-boundaries,” he says. “We are consistently optimising our way of working.”

Kongsberg has developed its own system, which it calls “Kongsberg Digital Cloud

Delivery Model” or KCDM. Part of the KCDM is an assessment of the “DevOps” maturity level – how far the various software development teams have progressed along their “DevOps” journey, Mr Lalit says.

Testing is very important part of the DevOps process – because you do not want to put software tools with new code in front of customers without being completely sure they work, will not cause extra security threats, or interfere with what they are currently doing. Kongsberg aims to use automated testing as much as possible.

Kongsberg Digital was established in 2016, to provide digital solutions to the shipping, oil and gas, renewable and utilities industry. It was launched with 450 employees as a spin-out from the parent company, Kongsberg, a technology company active in maritime, defence and aerospace, which has 144 bn NOK annual revenue (\$14bn).

## Software examples

Kongsberg Digital’s software for drilling integrates information from different service providers involved in drilling. There can be thousands of sensors, and many changes to the sensor set up.

To test the software before providing it to customers, it needs to be run on a similar set up data to the real world conditions, including sensor data from multiple wells and with multiple users.

Kongsberg has an automated testing system which can simulate several hours of the software being under a large data load, monitoring multiple wells, providing data to multiple users, visualisation with large data load, and multiple wells.

It can run legacy “CodedUI”, modern “Protractor” and API tests, where the testing software simulates someone actually interacting with the drilling software via the user interface.

Meanwhile on the maritime side, Kongsberg is gradually moving its products to be cloud services on a platform it calls “Kognifai”.

The core product group is “Vessel Insight,” for capturing and aggregating data from the fleet. Staff get access to fleet overview data, vessel specific dashboards and data analysis tools. It enables customers to make better decisions about how to operate their vessels.

There are apps in “Kognifai” for managing personnel onboard, managing paint, device connectivity over satcom, accessing weather data, and managing maintenance projects and bunker planning.

## Teams

Kongsberg Digital has established what it calls “feature teams” to develop and test software improvements. This setup resonates the KCDM setup driven by DevOps philosophy, and helps killing the silo mentality.

Each team contains people with all the necessary skills to carry the whole chain of tasks, from architecting new software improvements, coding them, testing them, delivering, monitoring and fixing any problems. The mantra is “you build it, you run it,” Mr Lalit said. “For any special or niche needs, we have a pool of resources helping our feature teams”.

Individuals in the team have roles such as developers, testers, operations, security champions, incident champions and automation.

The “security champion” ensures that work complies with company secure coding guidelines, and threats are modelled.

There can be different types of testers involved, including people testing APIs, people testing UIs, integrated workflows, and people looking at underlying code.

Each team also has a “scrum master”, who is a sort of leader who manages the software development process, around two week “sprints”, with the goal being to produce something usable at the end of it. “Everything that comes out of the 2 weeks sprint cycle should be deployable. Whether you deploy it or not is a different story.”

This kind of Agile based organisational structure replaces one where there were different departments for coders, testers, and software operations.

## Testing and security

Developing automated testing methods proved to be an important component of making DevOps work, Mr Lalit says.

The company developed its own testing framework called “Galaxy”, which reduced the amount of coding needed for testing by 50 per cent, without reducing test effectiveness.

There is a quick intermediate testing phase, and then a “heavy testing” phase which uses a large amount of automation.

There is a “failure analytics” system, which reports the reason behind any failure and suggests ways to improve.

Products need to be tested for “performance, scalability and reliability”, or PSR. This is all done with automated tests running for 1 to 3 days. There is also testing for disaster recovery.

A small number of customers still have their software deployed on premise, and these implementations need to be tested separately.

For security, there is a company security team which reviews if software tools comply with company guidelines, and can do their own penetration testing, to see how easy the products are to hack into.

Kongsberg uses various threat modelling tools and methods to secure software development, testing and deployments, which provides detailed descriptions of how to mitigate the potential threats it identifies,” Mr Lalit says.

## Microsoft Azure

Microsoft Azure is the primary hosting provider for Kongsberg Digital’s software. Azure also offers a range of services to help build and test the software.

Azure can support many software systems including machine learning, databases, Kubernetes, sensors (IOT), identity management and providing developer tools. “It has everything so cleanly integrated with our development hub that it makes the job easier,” he says.

The “Azure DevOps” software can be used to manage various aspects of the development cycle, including project planning and management, spring and backlog management, continuous integration / continuous delivery, control of source code, and collaboration.

# EM&I – laser scanning for FPSO tank inspection

Asset integrity management company EM&I is developing automated methods to inspect FPSO tanks with laser scanning

Asset integrity management company EM&I is developing automated methods to inspect tanks on FPSOs using laser scanning, so there is no need for people to enter tanks.

Tank inspection is considered by many to be one of most dangerous tasks which FPSO and tanker crew undertake, with a number of accidents reported on tankers. The spaces can be difficult to enter and exit. If crew have any accident or medical issue while in a tank, it can be difficult to summon help.

The solution developed by a Joint Industry Project (JIP) led by EM&I uses laser scanning at a distance, instead of close up inspection by people.

A laser beam is fired in multiple directions, and bounces back to a sensor next to the camera, enabling the computer to build up a 3D image of what the laser can “see”, using multiple points (known as a “point cloud”).

The same technology is used to make 3D models of old equipment, and also for navigation of autonomous cars.

The device does not have to be taken into the tank by a person – it can “see” the tank walls if the laser can be shot through a hole in the deck or an opposite wall.

Working with digital imagery taken remotely is something that the nuclear industry has done for a while, says Danny



Danny Constantinis, chairman of EM&I.

Constantinis, chairman of EM&I.

A typical scan takes about 8 minutes, where it could take several days with people in the tank for a traditional tank inspection, he says.

With laser scanning, it would be possible to inspect all the tanks on an FPSO with 2-3 people “in a few days” – rather than having 10-12 people onboard for 3-4 weeks, doing dangerous work which involves going into tanks, as it is done today.

An alternative option to shooting the laser through a hole is to have the laser scanner

mounted on a robot vehicle inside the tank. To guide the vehicle, railway type tracks would be fitted inside the tank, for example with rails a foot wide and 20 feet long. The laser could be installed onto a robot with wheels, which is lowered into the tank onto the tracks. This is probably a solution more for a new vessel than a retrofit, Mr Constantinis said.

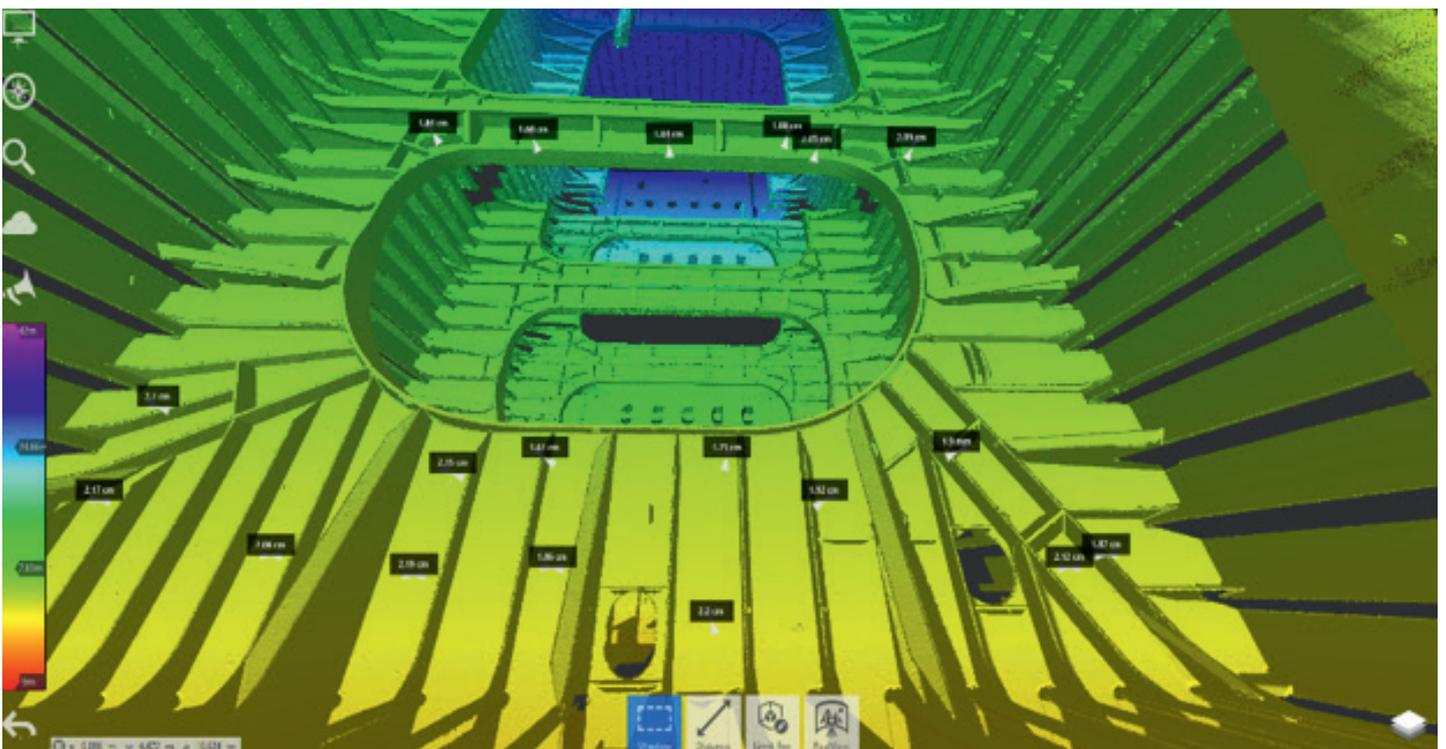
EMI considered drone mounted lasers inside a tank, but it proved to be not a very workable approach – it would still need someone in the tank to drive them. Also, the laser needs to be very static to take a good survey, so would be better sitting on something more solid than a drone.

Early laser trials were held in 2019 on an FPSO in Equatorial Guinea under the HITS JIP programme managed by EM&I.

EMI is seeking more projects with oil majors and class societies to further improve the technology. It should be ready for full commercial launch in late 2020 or early 2021.

## How it works

Laser scanning technology has advanced greatly in the past few years, and it is now possible to “see” in enormous resolution. A laser scan shows up distortion in the steel, rusty patches and paint breaking down. Laser scanning can reveal pits in steel due



A laser scan image of a tank

to corrosion, and areas where the steel is thinning or corroding. The data can also be converted into stress models, to identify where the weak areas are.

A big challenge when evaluating tanks is measuring the thickness of the steel (and if it has been thinned through corrosion). People used to tap the steel with a hammer, or by using a calliper (if they can access both sides of the steel), or ultrasonic technology – but all of this involves someone entering the tank.

EMI is developing a technique using “synchronous lasers”, when you do laser imaging from different positions in the tank, and then put the images together. This can be used to evaluate thickness if you can ‘see’ both sides of the steel with a laser and also relate the two laser positions.

If you can only see one side of a tank wall with the laser, one approach to measuring steel thickness is to use datum points, such as a point on the tank wall which can also be seen from outside the tank (such as an access point). You can use this datum point to connect together multiple images.

A similar technique is used in building construction to ensure (for example) different sections of piping connect together. Two pipe sections can be designed to connect at a ‘virtual’ datum point.

“We can measure the thickness as accurately as if a man was in there,” Mr Constantinis says.

Software can handle basic quality control over the data collection, so as to confirm that all of the tank area has been surveyed.

The laser data can be collected by a few specialist technicians and sent to the engineers. Surveyors are generally much happier analysing information from their desks, rather than having to pass medicals and survival training courses to be able to go on a helicopter and go offshore, Mr Constantinis says.

The remote surveyor could also review data while the survey is happening, and request that certain areas of the tank are given special attention.

EMI worked together with statistics experts to assess how much data is actually needed to get a high level of reliability in the predictions.

## Replacing divers for underwater inspection

The tank inspection project is part of a Joint Industry Project (JIP) which EM&I formed with a number of class societies and oil majors in 2013, looking at better ways to do

inspections on FPSOs.

The discussions clarified three concerns – the risk of using divers for inspection underwater, the difficulties inspecting tanks, and a desire for automated tank cleaning methods.

When looking at better ways to do underwater repairs, one solution was to find a way to fix a “cofferdam” (a box fixed to the side of a hull giving it protection while repairs are done) without divers.

It is normally done with divers fixing bolts to the side of the hull. But EMI found a way to do it by drilling holes into the hull from inside (using class approved ODIN® access ports) without allowing any water ingress, pushing wires through the holes, and then pulling the cofferdam into place from inside.

These methods have the advantage both of having fewer people exposed to high risk, but also requiring less travel offshore altogether.

It is possible to do hull inspections, fix valves, repair a sea chest (seawater intake system), without divers, using other methods, he said.

It works with any floating oil and gas equipment, including FPSOs and Mobile Offshore Drilling Units (MODUs).

## Automated tank cleaning

The next research project may be to look at automated cleaning methods for tanks. The challenge is to find a way to remove the liquid sediment which falls to the bottom of the tank.

The initial efforts are based around looking for technological ways to determine which parts of the tank justify most cleaning effort.

“We’ve tried different [automated] technologies to go through the sludge – it can be done but it is very slow at present but work is progressing to speed things up” Mr Constantinis said.

## Electrical inspection

Another interesting project looks for ways to inspect electrical equipment without opening it.

Normally, electrical equipment needs to be switched off to inspect it, which can lead to disruption of people using the electricity.

EMI developed an approach using techniques developed for medical imaging, to look at electrical boxes without opening them.

It is possible to see loose connections, wiring not properly crimped, or faulty seals.

Most people would approach the challenge by looking for “better ways of opening the box, but we thought ‘outside the box’” he says.

## Inspecting mooring chains

Another project is to find automated ways to do inspection of mooring chains of deep-water equipment.

Doing it with ROVs can be tricky because the ROV can move in the water.

But EMI’s technical group found a robot technology developed for the logging industry to climb trees, and developed an underwater version which could be used to inspect chains. It is now going into sea trials. The company has named it LORIS, after the forest primate which climbs trees.

LORIS will be tested in late 2020.

## EM&I’s approach

EM&I’s business approach is to orient around what question needs answering, rather than what technology can do. “There’s so much technology out there,” Mr Constantinis says. “Very often, the assembly of the technology is not the problem. It is understanding the question.”

“We know there’s solutions out there, our world is so advanced,” he says. “The difficulty is trying to nail down the real problem, and ensuring that if you solve it there’s a commercial interest.”

“We don’t stand up and say, ‘we’re the best in the world.’ We’re good assemblers of information – we simply act as a catalyst.”

Mr Constantinis originally trained as an aircraft engineer then as a commercial diver on the Maui gas field in New Zealand. This led to a career in the UK nuclear industry developing robotic systems.

This experience helped him found EM&I as a provider as innovative services and safety products to the offshore industry.

EM&I has offices in UK (Cheshire, Aberdeen, Jersey), Brazil (Rio de Janeiro and Macaé), Tianjin, Perth, Singapore, Nova Scotia, Angola, Malta, Kuala Lumpur, and Houston.

The “alliance” refers to the relationships it has with other industry sectors, including via the joint industry projects, and relationships with people working in aerospace, nuclear, medical and other industries.

EM&I is now forming a second Floating Gas JIP which addresses integrity challenges in the growing floating gas sector.

# ABB's "Augmented Field Procedures" platform

ABB has launched "Augmented Field Procedures", a platform for industrial customers to manage procedures and data entry for field workers in a more sophisticated way

ABB has launched "Augmented Field Procedures", as part of its "Ability" suite of solutions, as a means for industrial customers to manage the procedures and data entry for field workers in a richer, more sophisticated way.

It is designed for the oil and gas sector, and also chemical, process, power and water sectors.

The system can be used in any industrial environment, in greenfield and brownfield sites, for start-up, routine maintenance, and shut-down activities.

The software supports providing field workers with instructions about what to do, accepting data and other files such as photos. It can also provide and take data directly from control equipment, whether or not it is made by ABB.

Many tasks which field workers do are highly structured, with company "Standard Operating Procedures". For example, maintenance, equipment startups and changeovers, or isolating equipment, which involve a field operator following specific steps, for example "open valve X32 and check something."

Oil and gas companies define Standard Operating Procedures for many aspects of their business and are often required to do that by regulations.

There can be procedures telling what to do in an abnormal situation – instead of looking through paper manuals to determine what to do, someone can look it up on a tablet, she says.

People often follow the standard operating procedures written on paper, or a manual displaying on their tablets, guiding them what to do, what order to do them, and on which equipment.



Matilda Steiner, global Product Manager for Manufacturing Operations Management solutions at ABB.

ABB's aim is to "augment" these standard operating procedures – to provide more information and more guidance – so richer support to people doing the field maintenance work, says Matilda Steiner, global Product Manager for Manufacturing Operations Management solutions at ABB.

The software should help ensure the SOPs are closely followed, and also necessary information is recorded.

A number of accidents have occurred because the SOPs were not followed properly, or people did not understand them properly, or maybe thought that they had a better idea how something should be done, ABB said.

It is possible that the human-machine interaction could be via a head set screen, but more common today to use an industrialized tablet computer, Ms Steiner says.

The company is currently doing two projects with industrial customers, but is not able to name them at this stage.

"The people that join the industry now are used to working with mobile devices," she says. "They will be disappointed if they have to start working with paper and old technology."

## Integrate with control system

The Augmented Field Procedures system can also provide information to the field engineer brought directly out of the control system, such as the temperature in a tank or a liquid flow rate.

This can be more convenient than making radio communication to the control room to ask a question. It avoids disturbing the control room operator, and a risk of miscommunication.

The manual steps can also be synchronized with automated steps which the control system makes.

ABB's core business is control systems, and that is where it has a lot of domain knowledge.

Control system device communications are fairly straightforward, using OPC protocols.

They do not need to be using ABB control systems. "It can work in a completely non ABB environment," she said.

## How it works

The software provides both guidance and enforcement to people ensuring the proper procedures are conducted – in the same way that any online form does, ensuring that the recipient of the information gets the information they need, but not allowing you to submit otherwise.

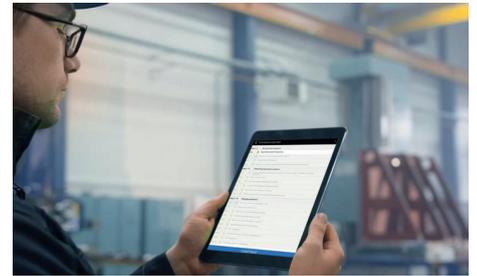


ABB Augmented Field Procedures Tablet

For example, the form may ask you to submit a photograph of something as part of the process.

The software supports data input in multiple ways. For example, it could require the field worker to scan a bar code on a valve as part of the process of entering data, so the computer can verify that the right valve is being opened and in the right sequence.

The operator can also submit their own comments, including comments about how good they find the procedure to be.

ABB is also developing a "chatbot" which can answer simple questions like "what is the temperature in the tank," or inform the operator if there is an alarm nearby. "Chat" may prove a better, more intuitive means of entering and receiving data than other approaches like alerts and dashboards.

People's supervisors can easily see what is happening, and the computer maintains a record of what was done.

"If we continuously collect the information, we can act on it," she says.

## Setting it up

Customers expect products like this to be simple to set up, Ms Steiner says.

There are two components to the set-up – entering the standard operating procedures (SOPs) and integrating with the relevant control system data.

Customers can set it up themselves, there is no coding required. ABB provides the support, training, and installation support. Customers define the procedures they want people to follow, and then they can start work quickly.

Work with customers will typically start by looking at "low hanging fruit", areas the customer wants to improve. "You can start in one area, then you can extend it," she says.

# Cognite – how digital tools can help suppliers

Cognite is helping equipment suppliers get useful data about their products in operation. One project, involving oil and gas operator Aker BP and pump supplier Framo, shows how data sharing can lead to a different business relationship between oil companies and their suppliers.

Cognite, an industrial software company based in Oslo, has an interesting project with Framo, a manufacturer of oil and gas / marine pumps based in Bergen, Norway.

Using Cognite's main software product, Cognite Data Fusion, Framo is able to access live data about its pumps in operation for its client Aker BP. This enables Framo staff to spot emerging problems, give advice, and better learn about how its pumps behave in real operating conditions. It supports a different working relationship with its customer, for example where it gets a bonus based on the uptime of the pump.



A Framo engineer monitoring pumps in active service

Aker BP gathers together data from sensors on all of its equipment, including Framo pumps, using Cognite's platform. The Cognite system "contextualises" the data (puts it together with other related data so it is more meaningful). It can then be provided to Framo engineers in a way which is useful to them.

"The data Framo collects is used to get an overview of the condition," says Trond Petter Abrahamsen, managing director of Framo. "We can roughly say that we use this for two purposes. One is the real-time monitoring to see the status of the pump condition here and now. In addition, we look at the historical data to be able to predict what will happen in the future."

"If a component fails or behaves irregularly, we can take action immediately, providing large potential cost savings. Learning from historical data also allows us to predict possible future events such as required maintenance and equipment failure."

Until now, most equipment suppliers did not know much at all about their equipment whilst in operation – only finding out after a major problem, such as a failure.

Now they can get an understanding of how it is running and give advice to their custom-

ers about whether something should change. They can predict failures which may occur if pre-emptive maintenance is not done.

Lars Atle Andersen, VP Operations – Technology & Digitalization in Aker BP, says that his company's vision is to "digitalize all our operations from cradle to grave" – with key elements being "transforming business models and activities, using digital technology and liberation of data flows."

We have the same flow of information and access to live data whether we are at home, at Framo or on the platform. We have control over all parameters", says Hans Christian Søråas, project engineer in Framo Services AS.

The project was run by a 2 man team, with one subject matter expert and one data scientist, to build models.

Cognite's software gathers and manages data from different systems, preparing it for further analysis. Framo receives the data clean, enriched and contextualized, about different aspects of its pumps. Since the data is available in the cloud, it can be accessed on PCs or mobile devices.

## Using the data

Framo uses the data to make sure equipment is being used the way it is supposed to, and perhaps warn the client about impending problems. They can spot trends, such as performance of a piece of equipment slowly declining. There can be automatic alerts sent to customers.

Framo probably has more expertise about how its pumps operate than its customers do. So the service is putting the data in front of the people best equipped to make decisions from it.

Data can also be used to find ways to improve product design. It shows equipment performance in real conditions, which are always different to the test conditions. It may identify areas to improve reliability, seeing where problems repeatedly occur over the fleet of equipment. Conversely, it may use the data to identify where equipment is over engineered. "This is super interesting for all equipment manufacturers to understand," says Kevin Gaze, director of product management, DataOps at Cognite.

They can use the data to build models,



Kevin Gaze, director of product management, DataOps at Cognite.

which may reveal a range of trends which often occur before part failures happen, so as to better predict failures in future.

## Business models

The standard business model for how a company like Framo works with customers is based around two components, sales of the product and the "aftermarket" – selling spare parts and services after it has been sold.

The weaknesses in this model are well understood – if the manufacturer does not care too much about the long term relationship, it has an incentive to focus on sales above all else (even if it sells a product which is not fit for purpose), and then try to force the customer to use the manufacturer as an exclusive channel for spare parts (even if the same parts are available cheaper somewhere else), and maximise the amount of maintenance done, even if it is not needed. You may recognize the same pattern from your car dealer.

But if a manufacturer can access data about its products in operations, the service delivery model can change. The manufacturer can have confidence engaging in different business models, such as where the customer pays part of the purchase cost based on uptime of the equipment in operation, or its total cost of ownership, rather than just the cost to purchase the equipment.

This model can be more efficient for all, because the company which knows most about the equipment (the supplier) is managing it,

and the oil company is only paying for what it is using, and the supplier carries the cost of poor equipment or poor installation – by having higher repair costs.

Suppliers have reasons to be wary of a full “cost of ownership” payment system too – because the operator will probably want to follow its own procedures and methods while doing maintenance, and make a final decision about what gets done. Also, while a supplier may have best knowledge of their equipment, they do not necessarily have expertise for keeping a large fleet of their equipment in reliable operation.

But there are intermediate steps between a contract based purely on product sales, and a contract based on paying for up-time. There can be an intermediate option, where the customer is paying for the products, and agrees to pay a bonus or receive a penalty payment according to the level of uptime achieved.

In this case, Framo and Aker BP staff have weekly meetings over Skype where they discuss data. They have signed a ‘smart’ contract for 6 years with an option for a fur-



Cognite staff Kevin Gaze, director of Product Management, DataOps; Petter Jacob Jacobsen, VP Business Development, Head of Oil & Gas; Pauline K. Øien, Director, executive sales

ther 6 years.

Aker BP is pushing many of its suppliers to move to these new ways of working. Al-

though not all suppliers want to change, Mr Gaze says. “Many suppliers are happy with the way they work today.”

## Contextualized data from Cognite operationalized with Low Code

Aarbakke AS, a high-tech machining company based in Stavanger, Norway, is using “low-code” software tools built with OutSystems, developed by PwC, running on data streamed from Cognite’s platform, to support its machining operators.

Aarbakke AS, a high-tech machining company based just outside Stavanger, Norway, is providing its machining staff with software tools created with the OutSystems low code platform, with data gathered and integrated by Cognite.

The system, covering 40 machines, could be built by just one developer (from consultancy PwC) in 4 weeks.

Aarbakke has about \$100m revenue, and around 300 employees, making advanced components for oil and gas activities.

The application provides useful insights to the operators of the machining equipment, so they can improve decision making. The data is presented as visualisations.

Data handled by the system includes sensor data (from the Computer Numerical Control machines) such as alarms, loads, pressures, and more. Also data about work orders from ERP systems, and some KPIs. The system also collects feedback from operators.

Data can also be displayed on mobile devices. There are admin tools which make it faster to integrate a new machine or device.

Because it is ‘low code’, the software is easy to change, for example if a machining operator would prefer a different data presentation.

“These operators are experts on their machines, many operating them for more than a decade. We wanted to enable operators to configure views they see on their own,” says Hunter Beck from Cognite. “They can dictate what they want to see in the dashboards. They know the machines and what they need to see better than anybody else.”

### Low code

The idea of “low code” is that code can be put together much faster, such as by dragging and dropping elements on a screen interface, rather than writing code by hand. The code itself is generated by software, based on what has been dragged and dropped.

Low code platforms enable a basic version of the software, or “prototype”, to be made “in a matter of days,” says Martin Gallardo, head of innovation and digital delivery at PwC Stavanger. “People are amazed by OutSystems when they see how quick you

can make user interfaces.”

The cost and time required to make reliable code is a big bottleneck in work to develop more useful, customised software applications. So if it can be made faster, that is a big benefit to digitalisation efforts in general.

People are starting to talk about “DataOps”, as the data version of “DevOps”, meaning to develop and improve data systems while people are using them, Mr Gallardo says.

Petteri Vainikka, VP Product Marketing at Cognite, says that the challenge is working out how data models can be deployed at scale – businesses in the oil and gas sector are not looking for a “minimum viable product”, more how fast they can get something rolled out to their entire operations. Systems like low code can help to do that.

It also means that people who actually use the software can provide input into how their software looks and works, known as “Citizen UI”, he said.

Many people are sceptical about low code, after experience in the past showing that if

they need just one uncommon feature, the whole system cannot be used and you have to do hand code instead.

Andy Pemberton, VP of OutSystems field engineering team, emphasises that low code systems are designed to be as broad in scope as possible. “The platform is very extensible, our goal is for you not to have to write complex code. We did a study once that showed 98 per cent of use cases get resolved without having to resolve to high code.”

But if you do need to write code to do something the platform cannot support by itself, you can write “high code” modules, such as in JavaScript, and run them within the platform.

The platform has tools to connect to databases, and connect to other software via APIs. “The differentiator for OutSystems is the ability to integrate,” Mr Pemberton says. “That’s why you see customers of OutSystems tend to implement much larger, enterprise use cases.”

Many of the tools were built out of a library of open source low code connectors and plugins which OutSystems makes available, in a service called “The Forge”. This can include elements of the user interface or data layers.

### Cognite’s role

Cognite’s role is to work out ways to make

data sit together beneath the user interface, so the right data gets ‘fed’ to the low code platform tools and on to the machining operators, a process it calls “contextualisation”. The Cognite data model makes it possible to easily expand from one machine, to all machines simultaneously.

“The goal was to take wealth of data at Aarbakke and make it available live to operators,” says Hunter Beck from Cognite. “We needed to make the data easy, intuitive, visual - to enable decision making.”

Cognite is continuously developing its “Cognite Data Fusion” platform to make it easier to integrate with OutSystems.

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## Cognite’s successful use cases

Cognite successfully built tools to help companies manage contaminated water, maintenance programs, turbine shutdowns, ship performance and risk factors

Cognite has reported a number of successful “use cases” - projects it developed for oil and gas and service companies, gathering, contextualising and visualising data to help its clients get real business results, in one case helping a client save \$6m a year.

Here are summaries from some published use cases. You can read the full reports, some with screenshots, on Cognite.com.

### Contaminated water

Cognite worked with Aker BP to build a system to quickly detect contaminated water in oil production systems, helping staff to draw conclusions about which wells were likely to “produce” contaminated water.

The project is estimated by Aker BP to save them \$6m a year, by helping the company spot problems and react to them more quickly.

Wells often produce water mixed together with oil. The water needs to be separated from oil before it can be disposed of. This can be done using separation systems on offshore platforms, but if the amount of oil in the water is high, it may be better to throttle the well which is producing the water, or find some other way to reduce the contamination level.

The model built by Cognite uses data from 200 physical sensors on production wells and equipment relevant to produced water.

It also calculates 100 “virtual sensors”, for example about fluid properties, which are inferred from pressure and temperature data, using thermodynamic calculations and information about the fluid composition.

The aim is to predict the oil in water concentration from each well, although it cannot be directly measured.

You can see near real time data on a dashboard, made using Grafana, an open source analytics and monitoring solution.

This dashboard can show engineers which part of their production facility might be the biggest drivers to their current oil-in-water concentration.

An Oslo data analytics consultancy called Expert Analytics was also involved in developing the data visualisation and advisory system.

### Gas turbine monitoring

Cognite worked with oil and gas operator Wintershall DEA to build a system to monitor if a gas turbine was shut down properly.

The gas turbine is on the Mittelplate oil-field, generating electricity for offshore operations.

Cognite built a visualisation system for engineers showing them the health of the system in different phases of the shutdown, such as “shutdown start”, “roll-out” and “end”. They can see if any sensor data indicates a divergence from what is normally seen.

The data outputs are viewed on a Microsoft Power BI dashboard.

Before this was built, engineers were relying on alarms to say that something had passed a certain threshold, but they did not have any way to get early warnings about failures.

Wintershall DEA estimated that the solution

saves them \$865,000 per incident, due to problems with the shutdown.

### Maintenance decision making

Cognite did a project for Wintershall DEA to gather a wide range of different maintenance data onto a dashboard.

It shows data about corrosion, component failure, and spending. Engineers can understand corrosion trends, see which components are least reliable, and see how well their predictive maintenance projects are working, compared to the costs of corrective maintenance.

It can cover the company’s oil and gas production across multiple installations, pipelines, vehicles and other assets.

### Monitoring pump health

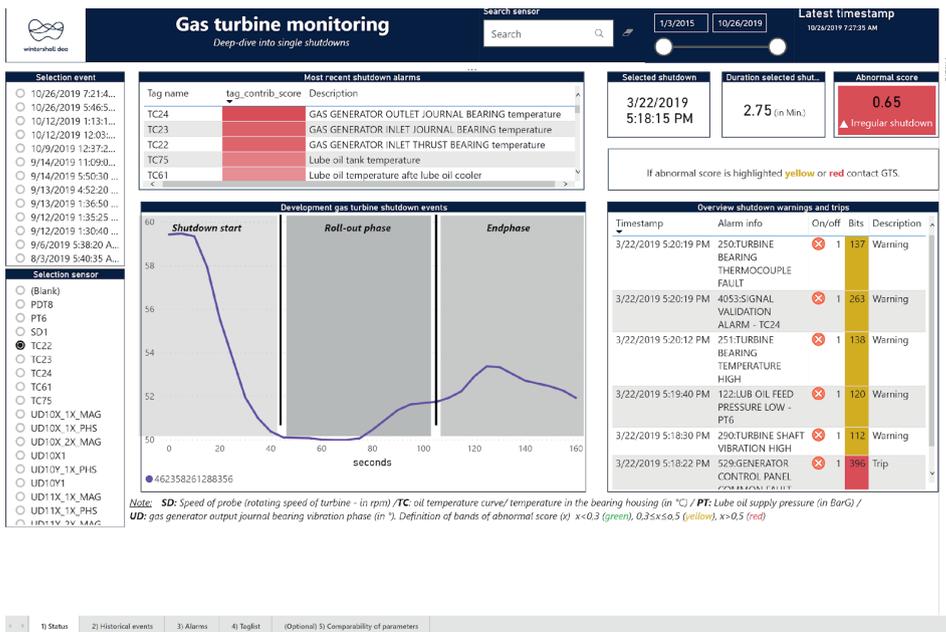
Cognite put together a data model for pump manufacturer Framo, to monitor the condition of its seawater lift pumps on Aker BP’s Ivar Aasen field.

As a result of the data model, Framo felt confident signing a contract with Aker BP where the compensation was linked to the uptime of the pumps, in a 6 year contract.

The pump monitoring data model is directly connected to systems for creating work orders for maintenance, and improving future product development.

Before the system was developed, Framo was not able to access much data about its equipment when it was in operation, unless there was a specific problem such as an equipment failure.

“With the release of these data flows, Framo



The spreadsheet was compiled before the company's weekly meeting to discuss priorities for maintenance of critical equipment. Now this is all done automatically.

## Cognite and PGS

In February 2020, Cognite announced a digitalisation project with seismic imaging company PGS, to help find ways to improve the vessel's shipping fleet performance, energy consumption and maintenance.

It will actively monitor and contextualise data to optimise fuel consumption and work out ways to reduce maintenance costs.

## Risk factors

Cognite developed a visualisation tool for risk data for Aker BP, combining data from multiple sources into one visualisation. It includes data on work permits, leaks, barrier impairments, well integrity status, noise levels and other temporary deviations.

The tool can be used to plan maintenance work, checking that there are no conflicts, such as high noise levels in areas work is planned to take place, or conflict between one planned task and another.

It is easy to add new information into the tool, such as a report about a strange noise.

It replaces a large amount of manual work which was done by Aker BP staff ahead of their daily work planning and risk assessment meeting compiling this data together.



Cognite's tool built for Wintershall DEA to help monitor if a gas turbine was shut down properly

has been able to predict the condition of equipment, foresee what will happen with the pumps in the future, and in turn plan effective maintenance," said Trond Petter Abrahamsen, managing director of Framo Services AS.

## Maintenance planning

Cognite built a system for Aker BP to be used for planning maintenance on critical equipment. It combines data from four different source systems onto a single dashboard, built using Microsoft Power BI.

The source data can include lube oil charts,

time series sensor data, and maintenance work orders.

It has colour-coded labelling to help the offshore and onshore maintenance organisation decide where to focus maintenance resources.

The dashboard allows for deep dives into individual work orders to find relevant information such as estimated time to completion.

Before the system was built, Aker BP staff were manually compiling data onto a spreadsheet, which takes 15 hours to make.

# Repsol – blockchain for supply chains

Repsol is exploring the use of blockchain to help participants in its downstream supply chains share data, working with Barcelona start-up Finboot

Oil and gas operator Repsol is exploring the use of blockchain to support sharing data between participants in its downstream supply chains.

It is working together with Barcelona start-up Finboot, which provides "middleware" to sit between buyers / sellers and various blockchain systems.

Repsol uses Finboot's supply chain module, called MARCO Track and Trace, to trace its midstream and downstream processes, from the refinery to final products, such as fuels, lubricants and chemical compounds. Repsol calls its system "BlockLabs".

A system has been developed which can register and record everything which happens to the physical product along the chain. "We focus on making sure that every step of the supply chain is covered," says Juan Miguel

Pérez, CEO & Co-Founder of Finboot.

There is a very complex supply chain, complex regulation, complex quality requirements, and "many different touch points".

"We're scaling the solution across many facilities in Spain - refineries, chemical complexes and facilities," he says. There are plans to try to expand it to the broader oil and gas and petroleum sectors, and to regulatory and financial supply chains, as well as physical ones.

Blockchain makes it easier for multiple parties involved in complex supply chains to collaborate, because they have a trusted reliable source of data, he says.

Many people associate blockchain with "huge adoption costs and high barriers to entry" – but by using Finboot, these can be much more

manageable, he says.

Finboot's core product, MARCO, is described as blockchain middleware, "a vehicle for the delivery of blockchain technology and applications to fulfil specific business requirements."

"MARCO creates an abstraction on top of the complexity of the technology, and configures that into your business processes, and makes something you can interact with," he says.

Mr Miguel Pérez advises that projects using blockchain should start small. "We need to make sure that the business case makes sense and we are generating a return for the customer before we scale the solutions," he says.

The system has been designed to be configurable, making it possible to add as much granularity as you want, and connect in other



Juan Miguel Perez, CEO, Finboot

industry sectors. For example, it might be extended one day to include supply chains of products made from petrochemicals, including packaging and clothing.

Jose Javier Salinero Rodriguez, Head of Innovation & Transformation at Repsol Tech-Lab, says that Finboot and Blocklabs is part of Repsol's "transformation program", testing new technologies and ways of working.

Here, "our goal to improve traceability and immutability of our information and processes," he says.

He has personally taken a role as "project lead" or "pusher / believer" promoting the technology within Repsol.

"For us, blockchain will be one of the most important disruptive technologies in the next 10 years," he says.



## Intelligent Plant – now connected to Power BI

You can now do Microsoft Power BI analytics on oil and gas equipment via Intelligent Plant's apps

Intelligent Plant, an Aberdeen company which makes a number of cloud based apps for handling sensor data, reports that its systems are now integrated with Microsoft's "Power BI" software.

It means that people using Microsoft Power BI can connect directly to the data historian on oil and gas equipment, if it feeds data into Intelligent Plant.

Many office analysts use Power BI and are comfortable with it.

Other common data visualisation tools are Spotfire and Tableau, which have a similar offering in this context, Bruce Nicolson, Senior Control Systems Engineer, Intelligent Plant.

Intelligent Plant comes up as an option in a choice of feed data within the Power BI software.

It helps that Intelligent Plant's apps already run on Microsoft Azure Cloud.

Intelligent Plant has built a number of "apps" to handle and manage data from specific equipment, and invites other companies to also build them, which it hosts on its "app store".

Until now, importing data into Power BI has been a complex challenge of extracting and uploading data from various databases, Mr Nicolson said. "With this you can connect directly to data historian."

Using this data conduit, you can bring data and its analytics into documents. You can do a range of statistical analysis into safety and system integrity.

### Alarm Analysis

Intelligent Plant also builds a number of analytics tools itself.

It builds an "alarm analysis" tool, extracting and analysing data from control system alarm systems.

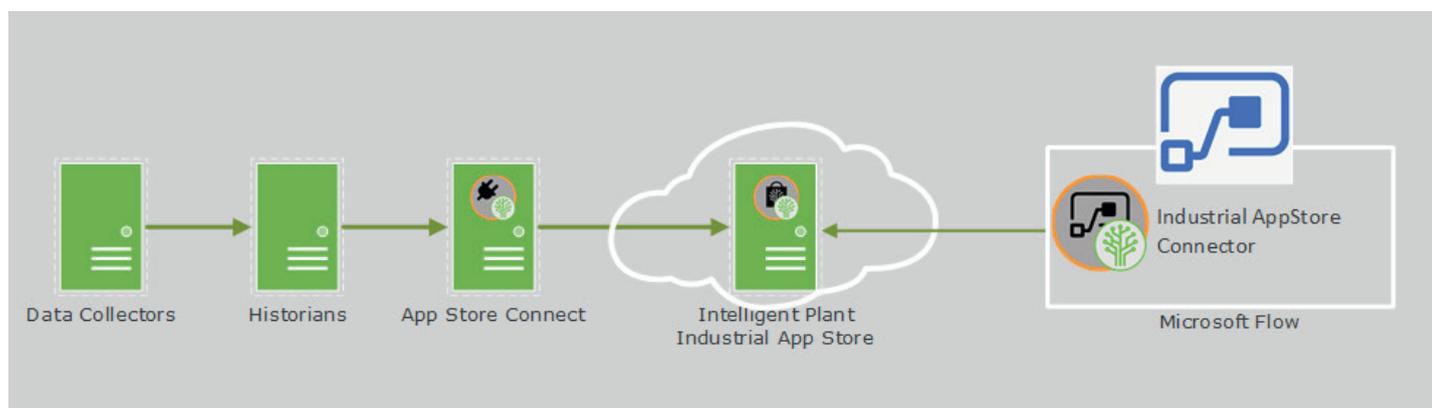
Many industrial operations have alarms badly configured, so that if something goes wrong, people get a flood of alarms and don't know which ones to turn to. Or they get one or two alarms which often sound when nothing is going wrong, Mr Nicolson says.

People get in the habit of switching them off without checking, which means that if there really is something going wrong, nobody knows about it.

The analytical data shows you the average number of alarms going off per 10 minutes. "This should not be more than one", Mr Nicolson says.

Ideally people should only have to deal with one alarm in any ten minute interval.

You can also analyse your "good" alarms and "bad" (false) alarms. The analytics may determine, for example, that one alarm is responsible for many of the bad alarms, and is worthy of attention.



The map of how data is collected and goes via historians, the Intelligent Plant App Store, into Microsoft software

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