COGNITIVE TIMES

PHILIPPE FLICHY
Strategic Business Dev. Dir.
Weatherford

FEREIDOUN ABBASSIAN
VP of Technology
BP

ALI RAZA
President
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by **Erin Russell**

UP, UP, AND AWAY WITH DOWNTIME

Going from preventative to predictive maintenance has Weatherford saving time and money—necessities in the oil & gas industry.

by **Erin Russell & John King**

PHASING IN THE COGNITIVE REVOLUTION

BP has always been at the forefront of the O&G industry. They've done the heavy lifting to lay the groundwork and are about to unleash a new era of productivity through the use of AI technologies.

by **John King**

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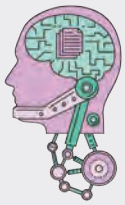

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Amir Husain
Editor in Chief

John King
Executive Editor
Production Director

Jon Coyle
Art Director & Designer

Victoria Salas
Managing Producer

Milton Lopez
Producer

Marla Rosner
Staff Writer

Contributing Writers
Erin Russell
Stuart Gillen
Kevin Gullikson
Keith Moore
Brant Swidler
Jeff Brown
Walter Rumpf

FROM THE EDITOR

by **Amir Husain**

In May, I had the opportunity to keynote at one of the world's largest oil and gas (O&G) gatherings, the Offshore Technology Conference (OTC) in Houston, TX. I have always been impressed with the vast array of equipment and software systems on display in the cavernous exhibition halls at OTC, but this year was even more exciting than usual. There was a tremendous focus and interest in the O&G community—drillers, rig operators, and large distribution companies—to utilize the massive volumes of data they have been collecting over the years. There is a sense the data is truly strategic and valuable. But how exactly will it be leveraged to drive value to the business?

For some time now, management consultants and others who push big data solutions have been using the phrase, "data is the new oil." Well, nowhere is this more true than in the O&G industry. And it's not merely about big data—it's really about artificial intelligence (AI) and the new possibilities sophisticated data exploitation techniques enable. AI is showing great promise in deriving real, meaningful insights from the masses of operational, maintenance, and performance data in O&G data centers worldwide.

The concepts of how to use data and AI-extracted insights to solve previously unsolvable problems, to drive greater efficiency, and to build the capacity to retain institutional knowledge in automated systems were top of mind for operators at OTC. It was tremendously exciting discussing how Automated Model Building, one of the techniques SparkCognition has pioneered and worked extensively to develop, can rapidly identify imminent drilling equipment failures ranging from stuck pipes to offshore rig failures; how Natural Language Processing can enable prescriptive maintenance, improve safety, and make training more effective; or how cognitive endpoint security technologies provide more complete protection against malware and attacks targeting the cyber-physical infrastructure of an O&G firm. Clearly, AI can and will be applied across a large number of use cases within the industry, and we are at the very early stages of exploring its potential.

This issue of *Cognitive Times* will continue the discussion that began at OTC, one we've been having with leading O&G ecosystem players such as Dover Energy Automation, Flowserve, Total, Weatherford, Schlumberger, and others. The pages that follow will present the complex problems that O&G companies must solve, and the value of AI in solving them. I hope you will enjoy the discussion as much as I have!

IS THE UTILITY INDUSTRY MAXIMIZING THE POTENTIAL OF MACHINE LEARNING AND IoT?

by **Stuart Gillen**

In 2007, Greensburg, Kansas was nearly destroyed by an F5 tornado, the highest class within the tornado rating system. The city's electricity and energy systems were left in ruins. Just ten years later, that same city has become one of the most energy efficient communities in the country. Greensburg is now largely powered by renewable energy that is efficient and economically beneficial.

This stunning transformation was made possible by the intelligence of the smart grid. These are networks that make use of digital communications and Internet of Things (IoT) devices to detect and react to fluctuations in power usage. With smart grid technology, it's now possible to make energy more efficient than ever before.

Smart grids resulted from the convergence of OT (Operations Technology) and IT (Information Technology). OT systems are used to monitor and control physical devices, and the processes happening within those devices, while IT systems are used to handle operations related to all forms of electronic data. In the past, OT systems were mostly isolated. Thanks to the advancements in IT, OT systems can now be decentralized. This enables companies to produce results more efficiently and effectively, all with lower costs. This convergence has fundamentally changed how organizations work, especially in distribution operations and system optimization.

MACHINE LEARNING AND IoT

The smart grid is undoubtedly the enabler for the future of utility, but where do IoT and machine learning come in? What is the best way for companies to understand and maximize the value of IoT and machine learning?

IoT refers to the rapidly growing network of physical objects that have internet connectivity. As a result, they have the ability to communicate with other objects, assets, and devices on the network. In essence, IoT is what allows smart grids to exist, since it's largely through IoT devices that utility companies can gather the exact, in-the-moment data on usage from all of their clients. This allows them to manage their energy supplies with more efficiency than was ever possible before.

This new flood of data from IoT devices, however, also creates an ideal environment for machine learning techniques. Machine learning, or technology that is capable of continuing to learn and grow past its initial coding, is the only way to properly leverage and make sense of the massive amounts of data that are produced by our complex electric power networks. If IoT is what provides the data, machine learning software is what can use that data to create models to analyze current usage in a scalable manner. It can even predict future usage patterns. Basically, machine learning is what allows companies to use the data they've collected and translate that data into predictive, prescriptive, and actionable insights.

It is machine learning and the IoT working in tandem that can create a truly intelligent smart grid.

It's not surprising, then, that a majority of modern smart grids already use IoT and/or machine learning. According to a SAS survey[1], more than 43% of utility companies are already using IoT and 20% are using machine learning.

Furthermore, over half of the companies that are using IoT and/or machine learning agree that these technologies are critical to their company's success.[1]

The same research also shows that even though many companies have a specific strategy for using machine learning and IoT, they still haven't fully harnessed their potential. There's a great deal of value that can come from using both of these powerful technologies in tandem. Some critical pain points IoT and machine learning can effectively solve for utility companies:

- Critical infrastructure protection
- Outage management
- Load forecasting
- Predictive maintenance of equipment
- Improved customer service

For example, energy outages or demand response events, where significant stress is placed on a grid, are extremely costly when they occur. Historically, utility companies have attempted to estimate the likelihood of such events using vague metrics and unreliable heuristics.

IoT and machine learning, however, can help avoid or ameliorate these situations. Those same machine learning models that allow companies to predict future patterns of usage can also predict demand response events and outages with speed, accuracy, and reliability. This enables teams to take timely preparatory action.

The cost of IoT components are declining, which will subsequently drive demand even higher.[2] Furthermore, regional governments are taking initiatives to roll out even more smart grids.[3] To keep up with this pace, utility companies will have to adapt by using the potential of IoT and machine learning to the fullest possible extent.

It is machine learning and the IoT working in tandem that can create a truly intelligent smart grid.

[1] http://www.mcrockcapital.com/uploads/1/0/9/6/10961847/autonomous-grid-machine-learning-iot-utilities-may_2016.pdf

[2] http://www.businesswire.com/news/home/20160222006470/en/Internet-IoT-Utility-Market---Global-Forecast

[3] http://www.marketsandmarkets.com/Market-Reports/iot-utility-market-116054824.html

ANALYTICS FIRMS EXPLORE OIL AND GAS MARKET

by **Trent Jacobs**, JPT Sr. Technology Writer

The oil and gas industry is facing an invasion of data analytics startups who saw a wide open gap in the market a few years ago, when talk of big data first began.

Many of these young companies vying for attention from producers are focused on alleviating the headaches associated with artificial lift systems. There are also a number of software products designed to handle difficult computations such as production forecasting and reserve estimation. Some are selling analytics as a way to combat the growing threat of cyberattacks. Other programs interpret human semantics to extract valuable information out of the entirety of a company's document library. Below is a closer look at what several of these analytics startups are offering to the industry—only there will be no deep dive into the layer cake of terminology that dominates this emerging software arena, e.g., artificial intelligence, machine learning, edge computing, etc.

Something needs to change. Network protection systems need to evolve. To understand how this needs to happen, it's important to look back in time at the history of security—starting long ago before cyber ever existed.

POWER OF INTEGRATION

A sign of the industry's accelerating uptake of analytics came in May when a number of the world's largest producers made a USD-26 million investment in an industrial-focused analytics startup from Silicon Valley called Maana. The list of financiers includes the venture arms of Saudi Aramco, Chevron, Shell, and GE. This may be a leading indicator of things to come because rather than focusing on any particular niche solution, Maana is a big-picture analytics platform. Able to reach between different silos within an organization, the program analyzes seemingly disparate sets of operational data and ties them all together.

Donald Thompson, Cofounder and President of Maana, said such data integration is able to generate "new knowledge" that oil and gas producers can leverage to drive performance in the field. "Most projects involve going and tackling a single isolated problem, but everything in a business tends to be highly interrelated," he explained. "So the failure of an individual pump is very interesting to understand, but its impact on production schedules is also interesting—if one pump fails, how should you adjust all the other pumps in order to still meet your production requirements?" Thompson, who pioneered knowledge and semantic-based search engine tools during his 15 years at Microsoft, gave another example of an oil and gas project involving malfunctioning field sensors. The sensors, managed by a remote monitoring team, were sending faulty telemetry alerts to the operator's support center. Unbeknownst to the latter group, the sensors had received a software update which was responsible for the glitch. By being in between the monitoring and support team, Maana connected the dots and determined the root cause.

"Individual analytics projects within each one of those groups," Thompson said, "would never have detected a correlation between the two groups and those are the type of things we're enabling now."

PUMPING UP THE DATA

One of the biggest targets for analytics vendors is artificial lift because rods, pumps, and motors are relatively easy for the latest generation of smart software to interpret and predict. Calgary-based Ambyint is one of those firms. The company feels it has an advantage over its peers because it is leveraging a decade of Canadian oilfield pump data gathered by its holding company and predecessor, PumpWell. Ambyint was formed to market an improved predictive maintenance program that analyzes the symptoms that precede a pump failure. Such programs alert producers to the precursors of a pump failure days before a total failure occurs. This allows field maintenance programs to be scheduled with precision and efficiency. The firm's software can also automate pumping operations based on production targets or to stretch out the mean time to failure. Though clearly logical, this pairing of analytics and automation is in its infancy. Nav Dhunay, President and Chief Executive Officer of Ambyint, said producers who buy into predictive analytics must first become confident of the core features before taking that next leap.

"This industry is a bit conservative when it comes to technology adoption, so the last thing somebody wants to do is trust that a computer can make a better decision than they can—even though if you look at the majority of accidents that happen worldwide, they happen because of the human element," he said. Ultimately, he added, software will win the day as it becomes better than humans at managing oil and gas wells running on pumps This transition will begin through a semi-automated system Ambyint calls a "recommendation engine," which requests that prescriptive actions be taken.

As production engineers accept more and more of those recommendations, "what we're going to do is turn this thing into an autopilot where it will start making decisions for you," Dhunay said.

READING BETWEEN THE LINES

Anyone with a smartphone has by now probably tried speaking to it to get directions, send a text, or run an internet search. Led by former oil and gas professionals who specialized in computer science, i2k Connect is trying to bring this natural language recognition technology to oil and gas companies.

But instead of spoken semantics, this company is teaching its software to understand written semantics. Moreover, it is trying to teach it oil and gas jargon using 15 different industry taxonomies.

"Companies run on data, and much of that data is in the text documents they create and store every day," said Reid Smith, one of i2k's founders. "Unfortunately, those documents are hard to find."

To solve the problem, this startup's intelligent software will pore over a company's unstructured text files and add structure by auto tagging each PDF file, email, slideshow, or Word document with a keyword. The end result is an internal search engine that mimics many of the features used by Google or Amazon.

The company is currently fine-tuning its language recognition platform in a partnership with the SPE, the gatekeeper to hundreds of thousands of technical papers that date back to the 1800s. Smith said: "It's the best available content that could be imagined to train our system."

The goal is to create an enhanced search capability across all SPE online content including the technical paper database, OnePetro. Content and papers will be categorized based on the i2k program's understanding of their true context as opposed to only relying on keywords. Smith described it as "enriching the documents with subject matter expertise."

That means, for example, technical papers from related topics will be tagged more accurately. A paper relating to production logging but that does not use that exact term within the document will still be tagged "production logging," making it more visible in OnePetro searches on this topic.

REAL-TIME PROCESSING

In August, real-time analytics firm SQLstream received a major endorsement of its platform when Amazon adopted it to become the engine behind a new web-based service for businesses. The San Francisco-based company is hoping to make a similar impression on oil and gas companies.

Named after the world's most common computer language, SQLstream says its platform is able to process more than a gigabyte of data per second with a delay of only 5 milliseconds.

Such processing capability is at the upper limit of what today's systems can handle and more than an hour faster than processing giant Hadoop, said Damian Black, the company's chief executive officer. He described the platform as a "universal mechanism for transforming any form of input, in any format, arriving at any time, into any output format."

This streaming data technology can be applied to just about anything using SCADA—supervisory control and data acquisition—systems. In modern oil fields it is hard to find anything not running on SCADA.

The SQLstream platform's flexibility includes a user-friendly interface that Black said requires no specialized training to master. Guided by the program's recommendations, users can build custom apps in minutes and establish rules that could be used to control automated field equipment.

Philippe Herve, Vice President of Solutions at SparkCognition, said the cyber security product can be used as a standalone service, or it can be married with the firm's predictive maintenance software to add an extra level of assurance.

With the back-end programming doing the heavy-lifting, users can change their minds and modify how data are analyzed or visualized on the fly. All modifications take effect immediately and without so much as a simple reboot. Black stressed that up until just a few years ago, such app development for real-time data was the domain of very expensive software consultants that needed weeks to deliver.

"I like to draw the analogy with spreadsheets," he said. "Spreadsheets changed the way that people analyzed data, utterly. They are so easy to use and you can do complex formulations and build financial models. We're doing the same thing now for big, fast data, except I think this is even easier to use than a spreadsheet."

DISRUPTIVE PRICING

Troy Ruths founded his namesake startup Ruths.ai in 2013 after earning his PhD in computational biology from Rice University in Houston. While working as a self-described "data monkey" for Chevron before graduating, he realized the potential of analytics to become a central component of the oil and gas business going forward.

But something was missing—a marketplace where producers could buy these applications without going through the cumbersome process of vendor selection.

So Ruths.ai created an exchange where it sells analytics apps it developed along with those created by other software developers. Today the exchange hosts more than 80 programs designed for geoscience, play-wide analysis, production operations, and other areas.

Many of these apps can be downloaded for a few hundred dollars and only a handful cost more than $1,000. Ruths said his intent is to disrupt the current pricing model for these products to make his exchange stand out amid an increasingly crowded field.

"These prices are an order of magnitude less than the competing counterparts out there, and what we are trying to do is lower the bar so more people can have access to these types of solutions," he explained.

One of the apps enables operators to quickly analyze workover candidates and generate economic models for each potential job. This is an example of a task that might take hours of research for a single engineer to complete for an entire field.

When using this program, as the cursor is dragged across a field map, the calculations are completed almost instantaneously. "You just give it the three pieces of data that it needs—workover history, production, and well location—and then it will go through and calculate the uplift factor-ratios for each job," Ruths said.

He added that tools like this also allow operators to find answers to important questions. Why are some wells doing worse than others? Is it a completion problem, or a problem with the reservoir? Are there any clear trends that show why one part of the field is producing better than another?

CYBER ANALYTICS

SparkCognition is another company specializing in predictive maintenance and has deployed its system with an airline manufacturer and the two largest operators of wind turbines in North America. It recently inked an agreement with Flowserve, the world's largest maker of oilfield valves, which is marketing the system as a way to avoid complete failures.

The Austin, Texas-based firm has also developed a cyber security analytics application that is being used by cyber anti-terrorism authorities and as a fraud detection system for banks. This may be an interesting area to watch since the oil and gas industry is one of the most frequent victims of cyber attacks and espionage.

Philippe Herve, Vice President of Solutions at SparkCognition, said the cyber security product can be used as a standalone service, or it can be married with the firm's predictive maintenance software to add an extra level of assurance.

"When an asset is starting to misbehave, is it because we have a failure on it or is it because someone has attacked it?" he asked. "If something goes wrong, you need to know why."

Herve added that unlike conventional antivirus software, which base their defenses around past attack methods, analytics-based security platforms actively monitor a company's networks for anomalies that may indicate when something or someone has invaded a secure system.

The SparkCognition software also runs constant internet queries to find new threats. When it discovers one, or detects an ongoing attack, the program automatically sends alerts and written reports to security experts to brief them on the situation.

Open Data Science 4:31PM
@odsc 23 Apr 2017

#United Airlines & Data Technologies to avoid "Turbulence" - it wasn't an overbooking problem, but a data problem! http://hubs.ly/H078RXc0

Open Data Science 7:55 AM
@odsc 30 Mar 2017

Recommending music on Spotify with deep learning http://ow.ly/opUW309uBTv #ODSC #DataScience

Dr Fakhar Khalid 12:13 PM
@FakharKhalid 25 Apr 2017

A great launch of a great report by @royalsociety. Onwards and upwards with the infinite possibilities of #ML in UK. #rsmachinelearning

Inc. 11:31 AM
@Inc 23 Mar 2017

The Internet of Things is changing everything. What will a connected world mean for you? @ChelseaMcC

ICIT Institute for Critical Infrastructure Technology
The Cybersecurity Think Tank
Signature Based Malware Detection is Dead

Michael 12:23 AM - 19 Mar 2017
@_cypherpunks_

ICIT Analysis: Signature Based Malware Detection is Dead http://icitech.org/icit-analysis-signature-based-malware-detection-is-dead/ …

The IoT Report 9:22 AM - 22 Apr 2017
@TheIoTReport

Are we going from "Artificial Intelligence" to "Augmented Intelligence?" http://ln.is/2cflv #IoT... by #SmartUrbanite via @c0nvey

Yusuf SHAIKH 1:38 PM - 29 Mar 2017
@YusufShaikh

@amirhusain_tx Best of Enterprise IoT Summit 2017. Amazing concept #AI and great achievements. Wish you many more.

Hi-TechDays 7:42 PM - 24 Mar 2017
@hitechdayscom

Elon Musk Wants To Link Human #Brains To AI With Neuralink To #Help With #Brain Injuries And Improve Comm #news #rt

Cognitive Builder 5:51 PM
@BuildwithWatson 20 Apr 2017

Surrounded front and back by #cognitivebuilder learners, hearing from @sparkcognition. Great night of technical discussion!

J.B. Bird 8:07 AM - 30 Mar 2017
@austinjbbird

The student hires the teacher: @UTCompSci's Bruce Porter does double-duty as CSO of @SparkCognition. @TexasScience bizjournals.com/austin/news/20

A.I. IN SOCIAL MEDIA

ALL ABOUT THE CUSTOMER

DOVER IS DEPLOYING A.I. TECHNOLOGIES FOR REVOLUTIONARY INSIGHTS

by **Erin Russell**

There are companies which you come in contact with throughout your day without even realizing it. From the moment you leave your house in the morning, their products exist in the background of your life, quietly impacting and influencing your daily routine. Dover is one of these companies.

When you stop at the gas station to fill up your tank, the dispenser you're handling is likely a Dover product, the OPW. Step inside for a bottle of water, and you may be reaching into a Dover refrigeration unit. Even the garbage truck emptying the station's dumpster could be could be manufactured by Dover. With four major segments under the Dover umbrella, the company's reach goes deeper than the pump at the gas station. One of the company's divisions, Dover Energy, contains Dover Energy Automation (DEA), focused on serving upstream and midstream oil and gas (O&G) customers with automation, optimization, and other value-added services.

Dover is a $7.5 billion company. There are multiple sectors within DEA, but the primary focus lies in onshore upstream and midstream O&G, while also providing offshore solutions. The work starts at the well site with multiple components operating at any given time: rod pumps that pump the oil in and out of the well, chemical injection systems, batteries of tanks that collect the production, and separators that may need pressure relief valves. With all of these assets, it's vital to ensure the facility and operations are secured and everything runs safely. DEA provides a solution that handles all of these aspects—from vibration monitoring to predictive analysis for determining when parts will fail.

Ali Raza, President of DEA, elaborates: "If somebody asks me exactly what Dover Energy Automation provides customers, it's (1) our domain expertise which gets translated either into an embedded software or in the services that we provide to the customers; and (2) we are the data collectors from the very root of the process, and use that data to optimize and add to our knowledge in order to ensure we deliver higher value to our customers."

"It's basically all connected to the equipment reliability that customers look for so they can operate their assets. We provide a solution with visibility across not only one particular compressor, for example, but every compressor across their ecosystem to see how they're actually impacting the overall company profit and loss, their reliability, and the equipment effectiveness."

There's a lot of expertise in the background of systems monitoring. Dover algorithms can show when maintenance is needed, and Dover uses SparkCognition as a machine learning engine to integrate into the intelligence platform of its hardware. With SparkCognition's technology, Raza hopes to achieve more proactive failure models, making the repair process seamless for the customer.

Maintenance for upstream providers used to be extreme. When engineers had to physically plug into machines, they would sometimes drive 200 miles a day in desert temperatures of 120˚F. Without predictive capacities, machines would simply run to failure. Now, the equipment is outfitted with sensors that provide data to computers capable of heavy lifting, and communication on a network keeps dangerous desert treks to a minimum.

The future of the oil well site, as Raza sees it, is an anticipatory model. A company has visibility of their thousands of wells, with models comparing performance to what is expected. If there's a degradation in the lifting process, the technology can identify the changed parameter and trigger a supply chain around the well site to order needed parts in advance. Hence, the well site has gained not only the ability to monitor and self-diagnose but also to aid the repair process. The vision is that oil wells will essentially run on autopilot after deployment.

"We provide a solution with visibility across not only one particular compressor, for example, but every compressor across their ecosystem to see how they're actually impacting the overall company profit and loss, their reliability, and the equipment effectiveness.

ALI RAZA
President, Dover Energy Automation

The onus is on DEA to provide analytics beyond what a client could produce in-house. DEA is connected to the end equipment, and therefore is the first recipient of data, and customers are beginning to expect a higher level of analysis across the enterprise. The services Dover provides now include collecting and contextualizing data, converting it into information for end users, and providing analytical models—with the help of cognitive technologies—that show added value to customers. Raza touts, "Dover has been very active in partnering with technology providers like SparkCognition in order to make sure we expand the value we provide to the customer and back to the industry. So far, it has been pretty awesome."

Dover chose to work with SparkCognition because of its competitive edge in creating self-learning models. For an example of how this partnership works, consider compressor monitoring. Dover (or the customer) monitors the compressor for malfunctions using data collected and algorithms built from Dover's expertise. SparkCognition's algorithms are then used to go beyond current models and process data from the entire enterprise, providing a different view of how the compressor is moving toward a problem state. Having the ability to analyze real-world scenarios creates a rapid feedback loop that aids the development process, giving DEA's customers remote visibility to their equipment in real time and directly improving safety and efficiency for the site. "It is extremely exciting to see the kind of feedback that we have been getting," says Raza. "There are some 'Aha!' moments for our own subject matter experts in there, and I think there will be many more."

As President of DEA, Raza is the innovator at the helm as Dover continues to adapt the Industrial Internet of Things (IIoT) to serve their automation needs. Raza has a notable background in process optimization, with a 10-year tenure at Honeywell Process Solutions, where he was vice president of the Advanced Solutions division before joining DEA. It was here that he realized the potential of the IIoT, especially after seeing the collaboration of SparkCognition and Honeywell Aerospace. Upon moving to Dover, he created an IIoT advisory board to fully realize its potential.

Going forward, Raza hopes DEA can facilitate anonymous information sharing to provide a greater dataset. "The IoT or IIoT is actually going to provide the ecosystem that people have been talking about," he asserts. Competitors sharing lessons learned and best practices to benefit the entire industry may seem optimistic, but those contributing knowledge should be able to provide maximum benefit for customers.

Another important aspect of DEA's operations is cybersecurity. In analog times, it was common to see physical protection for equipment, such as armed guards and barbed wire. The digital environment is now being provided similar protections. Though DEA mostly works with other partners for their cybersecurity, Raza notes there is convergence of the technology. "I think SparkCognition's analytics are going to be the key as well: finding anomalies in the data and data streams, and making sure that we identify [potential threats] way before, rather than after."

That's not to say the new technology comes without resistance. Given the rapid changes in the way of doing business for O&G, company owners can be hesitant to jump into something they don't fully understand. Raza has found that focusing on the tangible benefits—numbers regarding market position, injury reductions, and efficiencies—helps reluctant adopters realize the potential of AI technologies. Dover's prevalence in everyday life also becomes an advantage here, since the variety of businesses can help them show adjacent examples of success to specific industries.

For Raza, it all comes back to returns: "When I look at how we are working with cognitive technologies, the important consideration is how this is going to help our customers, rather than just becoming another cool technology in our portfolio."

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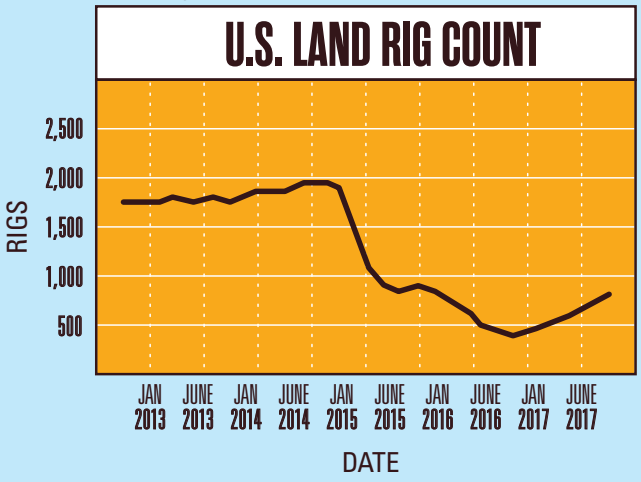
THE RICHEST RESERVOIR FOR OIL & GAS

by **Brant Swidler** and **Jeff Brown**

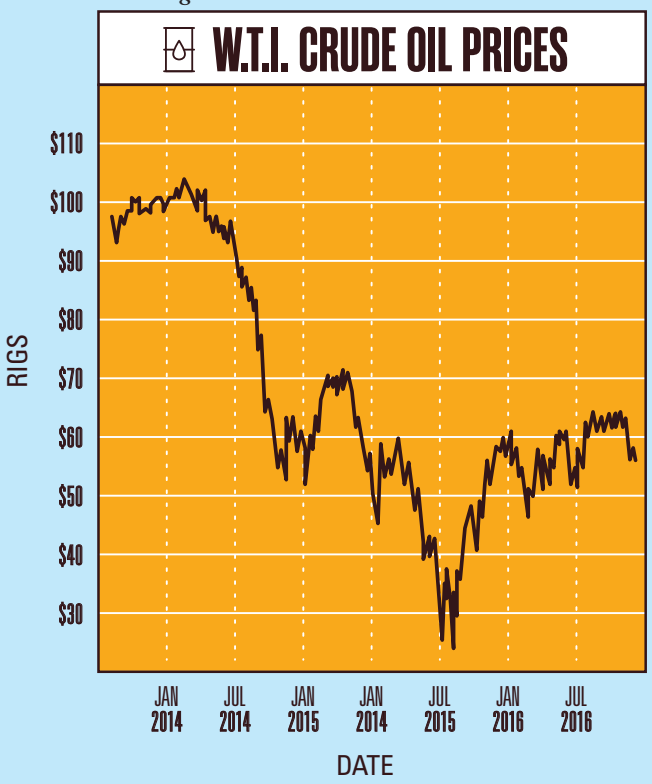
The state of the oil & gas (O&G) industry is stabilizing, as the US rig count is steadily increasing from its lows and the West Texas Intermediate (WTI) crude oil price has hovered around $50/bbl since its bottom in early 2016. Still, the industry has not rebounded to the peaks it saw in 2014. While many from the consumer side are happier to see the price of oil staying in the $50/bbl range, the upstream exploration and production (E&P) sector will need to adjust to these consistently lower prices. *(See Figure 1)*

The new normal of prices staying lower for longer is having a ripple effect throughout the industry. The difficult pricing conditions for operators will put downward pricing pressure on service providers who are often at the end of the pricing bullwhip effect. Offshore operations will continue to operate on the margin of viability and will have a much slower recovery. Unconventionals will continue to play a pivotal role as the swing producer (a producer that can increase or decrease commodity supply at minimal additional internal cost, thus influencing prices and balancing the markets). In general, now that the pricing shock from 2014 to 2016—where the price of WTI declined from $100/bbl to $25/bbl—is over and the industry can see some stability, oil and gas providers can now focus on strategies around the long-term macro challenges they face. *(See Figure 2)*

-Figure 1-



-Figure 2-



THE CHALLENGES

The companies that have made it through this most recent downturn and slow recovery still face many issues.

- ***A Changing Workforce***
  Many experienced workers have already left the industry, and those who remain are close to retirement. Although younger workers bring new skills and energy, they lack the experience and knowledge of those they are replacing.
- ***Lower Oil Prices***
  Unconventionals have become the marginal producer. Barring geopolitical issues, the rise of US shale producers has increased supply and thus created a price ceiling.
- ***The continued emphasis on health, safety, and environment (HSE)***

These challenges compel O&G companies to find new ways to enhance the capabilities of their changing workforce, build more efficient operations, and minimize their impact on the environment, all while continually improving health and safety practices.

While there are disparate technologies that address each individual challenge, is there a technological solution that can handle them all?

THE SOLUTION

Artificial intelligence (AI) and its most promising subfield, machine learning, have been around for decades, making promises that, quite frankly, have never been delivered. So, what's different now, and why should O&G take notice of what AI claims to offer?

A SEA OF DATA

Rapid drops in sensor and data storage costs over the past decade have resulted in a dramatic increase in sensor data measured and stored for industrial equipment. This vast data can provide tremendous insight—if you can make sense of it. In addition, affordable, high-speed connectivity to remote locations where drilling activities typically take place is becoming more commonplace.

TECHNICAL ADVANCEMENTS

Significant increases in computer processing speeds, coupled with new platforms for handling large amounts of data and improvements in algorithmic techniques, allow AI to start solving real world problems ***(See Figure 3)***. Evidence of this is all around us in the consumer markets: Google's autonomous Waymo vehicle, Netflix's recommendation engine, Facebook's facial recognition, and many more.

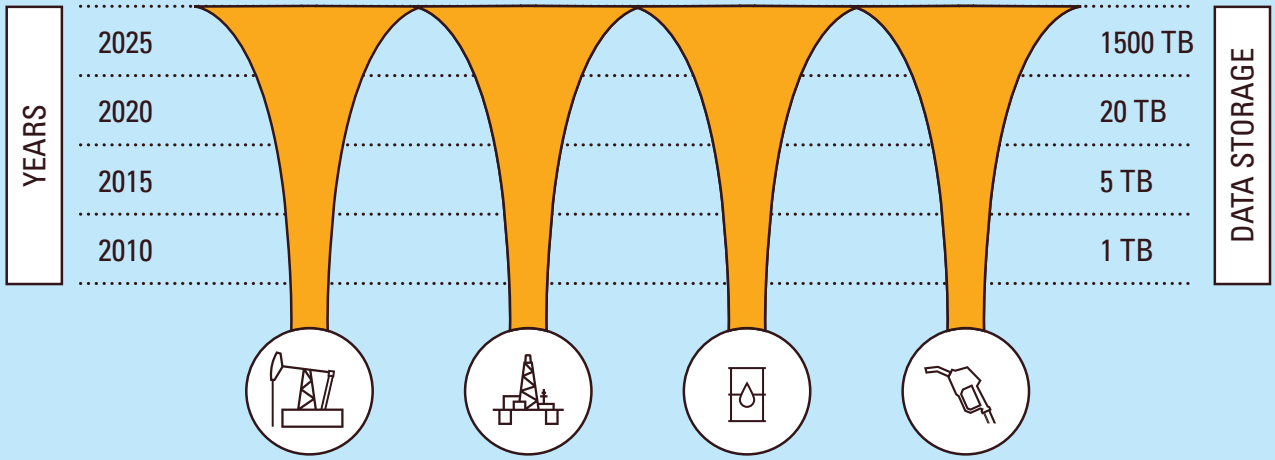
DATA-FRIENDLY WORKFORCE

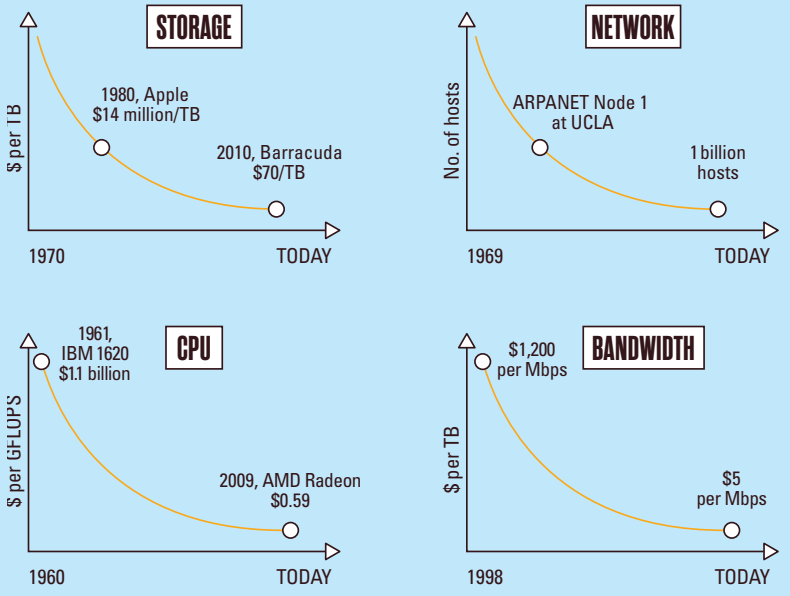
While the younger generation coming into O&G doesn't bring much industry experience, they do bring a comfortability with data and connected devices, as well as an expectation of their presence. Rather than feeling threatened by a computer or software program which could potentially take their job, they have no qualms working side by side with hardware and software that will help them do their job better.

These three conditions combine to create an ideal environment for AI. The sea of data has grown beyond human capabilities to process. Rather than using pre-written rules or physics-based programs to tell the computer what to do, machine learning thrives on large data sets by building models based on observed data.

> *Rapid drops in sensor and data storage costs over the past decade have resulted in a dramatic increase in sensor data measured and stored for industrial equipment.*

-Figure 3-





Significant increases in computer processing speeds, coupled with new platforms for handling large amounts of data and improvements in algorithmic techniques, allow AI to start solving real world problems.

THE IMPACT

With the advancements in AI and the macro trends leading toward the need for machine learning, the O&G industry is poised to use this technology to solve its most pressing problems.

A CHANGING WORKFORCE

AI systems can capture the knowledge and decisions of experienced workers and institutionalize it for less experienced and future workers. For example, if a production engineer is monitoring a well, the previous approach would have been to spend hours looking at each well's characteristics to determine if it requires maintenance. A machine learning model can look at all the wells that previously needed maintenance and identify a more advanced pattern of data that led a production engineer to make a certain maintenance decision. Then that model can be applied across thousands of wells in a field, flagging the wells that are at higher risk of needing maintenance. Here, the AI model has learned from the experienced production engineer and extended that learning to less experienced employees. Additionally, it allows the less experienced engineers to quickly evaluate a larger number of wells and focus only on the wells that need the most attention.

COST REDUCTION

The need to eliminate non-productive time (NPT) is an important objective of many operators. The main cause of NPT is unplanned equipment downtime, which can be addressed by the advanced predictive analytics capabilities of AI. These capabilities can provide days to weeks of failure forewarning for critical assets such as artificial lift systems, top drives, draw works, frac pumps, compressors, and more. Having this amount of advanced warning allows operators and service companies to get the right personnel and equipment on site to fix a problem before it occurs, or to plan maintenance ahead of time and amortize the cost of that maintenance over many assets.

HEALTH, SAFETY, AND ENVIRONMENT

The desire to protect people and the environment is a top priority for all E&P operators. AI can monitor assets to ensure safe operations. Critical equipment (such as blowout preventers and pipelines) and the structural integrity of offshore platforms can all be monitored to identify data patterns that alert of impending safety issues. Furthermore, AI can monitor drilling conditions to detect issues such as well kicks.

THE FUTURE

The oil industry is now stabilizing from one of the most severe downturns it has ever seen. Although focused on long-term sustainable growth, the industry faces major challenges—a changing workforce, lower margins, and HSE concerns—all of which must be addressed with technology. The simultaneous rise in big data, computing power, and a data-friendly workforce has enabled AI to take the role of the all-encompassing technological solution the industry needs.

SC COMICS

THE COGNITEAM

UP, UP, AND AWAY WITH DOWNTIME

HOW A.I. IS MAKING NONPRODUCTIVE TIME IN O&G A THING OF THE PAST

by **Erin Russell & John King**

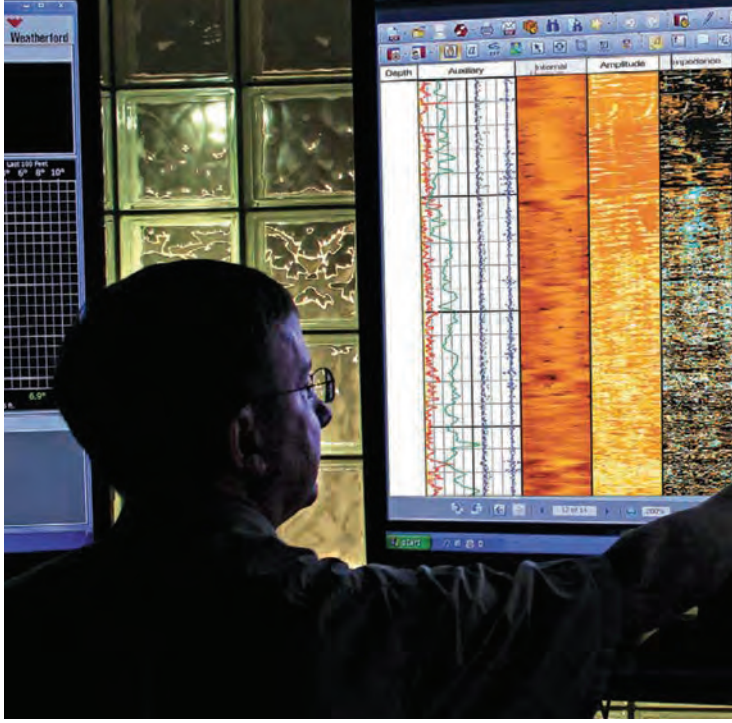
Weatherford International has come a long way since its founding in Weatherford, Texas in 1941. Now employing some 30,000 people in over 90 countries, the company has become one of the largest multinational oilfield service companies delivering innovative technologies and services to meet the world's current and future energy needs. The oil industry likely brings to mind old images of grimy rigs and manual labor. These days, the field requires sophisticated analytics tools far beyond a clipboard or field laptop. Weatherford provides its customers in the O&G industry with services to maximize safety and efficiency at every step of the well lifecycle—from construction to drilling to production. This can involve all types of hardware, a software platform for well monitoring and performance evaluation, or building digital models of drill sites.

One of Weatherford's leaders in charge of deciding where to go next, for both digital enterprise and market, is Philippe Flichy, Weatherford's Strategic Business Development Director. Flichy presently develops Weatherford Digital Enterprise offerings, mixing IIoT (Industrial Internet of Things), analytics, big data, physical simulation modeling software, process workflows, and services and hardware to better support Weatherford's customers.

Flichy immigrated to the U.S. after his family was targeted by communists in his native France (for this reason, he notes how the American flag holds special meaning to him). Prior to Weatherford, he managed the internet feed and intranet systems for the 2002 Winter Olympic Games, which, given the security concerns at the time, meant working with dozens of FBI agents to monitor for cyber attacks.

This experience, combined with his decades of executive leadership in bringing modern technologies to remote oil fields, shaped his perspective on cybersecurity, and the application of advanced technology to solve the O&G industry's biggest challenges. Flichy made a name for himself in the O&G industry by authoring papers showing how isolation was causing the oil field to lag behind on incorporating modern technology, and documenting how a holistic view of the enterprise could yield powerful results. His findings are supported by credible sources: a 2016 study from MIT Sloan Management Review and Deloitte ranked the O&G industry's digital maturity among the lowest, behind even agriculture and construction.

Operations in O&G are rough. Though oil will flow freely from a well at first, it soon needs more coaxing to come to the surface, which requires both hardware, software, and complex physical models to understand and optimize the extraction. "I'm not going to go into Petroleum 101," Flichy says, "but typically what comes out of those holes we're drilling is pretty nasty. All the equipment is subject to harsh treatments that are way beyond what the worst driver would do to a car." Hardware failures are a big, expensive mess (a single pump failure can cost $100,000–$300,000 per day in lost production), and can have severe environmental consequences.



To safeguard against nonproductive time, or downtime, much of the O&G industry employs preventative maintenance, a regularly scheduled program which makes it easier for maintenance managers to improve uptime and save money on expensive equipment repairs. These preventative measures ensure machinery stays in working order, a necessity in the O&G industry.

The traditional preventative maintenance approach in the O&G industry has forced maintenance managers to spend most of their time running from one crisis to the next. A regularly scheduled maintenance strategy is often an inefficient maintenance technique. Industry experts claim preventative maintenance programs cost more than a strategy in which machines run to failure. In fact, researchers at The Electric Power Research Institute (EPRI) have calculated maintenance costs on a 1,500-horsepower motor (e.g., in an oilfield pump): a traditional scheduled maintenance strategy costs approximately $36,000 per year, while a reactive maintenance strategy costs $25,500 per year.

The maintenance cost of the individual asset, or the difference between strategies, may seem minimal. However, when multiplied by the number of assets across an entire fleet, the cost skyrockets. For a fleet of 1,500 assets, the expense balloons to $54M per year for a scheduled maintenance plan and $38M for a reactive one. And these costs only account for maintenance—they don't include the true loss of a machine failure, which is in lost production. For O&G, equipment uptime is directly correlated to the company's bottom line. When drilling stops at a well site, cash flow associated with the well stops. Therefore, reliability is critical.

Fortunately, predictive maintenance, powered by artificial intelligence (AI), holds the key to better detecting equipment failures long before they become costly catastrophes. Those same EPRI researchers also concluded that a predictive maintenance strategy is the most cost-effective to eliminate the risks of secondary damage from catastrophic failures.

Weatherford is aware of this reality. Given the difficulty of accessing and repairing equipment (most oil rigs are in remote areas), a major area of differentiation for the company is their ability to use a predictive maintenance strategy to determine when their machines will fail. This approach provides Weatherford enough advanced notice to make the necessary preparations to fix impending problems with as little downtime as possible.

One of Weatherford's many solutions, a software platform, includes an element which relies on data from the edge (at the source of the data, i.e., the sensor). This platform paints a complete picture for operators by using data from daily production, mechanical sensor recordings, and static well properties to determine if maintenance is necessary or if operating conditions can be adjusted to alleviate the problem.

Flichy notes how, in addition to analyzing the data, Weatherford can act as a consultative ally to their customers: "Some companies have the time to do all that. Some don't. And that's when they can press the button in our software saying, 'Weatherford, help! There's a problem here. I don't have time. Please look at it.'"

If I start understanding where things are going to fail, I can be more organized. I can say, 'maybe it hasn't failed yet, but since I have a rig very close by and I have the crew and everything, go ahead and service that one now.' It allows us to be nimbler and start really planning things.

PHILIPPE FLICHY
Strategic Business Dev. Director, Weatherford

Thanks to these edge analytics (i.e., data collection and analysis at the sensor as opposed to a centralized data storage), Weatherford is rolling out a software platform to check the well from conception to the end of its production. The ability to fully understand your equipment—to have access to data analytics which guarantee asset life expectancy and control maintenance needs—is a huge advantage when repairs require crew to travel long distances and work in dangerous conditions.

Given the volatility of the O&G industry in recent years, compounded by an aging workforce (as many as 60% of current field experts are expected to retire over the next six years), efficiencies to make full use of employees' time are vital. Flichy sees this as an opportunity to move from predictive to prescriptive maintenance: "If I start understanding where things are going to fail, I can be more organized," he explains. "I can say, 'maybe it hasn't failed yet, but since I have a rig very close by and I have the crew and everything, go ahead and service that one now.' It allows us to be nimbler and start really planning things."

Reducing maintenance workovers has decreased nonproductive days by as much as 50% (as estimated by Flichy and the Houston Chronicle) which has a direct correlation to ROI. "We are a service company," Flichy points out, "and the ROI we are looking for is what we can help our clients to achieve."

So how can Weatherford engineers analyze data to make a decision on maintenance needs? Flichy offers, "Good ol' Excel," quickly adding, "The thing that you have to understand is when you reach a certain level with the petroleum engineers, it becomes a mix of high-level science and art. But analytics is not alone: it's analytics, it's big data, it's IoT. That's the digital enterprise." Flichy believes the new industry tools are changing the way the industry works, moving from reliance on spreadsheets to decision making based on centralized big data to increase accessibility and trust of the data.

This is also an area where AI can come into play—augmenting the knowledge of a production engineer. Previously, technology took the legacy approach to calculate mean time between failures. More sophisticated AI systems, like SparkCognition's SparkPredict, can collect the data from the well, monitor daily production and sensor recordings, and apply supervised learning techniques to pinpoint and predict when a site will need maintenance as well as its production output post-workover, making it easy to demonstrate ROI.

However, there are still challenges to data access. The specialized electronics required to work at 400°F temperatures are expensive, and the quality of data obtained in the "noisy" environment of magnetic fields is often called into question. Newer, more sophisticated sensors can self-diagnose and self-correct in real time. Business Intelligence estimated the number of devices at well sites will increase at a 70% compound annual growth rate. Flichy hopes the future of IIoT and edge analytics will help differentiate data by controlling information sent to central repositories versus data saved locally.

Choosing a company for their analytics proved to be a challenge for Weatherford. The field is lacking in experts on O&G, so Weatherford sought out adjacent experience (for example, previous work with wind turbines) and the ability to hear problems out rather than jump to a quick diagnosis. Those firms were given a sample data set to work with, and results were compared in terms of downtime, production, and ROI. SparkCognition led the pack and now works with Weatherford to deploy AI-powered analytics for their customers.

Flichy ends with words of advice to those who are skeptical of cognitive analytics: "I think it's like keeping a horse carriage when the car is coming. The first cars were not very reliable and not going much faster than the carriage. But pretty quickly, it became absolutely obvious that cars had an advantage. I think we're exactly in that same intersection point with cognitive analytics."

"The big vision is that we're going to have an increase of efficiency of the people we have because of workflows and anticipation. An engineer can look at data and make decisions faster, better, and safer."

COGNITIVE ANALYTICS CAN SECURE O.T. SYSTEMS IN OIL AND GAS

by **Marla Rosner**

The Internet of Things (IoT) has caused sweeping changes across nearly every industry—and oil and gas is no exception. Recent cyberattacks have begun to fuel worry about the implications of IoT for cybersecurity, and rightly so; a changing technological landscape means old methods for securing systems may no longer work.

The problem of security in operational technology (OT) is still more complex. IoT is leading to a watershed of changes in the organization of systems in the oil and gas industry, merging previously separate systems and bringing information technology (IT) and OT organizations together. Naturally, as more advancements are made to the structure of OT, security systems must evolve as well to reflect current challenges and concerns.

The static security systems of the past, consisting largely of a firewall to protect the perimeter of a network and an endpoint detection system to patrol the interior, are no longer sufficient. These measures are neither accurate nor scalable enough to protect OT systems under the new, IoT-enhanced paradigm. The best way to fully secure OT systems is to instead protect them with dynamic solutions powered by machine learning algorithms.

THE PROBLEM OF TRADITIONAL CYBERSECURITY

The exponential growth in the number of new devices and connections created by IoT means new potential gaps in security. Safety-critical industrial systems that used to be hidden deep behind firewalls are increasingly being exposed to outside networks that may or may not be secure. In order to maintain the integrity of systems in this new environment, IoT adoption necessitates a change in the architecture of OT cybersecurity.

The general approach to security in OT for oil and gas is more often one of whitelisting than blacklisting—blocking all but a few permitted connections, rather than attempting to sift through all signals and weed out malicious ones. This becomes vastly more difficult with the increase in connections and signals created by IoT. Furthermore, malware is no longer as uniform as it once was—malicious signals are often not easily distinguishable from the benign. As of the beginning of 2016, a full 27% of all malware variants ever created had been made during or after 2015, and it can only be assumed that this number has continued its swift growth since. In a time when both the sheer number of signals and the variety of attacks are sharply increasing, this makes simply identifying threats a challenge, and traditional defense systems can no longer keep up.

In a time when both the sheer number of signals and the variety of attacks are sharply increasing, this makes simply identifying threats a challenge, and traditional defense systems can no longer keep up.

The endpoint solutions that have been employed by oil and gas and most other industries up until now are built on signature-based detection methods. Not only are these ineffective against general attacks, they are typically only benchmarked off of a few hundred stale malware samples at best. This is far too static a solution to keep up with the rapid evolution of malware and the recent proliferation of threats. In fact, the annual cost per company of false positives from endpoint-based systems is already estimated at $1.3 million and 21,000 hours of wasted time on IT support—and as discussed above, the number of threats and the number of potentially vulnerable endpoints are growing rapidly. There is simply not enough IT manpower available to continue operating in this manner.

Perhaps most critically for the oil and gas industry, in order to be effective, traditional antivirus software requires massive amounts of system downtime. Even on robust desktops and laptops, antivirus software accounts for at least 15 minutes of downtime per week. On a typical IoT controller, which would not be designed for any kind of rigorous computing, that 15 minutes becomes hours. This is unacceptable for an industry where so much hinges on continuous, reliable production, but the only way around this with most antivirus software is to make the software so lightweight as to be completely ineffectual. A traditional antivirus with minimized system downtime would also be an antivirus that is not robust enough to catch many or most threats.

ANOMALY DETECTION AND MACHINE LEARNING

Where traditional security measures may not be able to keep up with this new connected world, a learning solution can. A dynamic system that is capable of learning even after it's been deployed can scale with the vast increase in both potential vulnerabilities and types of threats.

With the advent of IoT, preventing all threats from entering a network is far less feasible than simply detecting the ones that have already made it in. Anomaly detection is designed to monitor the behavior of endpoint devices within the network and flag any unusual behaviors or abnormal signals being sent out.

A type of security that should be of particular use and interest to the oil and gas industry is anomaly detection, or anomalous message detection. With the advent of IoT, preventing all threats from entering a network is far less feasible than simply detecting the ones that have already made it in. Anomaly detection is designed to monitor the behavior of endpoint devices within the network and flag any unusual behaviors or abnormal signals being sent out. For example, a learning anomaly detection solution would recognize and flag when command signals come in from an IP address that traditionally only hosts data acquisition equipment. Such unusual behavior could be the result of malicious software.

This is a particularly efficient approach for oil and gas for a number of reasons. Most facilities have only a small staff, and therefore lack the people, time, and resources to identify anomalous behaviors or potential threats themselves—a problem only exacerbated by IoT and IT/OT convergence.

Anomaly detection is also an approach well suited to securing OT systems specifically. Where IT systems may have a diverse range of signals and behaviors associated with their devices, OT systems are designed for repeatable communications. The expected signals and behaviors of OT components are fairly well defined, making anomalies particularly uncommon—and particularly easy to identify.

Anomaly detection software also offers further utility to oil and gas companies beyond identifying threats. Anyone can agree that anomalous behavior in OT systems is an immediate concern, regardless of the cause. Anomaly detection software is capable of picking up on anything that may be

going wrong in a system, whether it's due to malware or a mechanical failure. If a device is working improperly, it will be flagged as a potential concern no matter the reason. In essence, anomaly detection allows businesses to combine threat detection with predictive maintenance.

Not all anomaly detection software is based on learning algorithms. It's possible to use a rule-based approach instead, in which humans outline by hand what is and is not considered anomalous behavior—in other words, the rules of the system—and tell the software to flag any behaviors that do not fall within these predefined rules. This is not likely to be as effective as a learning solution, however, which relies instead on generating hypotheses using multiple data sets, even those that may appear unconnected or irrelevant. Subtler attacks may involve unusual behaviors that still fall within the normal rules of operation. For example, a control system may suddenly tell a device that regulates valves to close a valve that is usually left open. This is a normal type of message within a rules-based approach, sent between the correct devices for this context—but the context and timing is statistically unusual, so a security system powered by machine learning would flag this behavior where a rules-based system might not.

THE CASE OF STUXNET

Stuxnet is a prime example of a threat that could not be detected or predicted by most security solutions, but arguably could have been caught by a learning software. Stuxnet is a worm that specifically targets Windows-based Step 7 software in programmable logic controllers (PLCs). It propagates between nodes and IP addresses until it finds a target that falls under this category. Its infamous sabotage of Iran's nuclear program was carried out by infecting these PLCs and then using them to send new orders directing centrifuges to oscillate at resonant frequency—the frequency at which the centrifuges would essentially rip themselves apart. Even as this was occurring, Stuxnet also sent signals from the PLCs to control systems claiming that everything was running smoothly, making the worm—and the damage it had caused—more difficult to discover.

There are a number of steps in this process where a learning security solution would likely have caught Stuxnet. First of all, a learning anomaly detection software would have identified the initial propagation of Stuxnet between nodes in the system as anomalous, and therefore potentially malicious. Secondly, a Windows-based machine learning antivirus would have recognized that a worm had found its way into the device and blocked it from executing.

Even assuming Stuxnet made it past these first two lines of defense, a learning system would still have been able to identify an anomaly in the system as soon as Stuxnet began altering the operations of the system. Learning anomaly detection systems can operate out-of-band, meaning they do not go through PLCs to access the rest of the system. This means a learning software would be able to detect that anomalous operations were occurring, regardless of the false information being transmitted by PLCs.

It's clear that traditional security solutions are no longer capable of properly protecting OT systems and assets. Dynamic solutions capable of learning from data over time, however, are addressing the challenges of the new security paradigm. IoT and the integration of IT with OT are changing the face of cybersecurity for OT in oil and gas. These changes in the structure of systems—as well as the growing onslaught of new malware and zero-day attacks—require a change in the approach to cybersecurity. As both our devices and our threats become more intelligent, so must our security systems.

MAY

May
1-4

Offshore Technology Conference 2017

Data integrity, security, mining, analysis, and transfer are critical to oil and gas. These are not "buzzwords," but imperative discussion topics for the oil and gas industry because of the potential for significant improvements in safety, asset security, and environmental stewardship. The opportunity for improvements in performance, availability, efficiency, and profitability demonstrated in other industries, also holds promise for the oil and gas industry.

May
11

IBM's Deep Blue Beats Garry Kasparov

The 1997 match of IBM's Deep Blue versus world chess champion Garry Kasparov was the first defeat of a reigning world champion by a computer under tournament conditions. Played in New York City, this match represented a watershed moment in the advancement of AI technology.

May
15

Supreme Court Orders Standard Oil to be Broken Up

On May 15, 1911, the Supreme Court ordered the dissolution of Standard Oil Company on the grounds that it violated the Sherman Antitrust Act. The Standard Oil Trust, which was created by John D. Rockefeller and his partners in 1882, was in control of almost 90% of the country's oil production.

May
25

Geek Pride Day

Geek Pride Day brings together fans of all kinds of nerdom. It celebrates the original release of the first Star Wars film on May 25, 1977. It's also the Glorious 25th of May, an important date in Terry Pratchett's Discworld novels, which his fans celebrate with the sprig of lilac used by characters in the books. Finally, it's also considered "Towel Day," when fans of The Hitchhiker's Guide to the Galaxy show their readiness for anything, by carrying towels in honor of author Douglas Adams. There are meet-ups, parties, and more, so get in on the fun!

JUNE

June
3

Ruby Programming Language Created

Ruby is a dynamic, open source programming language with a focus on simplicity and productivity. It has an elegant syntax that is natural to read and easy to write. It was designed and developed in the mid-1990s by Yukihiro "Matz" Matsumoto in Japan.

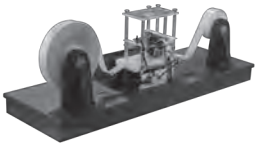
June
8

Tim Berners-Lee's Birthday

In 1989, Tim Berners-Lee changed the world with his invention of the World Wide Web. He wrote the first web client and server in 1990 while at CERN, the famed European Particle Physics Laboratory.

IMPORTANT DATES

June **23**



Alan Turing Develops Concepts of Turing Machine and Turing Test

In 1950, Alan Turing invented the classic Turing test, which states that a computer can be considered to exhibit intelligent behavior indistinguishable from that of a human, if a human being is unable to distinguish the computer's responses from those of a fellow human.

June **25**

SparkCognition's 4th Anniversary

The company was incorporated in 2013 in Austin, Texas, the brainchild of serial entrepreneur, inventor, and CEO Amir Husain. SparkCognition is now considered an industry leader, creating powerful and meaningful advances in the field of AI technology.

June **28**

Tau day

Pi, approximated at 3.14, is the ratio of a circle's circumference to its diameter, and is celebrated on Pi Day. But Tau, which uses a circle's diameter, deserves celebration as well. Tau is approximately 6.28.

JULY

July **2**

IBM announces the Model 650 computer

It is the world's first mass-produced computer.

July **9**

World Petroleum Congress (WPC)

WPC is held only once every 3 years, but it is truly the "Olympics" of the oil and gas world. This year it will be held in Istanbul, covering all aspects of the industry, including management of the industry and its social, economic and environmental impacts.

July **22**

Pi Approximation Day

The fraction 22/7 (hence the date) is a common approximation of Pi (π). The number is used in many fields of science, including planetary science, physics and biology.

July **29**

System Administrator Appreciation Day

This is the perfect opportunity to pay tribute to the heroic men and women who prevent disasters, keep IT secure and put out tech fires left and right.

Aug **28**

First oil well drilled in the U.S.

On August 28, 1859, George Bissell and Edwin L. Drake made the first successful use of a drilling rig on a well drilled especially to produce oil, at a site on Oil Creek near Titusville, PA.

FROM HISTORY & TODAY

AUGUST

PHASING IN THE COGNITIVE REVOLUTION

ONE OF THE WORLD'S MOST AGGRESSIVE INITIATIVES IN DATA COLLECTION, PROCESS, AND A.I.-POWERED ANALYTICS IS HAPPENING IN THE O&G INDUSTRY

by **John King**

A few key decisions can affect the entire course of your future. For Fereidoun Abbassian, Vice President of Technology at BP, getting caught in the middle of a political protest as a teenager in Iran was the catalyst for a life-shaping decision which would take him to England to finish his education. For large companies, such as BP, a decision to adopt the right technology at the right time can have a transformative effect, propelling an organization to the top of the industry. The reverse can be said of companies, organizations or individuals who don't make progress a priority—they get left behind. Examples abound, like Kodak clinging to film over digital, or Blockbuster losing out to Netflix. BP is one of the rare companies who seem to continually make the right technological moves, and Abbassian is leading company efforts in the deployment of cutting-edge cognitive analytics to optimize their old business in a rapidly evolving market.

A commitment to progress has propelled Abbassian to one of the top roles for technology at BP, where he is driving the company's culture of innovation. Growing up in Iran, he was always fascinated with science, and started taking university classes in civil engineering at an early age. But the country was politically volatile, and after Abbassian found himself in the midst of a demonstration while on his way home from school, his family promptly put him on a plane to England to continue his education. It was just in the nick of time—universities in Iran closed during the revolution, so he remained in England to complete an undergraduate degree in Civil Engineering and a PhD from Cambridge in Structural Mechanics. At BP, he has worked all over the world, from Azerbaijan to Angola, overseeing technology and safety for the company, finally ending in Houston as the Vice President of Technology for BP.

For all the talk of the lagging technology in O&G, BP is breaking the traditional characteristics of an industry not particularly known for innovation. Beginning in 2002, the company began a digitization process that Abbassian has personally divided into three phases: laying down infrastructure and monitoring assets, using physics-based models, and now building fully automated and remote-controlled operations. A key decision at each phase of the process helped secure the future of BP's ability to innovate.

Phase 1: Laying Down Infrastructure and Monitoring

Key decision: Investing early and heavily in computing ability

As with most AI projects, BP needed data to work with. "By infrastructure, I'm referring to making the data accessible," Abbassian explains. "We were producing a lot of data, but it never came onshore." To capture the information they needed, BP laid down 2,000 km of fiber across the globe, and to process it, constructed collaboration centers worldwide to enable the exchange of information between offshore and onshore. In 2013, BP constructed a Center for High-Performance Computing in Houston to handle the large amounts of data—at the time, this was the largest supercomputer built for commercial research.

Analytics was not the goal for the huge infrastructure investment at that point—the data processing was used for the purpose of mapping drill sites. "The motivation behind the high-performance computing was really driven by seismic requirements for our proprietary algorithm," explains Abbassian. Using the supercomputer, BP could monitor data remotely, watching production from 30 rigs in real time.

Phase 2: Advisory Period

Key decision: Enabling analytics

But data by itself does not effect change, and this is where BP shines. A 2015 report from McKinsey & Company found that, while ample data is collected on offshore rigs, less than one percent of it made its way to decision makers. Accessing the data is valuable. BP has been able to use collective data to predict repairs, sometimes minutes in advance, leading to massive improvements for business.

Around 2008, BP began using predominantly physics-based models (as opposed to the data-driven models to come) to provide insight on drilling and production operations. The ability to have more data and work with that data gave rise to some predictive capability, resulting in the first major advisory system: Well Advisor. "Well Advisor enabled us to use the data that was coming from our rig sites and analyze that data in real-time to inform operational decisions," Abbassian elaborates. "Our focus there was to reduce nonproductive time."

Here, they were immediately able to see huge returns. For example, each incident of a stuck pipe (when a pipe gets stuck during a tubular running operation) can cost BP $10-50M. Since implementing Well Advisor and gaining the ability to predict a breakdown, there have been no such incidents, saving the company an estimated $100M every year.

BP's second advisory system, Production Management Advisor, targets optimization of the hydraulic network. The system looks at actual production data, runs a physics-based network model to back-calculate what the optimum setting of all the wells are in terms of pressure and flow, and then advises the optimal operating conditions. On average, this optimization has added 20,000 barrels of oil per day of production, or about $1M per day in revenue. Making the decision to prioritize collecting and manipulating data at a large scale was showing a clear ROI.

To further these efforts, BP entered a period Abbassian refers to as creating a "data lake," consolidating all operational data into one place. And the vast imagery of a lake is not hyperbole: implementing the Plant Operation Advisor, a third system currently in development with GE, across all producing assets would yield five million data records per minute—more data records than produced by Google searches in the same timeframe. "We are currently running distributed acoustic sensor fibers in our wells in Azerbaijan, Norway, and the North Sea," Abbassian adds. "Every hour, from every well, we are generating 1 terabyte of data per second. It's equivalent to 1,000 Netflix movies downloaded simultaneously."

Phase 3: Automation with Cognitive Learning

Key Decision: Using cognitive technologies for predictive models

After the game-changing decision to lay the groundwork for data collection, both physically with massive amounts of fiber and computationally with their powerful data centers, BP is now aspiring to reach a higher level of insight. The foundation they've built can now be used to deploy AI technologies throughout their environments, unlocking new reservoirs of previously unreachable intelligence. "I think we are entering phase 3 as of last year," Abbassian estimates. "The vision there is that, through creation of a digital twin of our assets, we could get to a place where we could operate digitally before we operate in the physical world. Could you imagine that? And could you imagine if you could execute things and troubleshoot things in a very safe environment before you do it in the physical world?" Though progress

We bring domain expertise, we bring our data, which is proprietary to us, our partner companies bring their capabilities in the digital and cognitive space, and we co-create.

FEREIDOUN ABBASSIAN
Vice President of Technology, BP

in this phase is ongoing and the goals lofty, the potential rewards are literally life-saving.

Abbassian mentions several factors contributing to BP's decision to digitize: "Safety is number one priority for the company, and digital has got a huge role to play in enhancing the safety of our operation." He also prioritizes, and has seen, efficiencies in access to resources, operations, capital, recovery, and staff. The timing of the move to data-driven decision-making was spurred by the need to adapt to a long-term oil price and the cost-efficiency of digital solutions (sensors have become pervasive and cheap).

Cognitive processing plays a huge role in interpreting BP's data lake. Taking the example of Plant Operation Advisor, BP currently has the ability to monitor facilities, take remedial action, and determine root cause. "What we cannot do is to generate best practices and recommendations automatically, and that is why we need cognitive technologies." Abbassian explains. "We need some human capabilities such as understanding, reasoning, and learning to be able to mine this massive digital knowledge base we are creating to be able to come up with the best, unbiased recommendation at any given time. It's very much about augmenting the reasoning capability of the end-user through sheer computational power and making that reasoning as unbiased as possible."

While a company like BP seeks to lead by retaining ownership of certain technologies and keeping them in-house, it's simply not possible for all aspects of their business. Abbassian explains that BP's strategy has been to keep key proprietary technology—like that reserved for seismic research and exploration—within the company, but partner with others, like SparkCognition and GE, to combine strengths. "We bring domain expertise, we bring our data, which is proprietary to us, our partner companies bring their capabilities in the digital and cognitive space, and we co-create."

Since scaling to the level of an organization as large as BP presents such a challenge, the company works with partners to demonstrate proof of concept before fully engaging. This proof of concept has become key in forging ahead with cognitive learning, and is essential in influencing decision-makers. "It's not technology that is going to be the biggest hurdle; it is really our mindset that will need a major shift to enable this massive transformation," Abbassian predicts.

However, with innovators like Abbassian, BP's collective mindset keeps them on the forefront of the cognitive transformation. Their foresight to invest early in infrastructure and analytics capability, and approach new technology with an open mind has now put them in a unique position to aggressively pursue cutting-edge efforts. Just as the right decision to move at a critical time provided Fereidoun Abbassian with continued educational opportunities, so have BP's forward-thinking decisions put them in a position to lead the phasing in of the cognitive revolution.

A DATA-DRIVEN ANALYSIS OF WHERE YOU SHOULD WATCH THE SOLAR ECLIPSE THIS YEAR

by **Kevin Gullikson**

There will be a total solar eclipse on August 21, 2017, the first such eclipse in the United States since 1979, and the last until 2024. If you are anything like me, you are now thinking, "Where do I watch this event?" Although there are several maps of the narrow path out there, there is a different question that this post will answer with analytics: "Where is the best place (the view least likely to be obscured by clouds) to watch this event?"

THE DATA

This analysis used historical cloud cover data from the Global Data Assimilation System (GDAS) archive, which comes in the form of the cloud cover percentage every three hours in a grid of latitudes and longitudes. I pulled all of the U.S. data available within one week of August 21st for every year from 1979 to 2010. Data at each grid point was specific to 18:00:00 UTC, the closest to the time of the eclipse.

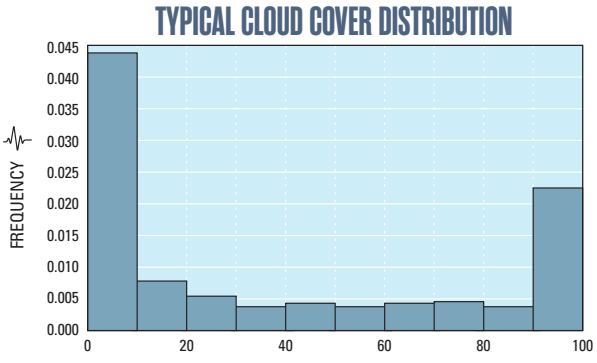
Plotting the average cloud cover at each grid point, with the lowest average that falls within the eclipse path, seemed to hint at the "best" location. However, that approach involves the assumption that the average is a good descriptor of the historical cloud cover distribution. Put another way, it assumes the cloud cover over a given grid point follows a roughly Gaussian distribution, or at least a symmetric and single-peaked one. ***Figure 1*** shows the contrary:

The cloud cover distribution tends to peak at 0 (clear skies) and 100 (overcast). There are therefore two statistics to plot to decide where clouds are least likely to hinder the eclipse viewing experience:

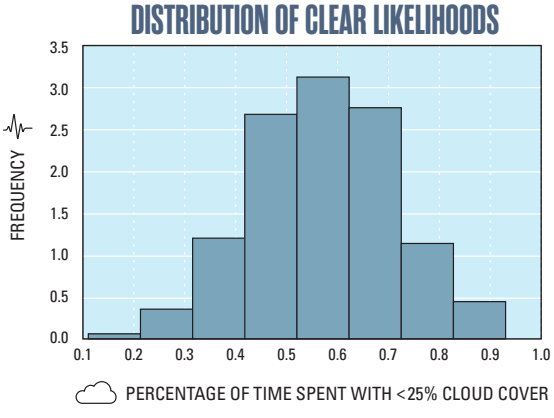
1) How likely is it to be clear (or the fraction of historical data with cloud cover under 25%)? ***(See Figure 2)***

2) How likely is it to be overcast (or the fraction of historical data with cloud cover over 75%)? ***(See Figure 3)***

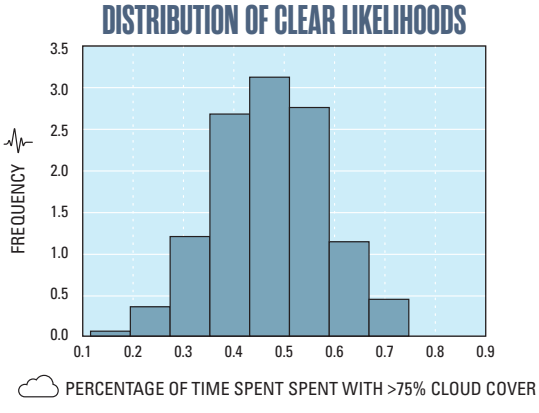
-Figure 1-

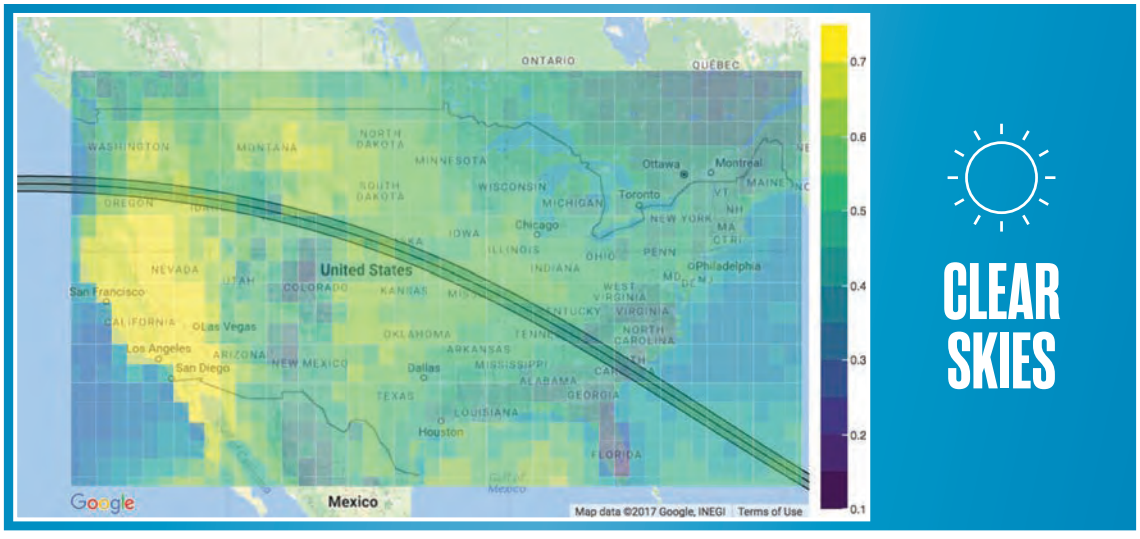


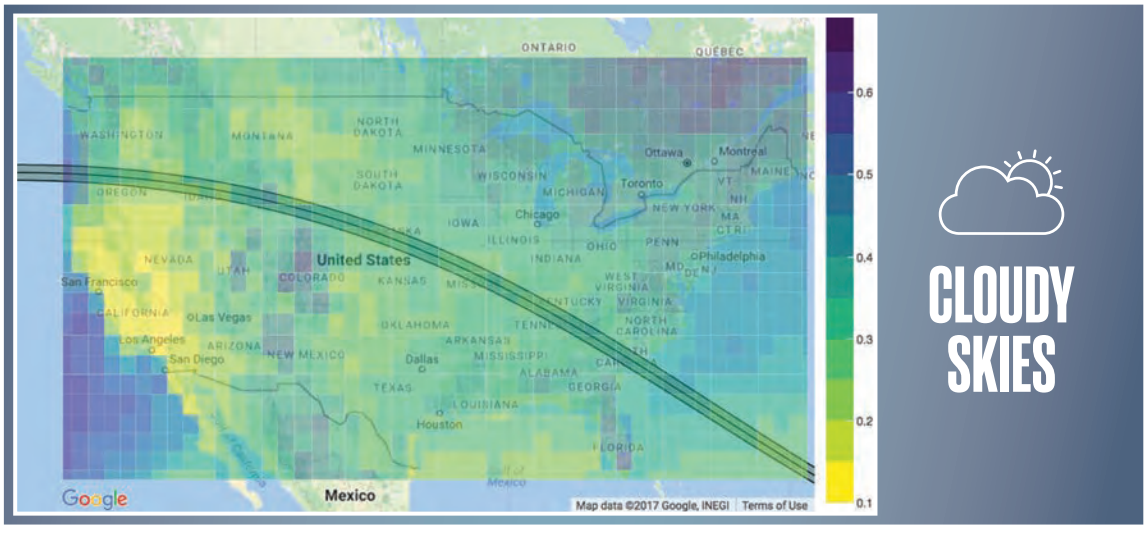
-Figure 2-



-Figure 3-







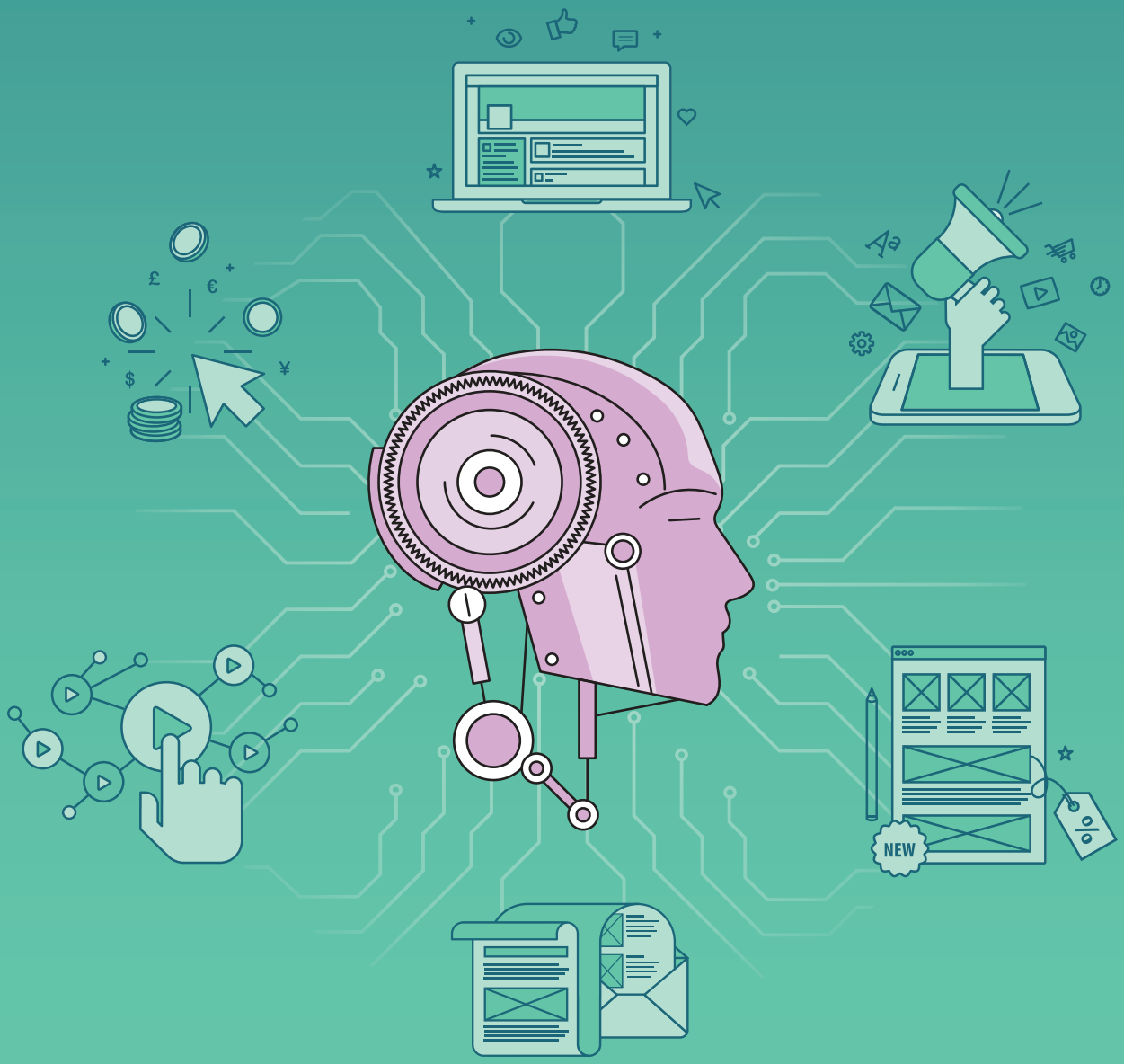
WHERE SHOULD YOU WATCH THE ECLIPSE?

The two plots above show the likelihood of clear/cloudy skies in the US during the eclipse. They are color coordinated: yellow="Sunny and good to go!" and dark blue="Cloudy, so don't watch here!" The statistical uncertainty on the frequencies is about 5% and labeled with a binned color scale, such that a different color roughly indicates a statistically different value. The eclipse path is plotted with a gray curve. If located in this path, you will get to see the total solar eclipse, lasting longer the closer to the center you get.

The most striking feature of both plots is sunny California, which is very likely to be clear (~80% chance) and not overcast (<10%). Unfortunately for Californians, the trajectory of the eclipse passes over them! The best parts of the country for viewing the eclipse are Oregon and Idaho. The Payette National Forest places itself as the best wide-open view, with a 66% chance of clear skies and an only 20% chance of overcast skies.

The Midwest states (Nebraska, Kansas, and Missouri) are equally good for witnessing the eclipse with the probability of overcast skies at about 25% throughout. Moving into the Southern states (Kentucky, Tennessee, and South Carolina), that chance goes up to about 30% while the chances of a clear sky fall below 50%.

May this analysis help you decide where to watch the total solar eclipse this upcoming August. Since the eclipse falls on a Monday, you will likely have to take the day off and drive or camp to see it, unless you are lucky enough to already fall in the path of totality. For any readers in Kansas City, I sure hope you take a moment to go outside, look up (with protective glasses, of course), and experience the astronomical event of a total eclipse.



A.I. IN MARKETING

HOW MORE DATA MAKES "ARTIFICIAL" FEEL PERSONALIZED

by **Walt Rumpf**

At their core, sales and marketing disciplines are based on understanding the psychology of why people spend money. At times this behavior doesn't seem easily predictable, and although there are patterns in people's spending behavior, many purchase decisions often change from day-to-day, seemingly sporadically. However, by applying Artificial Intelligence technology to the massive amounts of available consumer data, marketers have new and ever improving tools in their advertising and sales arsenals. Although there's still a ways to go before personal home assistants are buying products at someone's beck and call (Amazon's dream come true), the decision to easily make a purchase is a few taps away on your mobile device.

The ease and connectivity of a streamlined consumer environment isn't without its downsides. Friction is now developing from information overload when making a purchase, as well as shorter attention spans that distract us. This is where AI tools like natural language processing, machine learning, and deep learning are making a difference, which is impacting where our attention, and our money, goes. Before diving into AI applications for marketing, it's important to provide some background on the subsets of AI technology that are driving the current "cognitive revolution."

MACHINE LEARNING

Algorithms process and analyze data, and build models that will predict or improve performance for that data set in the future. Within machine learning, there are three categories: supervised learning (which aims to optimize to a specific outcome), unsupervised learning (which aims to identify what normal behavior is) and reinforcement learning (which aims to optimize some reward scenario).

NATURAL LANGUAGE PROCESSING (NLP)

NLP is the ability for a computer (or other machine) to understand human language. This is most commonly seen with a person dictating commands to a computer (or mobile device) and having information fed back to them. That is person-to-machine NLP, but it can also work the other way, going from machine-to-person. This is accomplished by the machine analyzing large amounts of related text to identify similarities in available information and provide a summarized, easy-to-understand response to human queries.

NEURAL NETWORKS

Within the human brain, there are billions of neurons through which information flows to make decisions and carry out our everyday lives. For example, to identify a particular type of fruit, some groups of neurons might identify what color it is, while other groups would analyze the shape. In the context of a machine, there is a lower number of neurons than you might find in the human brain, and each "neuron" is responsible for a particular decision or action. Like in your brain, these decisions pass through one another in what is called a neural network.

DEEP LEARNING

Sometimes used synonymously alongside machine learning in marketing material, deep learning is simply the concept of using more complex neural networks. Instead of having a simple neural network with a few "neurons," a Deep Neural Network (or DNN) will contain many layers of neurons.

Marketing professionals pride themselves on staying ahead of the curve, whether it be anticipating trends, understanding buying behaviors, or keeping up with the evolving nature of communication. As available information continues to grow, consumers have come to expect a more personalized buying experience where a basic understanding of their needs is already known and relevant content is served to them, all within a timely manner. So how can something with "artificial" in its name deliver a more natural, customized experience to users?

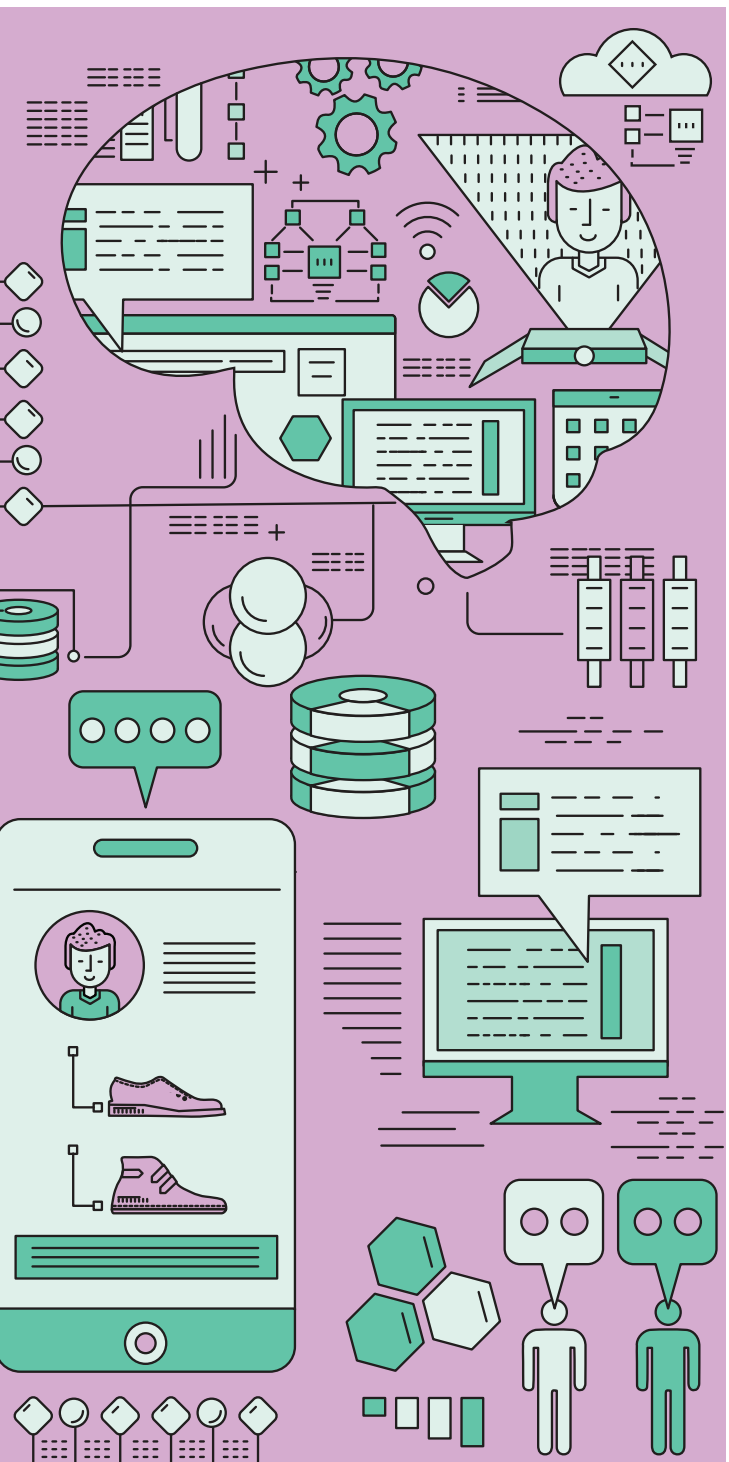
LEARNING YOUR BEHAVIORS—THE END OF A/B TESTING

As more actions and signals are monitored during the purchasing process, and the sharing of this information is becoming increasingly accessible, machine learning is able to utilize this data and unleash its potential as marketing intelligence. Being able to better understand the websites that potential customers visit, their behavior on those websites, customer actions on social media, purchases they've recently made, emails they've engaged with, and so on, help marketers more broadly understand what improvements should be made. Recent advancements are allowing marketers to anonymously connect the data from these platforms so as to better market to you specifically (either through your email, cookies, or possibly IP address).

Many online users have Facebook connected to a variety of services, thanks to single sign-on and verification tools. For example, music streaming services like Spotify or Pandora are able to suggest music based on your likes, and Facebook can use that information to promote events and music. If I am a music agency trying to promote my artists or a venue hoping to sell out upcoming shows, I can look to these services and see what your friends follow to determine advertising targets.

Simple recommendation engines that suggest what you should listen to next or "people who bought this also bought" recommendations are examples of machine learning algorithms. When a suggested song or movie gets downvoted or when an item is bought after being recommended, the machine learning model is reinforced and further optimized. With more data and information available to analyze, marketers can look at models generated from machine learning to make more educated decisions and create a more contextual buying experience for consumers.

In the not-so-distant future, AI-based writing products will be able to start writing content based on topical inputs and data from previous posts.



TRUE BUYER PERSONAS

When someone begins looking for a particular product or service, or identifies a problem that they are trying to solve, there is often a particular process they follow to assess their options. Each individual has their own way of conducting this search. For years, marketers have been analyzing purchase behaviors with questions like, "What was the source that led someone to our product? What was their behavior once they went on the site? What engagement tactics were effective to advance someone through a sales cycle?" With this information, marketers would build profiles around a few select samples of successful conversions. These profiles were then turned into "buyer personas," and the next time someone turned up with a matching title, position, company type, department, or other such criteria, marketers would try to replicate strategies that had been successful with that persona in the past.

Although this thinking has worked for the past few years, the reality is that even though someone might be an engineer, that doesn't mean their personal system to evaluate products is the same as other engineers, or that two medium size companies in similar industries have a similar buying process. Thanks to the scale of processing power and cognitive computing, more data can be analyzed in a more isolated environment and then continually optimized to better understand potentially interested buyers. Individuals in different roles from different types of companies might do their preliminary research on similar content sites, have active Twitter profiles, and look for company information outside of the vendor companies' actual websites. With machine learning, these variables can be identified and analyzed to market to these potential customers directly on Twitter, and engagement efforts can be focused on leading them to third-party sites.

BETTER CONTENT

The focus on inbound marketing over the past five years has led to significant improvements in the quality of content being produced. Marketers are now creating content with consumers in mind to help increase awareness and provide educational information on topics that might lead a buyer to a specific line of products. Now, with the ability to track a user's behavior and target similar buyers, marketers can push this content to outbound channels based on their interests. This is mainly done through marketing automation, where a particular trigger like viewing a page on a website or clicking a link in an email would lead to what content is served next. Machine learning can optimize for the best-performing content in real time and alter which content is served based on how well that content is performing, thus augmenting a marketer's ability to analyze their content and its performance.

When it comes to producing content, there are several natural language processing and machine learning tools to help marketers identify the best topics and keywords to write

about. These tools can analyze content to provide predictions on how successful it might be, and make suggestions to improve the content. In the not-so-distant future, AI-based writing products will be able to start writing content based on topical inputs and data from previous posts. In the case of social media, machine learning is able to build a model based on engagement from past posts and analyze content from related popular topics to make recommendations for post topics. The Washington Post (owned by Amazon) is already using this natural language technology to analyze financial reports and then write articles, which are published without any further human review.

IMPROVING SPEED OF INTERACTION

Improvements in technology have increased expectations from customers, whether consciously or subconsciously. This is particularly true in regards to time, or more appropriately, customer patience and attention span. New mediums for customers to connect with companies have created a huge challenge for marketers to keep up with. This has led to the recent rise in "bots" that are able to intelligently alert you to important customer engagements and even go as far as responding on behalf of the company so as not to keep customers waiting.

Despite the challenge of keeping up with all of these new outlets, marketers want to encourage customer engagement. By introducing additional lines of communication, marketers put themselves in a better position to capture customer interest and/or create a delightful service experience. More companies are adding a "live chat" feature to their sites, and Facebook now offers business users the ability to communicate with customers through Messenger. In most cases, these communications begin with a chatbot. From a customer service standpoint, this allows the company to quickly respond to customer questions or provide timely updates on the status of an order.

When combining these technologies with the other enhancements mentioned above, you can imagine a future where relevant content is served based on previous behavior as well as behaviors of similar profiles, all in a manner that will lead to a positive buying experience. Maybe someone prefers tutorial videos while others would prefer to have someone call and walk them through a process. Marketers will be more capable of determining which customer is a good fit, who might be a problematic customer, and who is just browsing—tire kickers. This information will then be used to guide the customer's journey. As more information is tracked throughout the buying process, marketers will be able to create a better buying experience. This will continue to drive the slow rise of customer expectations.

Data is driving advancements in our society, not just in marketing, but across all disciplines. If you can measure something (or even define it), you can optimize it. Marketers aren't interested in selling data they collect—at least, not the smart ones. For them, the value is in using the data to learn and deliver better experiences to their customers. AI gives marketers the ability to identify hidden connections and patterns that might have never been realized to create better content and marketing strategies. It allows consumers to be reached in the manner they most prefer and gives them as much (or as little) information as they might need to make a buying decision. These improvements are subtle and gradual, but are creating noticeable differences in the purchasing process, largely due to advancements in AI. As with any department, the most important thing to remember with AI for marketers is to not get stuck in what AI can do, but instead look at the problems you are facing and ask yourself: what can AI do for you?

COOL MARKETING AND SALES A.I. TOOLS

Crystal Knows

One of my favorite tools, Crystal analyzes a person's publicly available information and writing style, then runs it against a personality profile to show the best way to communicate with that person. *crystalknows.com*

Lead scoring (MadKudu, Infer)

These tools analyze your database and build a model to identify the characteristics and qualities of your best prospects. If you're considering machine learning-based lead scoring, it's important to be patient. Give the model time to optimize against your ideal customer behaviors. It also never hurts to have more data (recommended data tool—clearbit.com). ***madkudu.com, infer.com***

Acuity Ads

Digital advertising has changed dramatically over the past couple of years as the different mediums and scale of online advertising space has increased. This has led to a rise in what is known as programmatic advertising where machines are buying (and selling) ad space instead of humans. Acuity has a unique algorithm that is able to optimize the sites, mediums and ads that are served based on a desired marketing outcome (such as clicks, content downloads, demo requests, and more). ***acuityads.com***

Kylie.ai

Although this product is still in early development, it is the tool I have dreamed of since I discovered machine learning and natural language processing. Kylie analyzes the contents of your emails and automatically drafts responses for your most common emails. Their applications are strongest for customer service but soon will automatically draft templates for sales teams.

Nudge.ai

The way you can be most effective in today's sales environment is to be relevant. Nudge helps take out the lengthy research process on your prospects by providing you with relevant news stories about individuals and their companies while you're writing emails.

PREDICTING NFL SUCCESS AND THE MYTH OF THE 4.4 SECOND 40-YD DASH

by **Keith Moore**

Year after year, we see sports franchises aggressively seeking the strongest, fastest, most athletic players that can help them win. In fact, the NFL has built an entire industry on accurate player scouting and analysis as athletes transition from college football to the pros. The measures taken by football clubs range from sending scouts across the nation to hiring economists to run their personnel department (most recently done by the Cleveland Browns, who hired Paul DePodesta of Moneyball fame).

However, many of the practices in sports scouting, especially the NFL, are archaic in nature. While sports like baseball have great heuristics (like Sabermetrics) that have grown popular over time, the NFL has never developed a consistent analytical methodology for player evaluation. In an era where an algorithm can successfully fly a plane or pilot a car safely through a crowded street, NFL teams still draft players based on gut feelings or how fast they can run 40 yards in a straight line. It's actually very common for teams to place wide receivers that can run a 40-yard dash under 4.5 seconds higher on their draft board with little consideration of other tests. To those of us in the profession of data science, this is a lost opportunity and a devastating waste of resources. Millions of dollars are gambled on contracts that ride on only a few data points for justification. It is time for an analytics revolution in the NFL, and it all starts with a February showcase often dubbed the "Underwear Olympics," or more formally, the NFL Combine.

The NFL Combine is an event in which NFL prospects perform athletic tests like the 40-yard dash and broad jump so that teams can better understand the athletic potential of a player. Teams use this data to try and assess how well a player's athletic traits can translate into NFL production. However, this information is used in a piecemeal fashion, meaning sometimes teams make bets on players based off one single aspect of their performance metrics. This would be akin to a mechanic determining the health of your entire vehicle solely by checking the oil.

It is proven that NFL Combine scores can successfully be used for predictions, as is evidenced by numerous research publications. However, no major publication or team has ever announced the adoption of any advanced machine learning for player evaluation. Because some of us at SparkCognition

are avid football fans and are always looking for a leg up with our fantasy sports teams, some folks in our office decided to see if it was possible to use NFL Combine data to create an all-encompassing prediction for success at the next level.

The results were fantastic, accurately predicting the likelihood of success (barring injury) for the majority of our testing on wide receiver data *(See graph below)*. The plot *"NFL Wide Receiver Predictions vs. Actual Production"* shows wide receiver success prediction versus actual wide receiver success scores. The predictions were determined by feeding the player's combine results into machine learning algorithms. The actual scores were calculated by weighting yards/game, yards/target, and total touchdowns over the player's first three seasons. It's easy to see that a simple machine learning approach is capable of precisely, if not perfectly, predicting success. Notice that there is a linear trend between predictions created and actual prospect performance.

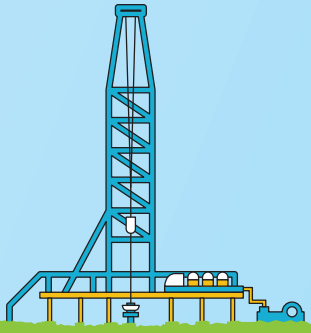
What is amazing about the potential of this analysis is that it is based solely on eight tests that players take during the NFL Combine. It doesn't factor in body measurements taken during the event, player interviews, or any historical performance data. If it was possible to add the wealth of tangible data available to NFL teams to this analysis, a highly powerful predictive capability could be uncovered. This could then be used to supplement scouting departments, making them capable of analyzing every movement of every draftable prospect across the nation.

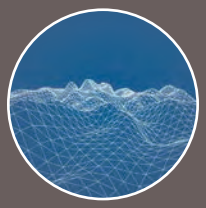
In conclusion, NFL personnel departments could be running much more efficiently by using machine learning to predict the future success of a prospect. Because of machine learning's ability to consider multiple facets of data and how they correlate, artificial intelligence will provide a more complete perspective on the future capabilities of any prospect. With more data for the prediction models to train with, there is significant potential for machine learning to supplement or replace components of the existing scouting process. If any team needs some help on where to start, call us at SparkCognition. We're fans, too.

NFL WIDE RECEIVER PREDICTIONS VS. ACTUAL PRODUCTION

SCORE= 0.5* YARDS/GAME + 0.2* YARDS/TARGET + TOUCHDOWNS

A TIMELINE OF DIGITAL TECHNOLOGY IN OIL & GAS





1977
INTEGRATED ASSET MODELING
Computer modeling of both subsurface and surface elements is first used.

1980s
3D SEISMIC TESTING
Improving upon 2D seismic testing, the method of using shock-waves to map subsurface formations in 3D becomes widespread as computers become more powerful.

1980s
HORIZONTAL DRILLING
Used to extract oil and gas from sources that run horizontally, this type of drilling becomes economically viable due to improvements in equipment, motors and other technology.

1990s
REMOTELY OPERATED VEHICLES
ROVs become commonly used for undersea equipment intervention, inspection, and repair.

2002
4D SEISMIC DATA
Created by using time lapse to analyze repeated seismic surveys of a producing hydrocarbon field, seismic data is first used in this way at BP's Valhall field in Norway.

2003
EXXONMOBIL FAST-DRILL
This drilling process optimizes the system's energy consumption and produces significant improvements in performance.

Mid-'00s
LOW-COST WIRELESS
As wireless technology becomes more available and affordable, the stage is set for digital oilfield technologies.

2006
SMART FIELD TECHNOLOGY
Shell becomes an early adopter of digital oilfield technology, using sensors to gather data on a variety of conditions.

2011
DRILLING iBOX SYSTEM
GE Oil & Gas launches The Drilling iBox System, providing valuable insights from collected data, and enabling condition-based and predictive maintenance.

2013
SITECOM WELL ADVISOR
This software suite, by Kongsberg and BP, is used to make decisions at all phases of well construction. The tools archive data and provide support in real-time.

THE FUTURE: DIGITAL TRENDS POPPING UP IN THE INDUSTRY

The IoT is already allowing oil and gas companies to gather large amounts of data, which is being used to increase production, reduce maintenance costs and improve efficiency.

Wearable 3D computer devices

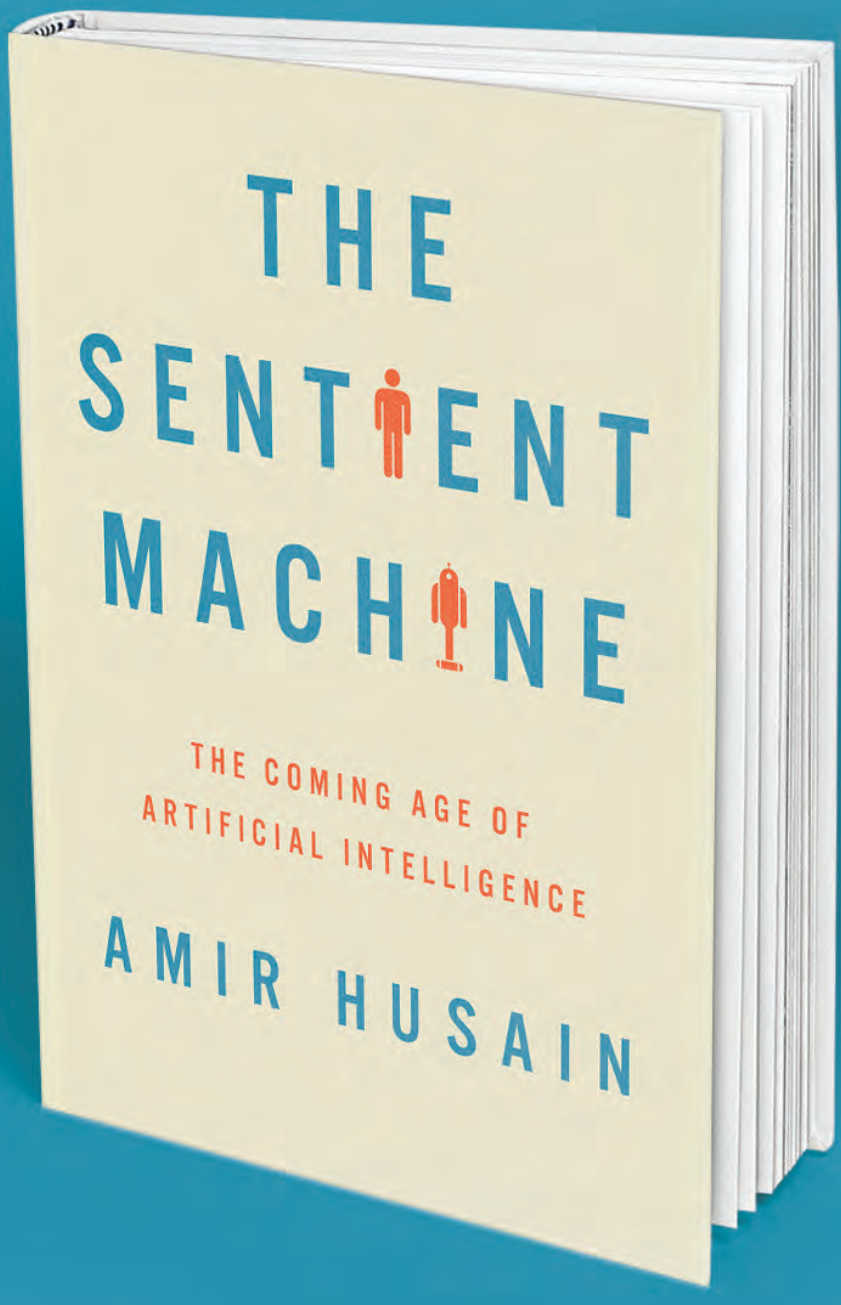
Monitoring tools to prevent/minimize leaks

Automated cyber security

Unmanned aerial vehicles to monitor large, remote areas

CNBC DISRUPTOR 50 2017

#20 | SPARKCOGNITION™



Acclaimed technologist and inventor Amir Husain answers the universal question of how we can live amidst the coming age of sentient machines and artificial intelligence—and not only survive, but thrive.

COMING NOVEMBER 21, 2017

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