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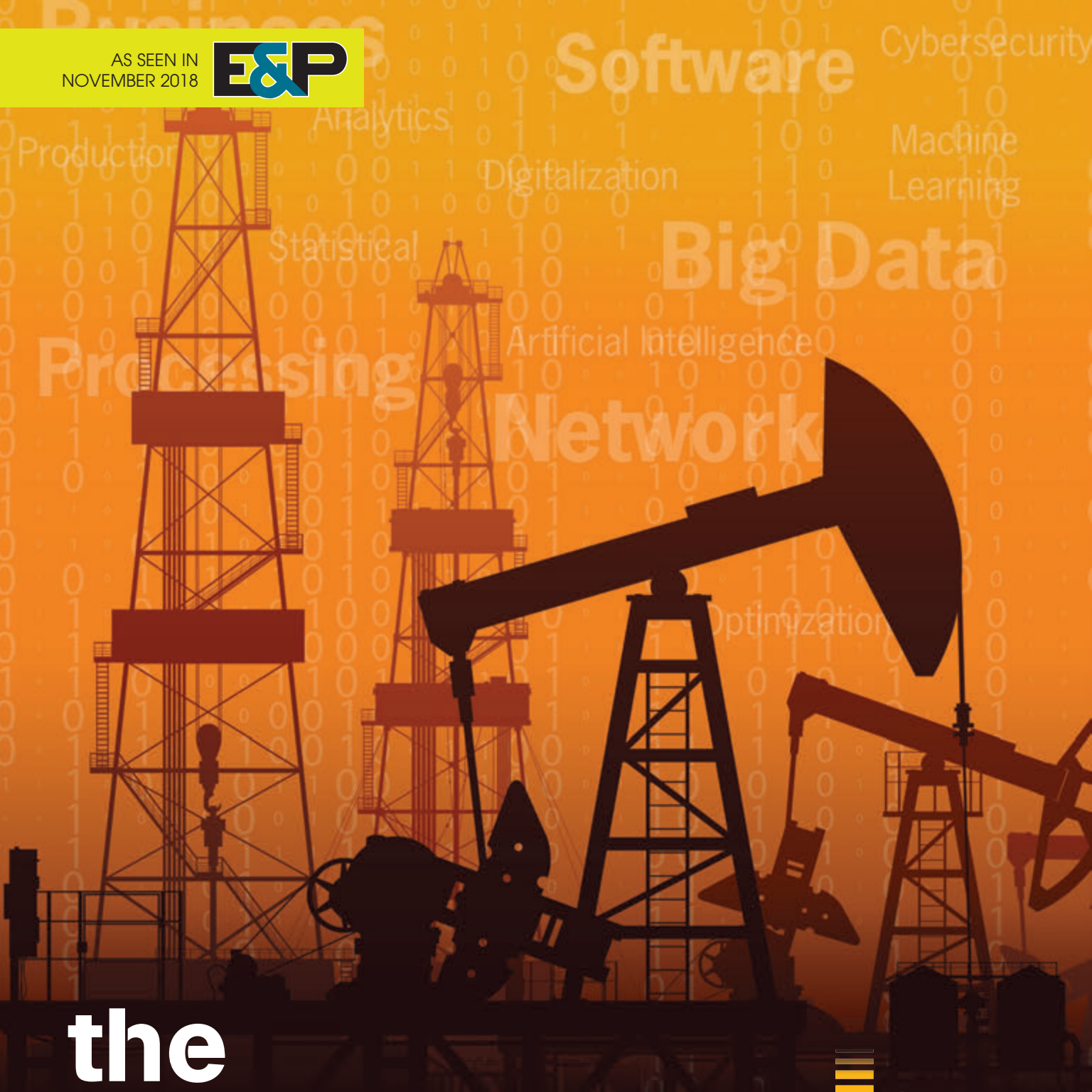

the NEW OIL

Refining Big Data for even greater value

With a number of successful projects under its collective belt, the oil and gas industry is proving Big Data is more than just a buzzword. (Source: Makhnach_S/*Shutterstock.com*; Design by Felicia Hammons)

Jennifer Presley, Executive Editor

Technology has long been a key driver in the success of the oil and gas industry. Digitalization—the use of digital technologies to change a business model and provide new revenue and value-producing opportunities—is driving the industry to a whole new level. In these post-downturn times, everybody is keeping a close eye on the bottom line and adopting solutions that help keep costs low without compromising workplace safety. The promise that data analytics, machine learning, artificial intelligence (AI) and more can provide these sought-after solutions is growing.

However, as is the case with most raw materials, value often increases with improvement. Raw data, like crude oil, also must be refined for its real value to shine brightly.

This data refinement process is one that the oil and gas industry has come to embrace in recent years. Aided by advances in high-performance computing, networking, storage, machine learning and more, operators and service companies alike are installing the infrastructure and writing the algorithms necessary to mine and refine the data into actionable steps.

Big Data is beginning to deliver big results, but is it doing so fast enough?

"The industry has seized the opportunity, but the pace at which it's been able to pull that opportunity forward and leverage it has not been at the right pace," said Darryl Willis, vice president of oil, gas and energy for Google Cloud, in an exclusive interview with *E&P*. "We have to pick up the pace of transformation and change. Everyone is using the right buzzwords—artificial intelligence, machine learning, digitalization—but truly leveraging it is taking too long."

By some estimates, just 5% of the data collected by the industry are used, but that percentage is set to increase significantly as oil and gas companies continue their digital transformation. Gartner reported in its "2018 CIO Agenda: Oil and Gas Industry Insights" that 54% of oil and gas companies are undergoing digitalization efforts. According to IDC Energy's study "IDC FutureScape: Worldwide Oil and Gas 2018 Predictions," 25% of major operators are invested in asset performance management while 75% of oil and gas companies have at least one digital transformation initiative in full operation.

"Data have always been the new oil, literally. Mining large seismic surveys and predicting new pay zones from historical well logs have always played a key role," said Ramoj Paruchuri, studio director of Accenture's Innovation Hub, in an exclusive interview with *E&P*. "What has transformed in recent times is the information that is getting collected from newer types of sensors and devices to assist operations from drilling and completions to production and in managing surface networks."

According to Paruchuri, oil and gas companies are accustomed to having a longer-term view on their investments, reflected in how digital projects are evaluated.

"Innovation applicability and digital business case studies cannot be assessed just using traditional metrics and should also include such tools as usage and satisfaction index and time-to-decision and outcome impact indicators," he said.

"It is understandable that commodity price swings significantly impact the margins, so having a measured cost take-out strategy is critical. We recommend [that] companies use digital and artificial intelligence beyond cost-cutting to improve in asset and worker productivity that impacts top line growth," Paruchuri added. "Successful oil and gas companies who have adopted this have continued to see an uptick in growth by 5% to 8% year over year."

As the industry continues to undergo a digital transformation, there have been challenges faced, partnerships formed and solutions found. In exclusive interviews with *E&P*, operators and digital transformation experts share details on projects that have made an impact. Additional articles in this month's cover feature examine the efforts underway on data collaboration and how Big Data—this century's oil—is impacting all facets of the industry.

Operating in the cloud

It is only in the last decade or so that the idea of cloud computing captured the public's attention, moving from concept to buzzword to broader acceptance, following a path similar to that of the internet. Moreover, like the internet's precursor, ARPANET, cloud computing has been around since the 1960s. Andrew McAfee, co-director of the MIT Initiative on the Digital Economy at MIT's Sloan School of Management, noted in a 2011 *Harvard Business Review* article that at that time the idea of shared storage space or processing complex algorithms using high-speed computers located on offsite premises garnered considerable skepticism among technology professionals attached to onsite computing systems. While all that is provided by a cloud network can be accomplished on premises, to do so would be "surprisingly difficult, expensive and time-consuming, especially if a company is trying to repurpose older legacy technology for the modern age," he wrote.

Seven years later, remnants of that skepticism are quickly disappearing as the benefits of cloud computing solidify.

"With the onset of cloud operations, we now fully see the ability of our industry to innovate, not in years or even decades, but in weeks," said Arno van den Haak, head of worldwide business development oil and gas at Amazon Web Services (AWS). "The beauty of the cloud is that it is a two-way door. It allows one not only to innovate fast, but to fail fast, to learn, to iterate and to drive to completion very quickly and with minimal expense."

An operator using this "innovate fast, fail fast" approach is, according to van den Haak, Australia's Woodside Energy. The company has fully embraced cloud computing capabilities in its daily operations.

Shaun Gregory, executive vice president and CTO for Woodside, recently shared details of its first Big Data prototype with attendees to Halliburton's Landmark

Woodside Energy's Pluto LNG facility has more than 200,000 sensors built into it, monitoring and measuring various attributes of plant operations 24/7. (Source: Woodside Energy)

Innovation Forum & Expo. "Woodside's innovation philosophy is structured around identifying the problem. The business needs to get value quickly, so the way to do that is to solve the problem," he said.

"Problem first, then think big. Don't try for an incremental change, get a prototype going on a small basis because that lets the engineers and scientists push the boundaries while striving for change. Then get it into the business quickly. If the technology is not scaled into the business, then you are not returning value to that investment. Think big, prototype small and scale fast."

For Woodside, the team chose to start with the problem of how to increase revenue at its Pluto LNG Park. The onshore facility processes gas from the offshore Pluto and Xena gas fields in Western Australia. Gas is piped through a 180-km (112-mile) trunk line to a single onshore LNG-processing train. The $10 billion facility came equipped with 200,000 sensors used to measure various attributes like temperatures and pressures.

"We had an incident occur at the plant called 'foaming.' Basically, overpour your beer, and it foams over. That's an issue in the plant because the 'beer glass' is four stories tall, and you can't see it," Gregory said. "On this particular column where we had the foaming issue that took the plant down, there were about 10,000 sensors on it."

Early detection and prevention of foaming in the acid gas removal unit—a critical part of the production process—became the company's first prototype using Big Data generated by those sensors.

"In the incident to report, an engineer pointed out that about 3 hours into what took about 8 hours for this incident to happen, a specific action was not taken," he said. "The incident cost Woodside $300 million in lost revenue that could have been prevented had an action occurred hours before to stop the foaming."

By connecting the sensors to the AWS cloud platform and using AWS' Big Data technologies along with IBM's Watson analytics platform, the company was able to crunch its more than 30 years of operational data along with the sensor data to develop an algorithm to identify the point in time to prevent foaming.

"Six weeks later, not only could we find it, we found it four days—not five hours—out," he said. "It scaled perfectly. AWS accepted all these new data and did not skip a beat."

Gregory said data streaming in from 10,000 sensors was not something that anyone could "digest in the past," adding that the cloud, Internet of Things (IoT) and data analytics enabled the company to tackle bigger problems than what it previously would have contemplated.

That operator gained significant insights into its operations through its willingness to think big, prototype small and scale fast, van den Haak noted.

"It is a great example of working on a real business problem, prototyping and seeing the business impact of it extremely fast. The new insights that they gained helped make it possible to scale locally and globally," he said. "Having those insights was transformational for Woodside."

Leveraging transformation

With an acreage position that spans an area the size of New England, Hess' Bakken operations are expansive. As North Dakota's second largest producer, keeping production flowing for the company is critical. The company leveraged digital technologies to drive reliability, productivity and efficiency safely. Through its use of exception-based surveillance (EBS), actual issues affecting well operations in the field are identified. The company has spent the last few years developing this type of system to identify its sick wells from the healthy ones.

"Traditional oil and gas production surveillance was service technicians driving around and checking wells that made squeaks and leaks and looking for wells where the pumps were not going up and down," said Mike Turner, senior vice president of production for Hess. "You're in a place with 1,600

Hess' use of EBS in its North Dakota Bakken operations is delivering significant returns for the company. (Source: Hess)

wells, 600 pads and facilities spread out over a space the size of New England with more wells being added. Driving around and checking is not a good kind of health care plan."

Starting in 2015 the company has been developing the necessary infrastructure to make EBS a viable option—Wi-Fi, fiber optics, sensors and more—and connected to remote operations centers to gather and store operational data.

"Our reliability operators receive signals from the wells indicating there is an issue and that attention is needed to resolve it. We have various steps along the way that ensure the signals are processed correctly. All of this work has been integrated with our Lean approach to manufacturing that we've been implementing," he said.

Currently, the company receives 10 production signals to monitor the health of the wells, including oil in water level, gearbox loading and number of pump cycles, among others.

"We're adding new signals all the time," Turner said. "It is just like the medical industry; we're adding more opportunities for EBS on our wells, our facilities, our treaters and all of our equipment throughout North Dakota. We use EBS offshore, too, but it makes a big impact in the onshore shale space."

For example, EBS is used to detect tubing leaks created as the result of rod wear. The company's MRI subsurface team identified triggers to detect these leaks. Previously, several manual steps performed at the well site were needed to identify the leak. Now, real-time data automatically flag the reliability operator to the potential leak in advance, Turner noted.

"For every signal, we catch in this process versus the traditional troubleshooting process, we reduce the troubleshooting time by three days and save up to 216 boe/d of deferred production just on tubing leaks alone," he added.

Turner went on to note that the implementation of EBS across the Bakken has helped restore production more quickly and economically with remediation now occurring 75% faster than three years ago—capturing millions of dollars each year in what would be otherwise potentially lost production.

These data, along with drilling and completion data, production info, rod pump parameters and more, are collected and analyzed to find common well clusters and build regression models to find problems versus waiting for the failure to occur proactively, he added. These signals also provide insights that are leading to the construction of better wells.

"One of the big areas we are working on right now is well tortuosity. You hear a lot about how low cost a well was to drill, but if it was drilled with an unacceptable angle, then

there is a well defect present," Turner said. "Our production signals have shown that the wells with the highest angles of tortuosity are the ones that have the most failures. It is still a work in progress as we're looking at not just the wells that failed but also those that have had long lives."

Through its use of EBS, the digital transformation has become embedded into the company's culture of operational excellence driven by its adoption of the Lean manufacturing philosophy. Ownership throughout the organization is key to its success.

"It is a cultural transformation in that it is not just engineers generating signals and sending personnel out into the field to execute. Ours is a culture of continuous improvement, built at every level of the organization," he said. "You need a combination of strong leaders and people that understand why it is being done a certain way and why it is important. These wells are going to be here for a long time. Half the cost of an unconventional well is in the operating; the other half is in the capital. Pay attention to the operational side, not just the drilling side."

Partnering for success

Schlumberger, like Hess, also has adopted the same spirit of creating and enabling a culture of continuous improvement through the use of digital technologies.

"Embracing new technologies generates a lot of excitement within Schlumberger. We have a natural bent in that direction, an almost genetic bias toward wanting to discover the next new technology," said Gavin Rennick, president of Software Integrated Solutions for Schlumberger.

"From a leadership standpoint, it is critical to see that this is supported from the top and enabled from the bottom. For us, the most personal way of doing that is through training our employees, giving every employee access to the tools and capabilities to create or participate in working groups."

For an industry built on data, sorting out good quality data from low-quality data has long been a difficult and time-consuming challenge, but Rennick believes the company has found a way to make that process far more efficient.

"It is important to understand that all data can be valuable and, when utilized, patterns within the data that do not seem intuitive can be realized," he said. "Having an ecosystem that supports all of the tools to handle the volume of data also is essential. Working with Google enables us to do both. Their technology stack is built to handle Big Data."

That partnership with Google Cloud was formally announced in 2017 with the release of Schlumberger's DELFI cognitive E&P environment.

"The amazing thing about the DELFI environment is that it allows our customers to combine their data and petrotechnical expertise with new digital technologies such as AI and analytics tools, and is customized to E&P based on our knowledge of the domain science," he said. "Our customers can automate and orchestrate processes in a customized and intelligent way, from a sophisticated interpretation of a piece of data down to the basics of evaluating its quality," he said. "Many of those elements are key services and technologies built into the data ecosystem that is provided within the DELFI environment, and as the environment is open, they are also able to create their own."

In the quest for lower cost and maximized efficiencies, operators are moving away from silos toward a systemwide approach to development. The digital transformation is facilitating this move, making innovation and technology development more of a collaboration rather than a solitary pursuit.

According to the company, the DELFI cognitive E&P environment enables a new way of working for asset teams by providing technology for seamless integration between geophysics, geology, reservoir engineering, drilling and production domains. The environment leverages data analytics, machine learning, high-performance computing and enables collaboration across E&P teams.

"We made the connection with Google early on, so we could work together to solve specific challenges the industry was facing," Rennick said.

The companies first partnered on overcoming specific challenges around seismic, and from there it "blossomed into a much broader business relationship where we are now bringing products to market together. That is possible when you have a level of technical respect and a tremendous level of trust with the company with whom you've partnered. Those sorts of relationships are what you need in order to be successful in the world at large and certainly in this industry going forward," he said.

DELFI enables users to take advantage of E&P domain science and knowledge using the latest digital technologies to unlock the value of data. (Source: Schlumberger)

Where will the industry be in five years?

Ramoj Paruchuri

"With a forecasted 31 billion connected devices just in the next few years, the global market for the Internet of Things and analytics is expected to disrupt every business process that we fully know today. Organizations will reinvent their production and supply chains to be intrinsically smart with self-learning analytics at the edge and in the cloud to maximize business value. As the industry becomes more connected, operating under persistent threats and sophisticated cyberattacks will be a new norm. Blockchain technology, which is a distributed and cryptographically protected ledger system, and security platforms based on blockchain will influence how oil and gas companies embrace cyber resiliency."

Mike Turner

"While many people do not think of our industry as a tech industry, we should never forget that advances in technology have unlocked vast new supplies of oil and natural gas from shale, transforming the global energy landscape in the blink of an eye. I expect that the pace and power of technology in our industry will continue to change exponentially, enabling economic progress and delivering incredible prosperity."

Darryl Willis

"I believe over the next five years that some of the medium and smaller companies will probably start to use a lot more of their data. I hope that some of the larger companies will be fast followers as well. We need to be pushing somewhere between 50% and 100% utilization of the data that we have at our disposal. I'm expecting to see exponential growth in the utilization of data. Moreover, I do believe that companies that, ultimately, use their data will be those that win, and companies that don't use their data will lose."

Gavin Rennick

"We will look back and be amazed at how far we've come. When you walk into an operations center or office of any company in the industry, you will take for granted access to a vast amount of information that's not just raw data—it's data that have been put in context, interpreted and delivered in meaningful ways to enable the business. The same could be said about machine learning. By then scientists and engineers will be used to having AI and analytics tools as part of their daily work, just like email and chat are available today. The rate of change and the absorption of digital technology in oil and gas across the next five years is going to be exponential, and that's great news."

Arno van den Haak

"We are at the start of our business, similar to where the car industry was in the 1900s when there were over 4,000 registered cars in the U.S. Last year that number was close to 270 million cars. I'm not predicting that it will take us another 118 years to reach the same amount of customers and penetration, as we've seen with the car, but I do believe it is an analogy that holds. A big trend we're seeing is the ongoing migration of entire data centers that are saving quite a bit of money. More companies are making the bold move to go all in because of the benefits and the transformation that they see underway in other industries."

The launch of the DELFI environment saw the deployment of an E&P data lake on the Google Cloud Platform that comprises more than 1,000 3-D seismic surveys, 5 million wells, 1 million well logs and 400 million production records from around the world, according to a Schlumberger press release.

"Our partnership with Schlumberger is a multiyear collaboration with several areas of focus. One is a focus on Big Data and the E&P data lake," Google Cloud's Willis said. "Another huge component is the focus on high-performance computing and also on artificial intelligence, particularly on accelerating seismic interpretation and in 3-D modeling."

The E&P data lake is based on Google's BigQuery, Cloud Spanner and Cloud Datastore platforms with more than 100 million data items comprising more than 30 terabytes of data. The Schlumberger Petrel E&P software platform and INTERSECT high-resolution reservoir simulator is running on a Google Cloud Platform integrated into the DELFI environment. E&P