Predictive Analytics in the Oil and Gas Industry
Reduce Risk – Boost Efficiency
What's Next?

2018 Whitepaper

Predictive Analytics in the Oil and Gas Industry
Reduce Risk – Boost Efficiency

Whitepaper process: Key themes and ideas detailed in this document were harvested from a roundtable event under the Chatham House Rule during the ADIPEC Exhibition and Conference in Abu Dhabi in mid-November.

In alignment with Moore's Law, computer power has doubled every year since the 1970s and more data has been generated in the last two years than in all of previous recorded history. What does this mean? There is a wealth of underutilized data that predictive analytics can leverage to give unparalleled insights for oil and gas companies: an industry beset by uncertainty can now glimpse into the future. It is still early days in the Middle East's digital journey to reduce risk and bolster efficiency in order to achieve a holy grail: robust and affordable energy security. What's next?

Predictive analytics are essentially a highly intelligent heads up that enables action to be taken affordably and efficiently, saving millions of dollars and potentially even lives. Research reports company Stratistics MRC expects the global predictive analytics market to grow from $3.89 billion in 2016 to $14.95 billion by 2023 – a compound annual growth rate (CAGR) of 21.2% *(See right: Key Findings: LR's Technology Radar Report).*

Predictive analytics is in the same digital toolbox under the umbrella of the 4th Industrial Revolution as artificial intelligence (AI), robotics, sensors, 3D printing, blockchain, digital oil fields, digital twin stimulation and many others. Already, predictive analytics are being tested and applied in machine learning to improve safety capabilities in unconventional oil wells to change management attitude and behavioral modelling to reduce the frequency of safety incidents. Exploring fully automated drilling platforms, automated analysis of subsurface data and designing the 'rig of the future' are also on the list. As the level of unpredictability for energy stakeholders intensifies, having a clearer idea of what may be around the corner is highly valued *(Page 3: Pressure cooker).*

Key Findings: LR's Technology Radar Report

57

More than half of the world's 100 largest oil and gas firms are using, or have plans to use, predictive analytics. For example, integrated oil majors, such as Shell, Chevron and ConocoPhillips and field service companies, such as Schlumberger and Halliburton, are applying predictive analytics across their global value chains.

40%

Of these 57 companies, 34 are using or have plans to use predictive analytics. Nearly half (40%) still need to catch up.

$325,000

Companies using predictive analytics are benefiting from a $325,000 saving per rig by using machine learning to predict drill-bit locations.

$7mn

Predictive analytics are saving companies $7 million on gas pipelines in the eastern US through predicting failures.

1.2%

Just 5 of the 425 patent applications relating to predictive analytics filed around the world between 2012 and mid-2018 are specific to oil and gas – an unnerving 1.2%.

$50bn

The use of predictive tools is most advanced in companies earning annual revenues of $50 billion or more, as well as those with the highest market capitalization levels.

$700,000

Using pattern recognition software, a US nuclear plant can predict faults in condensate and reactor feed pumps and a water temperature controller – saving an estimated $700,000 in avoided costs.

Which lane are you in?

Energy stakeholders are all at different stages in their digital journey; harmony remains scarce. Some stakeholders are accelerating around the sharp bend of digital evolution, while others have not yet started turning the steering wheel. Roundtable participants' anecdotes gathered from industry leaders worldwide highlighted this diversity. One spoke of how a CEO of a refinery is already concerned that his newly-built facility will fail to keep pace with the rapid-moving world of digitalization. Loaded questions keep him awake at night, such as: "Have we thought enough how to manage the digital risk on this massive investment?" A port operator said he is beginning to think about how to use the "amazing data" generated by his assets to sharpen his competitive edge, while a fuel storage operator plans to only address and embrace digitalization in the early 2020s. Which lane are you in and should you shift up a gear?

Pressure cooker

The tall order that energy stakeholders face keeps gaining height. The near-30% gain that the United Nations (UN) anticipates in the global population by 2050 is echoed across the Gulf, spurring energy demand. The inevitable rise in ambitious low-carbon targets spurred by the political and public commitment to the Paris Agreement and equally inevitable pockets of frosty geopolitics add to a pressure cooker that would jeopardize energy security if it blew. Giving the digital tools of the 4th Industrial Revolution a cold shoulder would be an expensive mistake. Why add to the guesswork in an industry characterized by its myriad of unknowns? Investing time, resources and money into digital solutions that maximize the clout of predictive analytics and the wider digital toolbox makes sense.

"Approximately 3% of the possible data on an oil rig is harvested. What knowledge are we missing out on in the remaining 97%?"

Cultural shift

Predictive analytics aim to shift the oil and gas industry's mindset from a retrospective to a predictive approach, which enables companies to get that bit closer to having a crystal ball. Roundtable participants warned that this is not an overnight effort; it requires a deep-rooted cultural shift *(Page 2: Which lane are you in?).*

Industry should aspire to know what the next step is in advance of it happening, rather than analyzing events because something has already occurred. This feeds into a directed, rather than a reactionary, evolution, roundtable participants explained. It encompasses actively considering what can be changed in the environment in order to dictate the future as much as possible, therefore hedging against risk as much as possible.

The value of this shifting mindset has far-reaching benefits, with roundtable participants pointing to how it can improve safety and decrease the associated costs of accidents in the industry. One example is how motor vehicle crashes cause more than 40% of work-related deaths in the oil and gas extraction industry, with the average on-the-job fatal crash costing employers at least $671,000, according to the National Institute for Occupational Health and Safety (NIOSH).

Clearly this trajectory of human risk and associated costs is more avoidable by taking advantage of the digital toolbox, including predictive analytics, to identify potential trouble spots. For example, roundtable participants pointed to success in Oman,

1st

Unconventional wells, mainly in North America, have been the biggest early beneficiaries of predictive analytics so far. Companies operating shale production sites have used predictive techniques to improve the accuracy of well production forecasts, well placement and drilling. Such efforts are clearly paying off, as the IEA said the US could be the world's biggest oil producer by 2023.

4.21

There is still a long way to go. Early-stage maturity scores can be generated for the oil and gas sector and its sub-categories based on quantitative representations of the extent of companies' predictive analytics use. This approach reveals that early-stage predictive analytics maturity of the top 100 oil and gas firms is 4.21 on a 0–10 scale.

3

Artificial Intelligence (AI) is unlikely to be applied beyond niche applications for another three years.

Full report: LR's Technology Radar special report – Predictive analytics in oil and gas: The future in focus.

"With oil at around $60/bl, the world's biggest oil companies – including the UAE's ADNOC and Saudi Aramco – want to increase efficiency to streamline their budgets. This means getting as close to a crystal ball as possible. Enter predictive analytics."

where the increase of digital tools in recent years has seen the average number of staff on an oil rig fall from 100 people to 20 people – an 80% reduction.

The cultural shift must also improve the industry's digital fluency. This requires a proactive approach along the entire value chain; technology will not improve itself. Roundtable participants stressed how innovative research and development (R&D), sustained funds and quick commercialization are key to ensuring the positive momentum behind the 4th Industrial Revolution continues. This is not a new idea, but the urgency behind it is.

At the beginning of the century, Ray Kurzweil, Futurist and Chief Engineer at Google, predicted that 20,000 years of progress would be crammed into the next 100. But roundtable participants agreed that the 4th Industrial Revolution means the rate of progress will be even faster. By 2020, more than a third of the desired core skill sets of most occupations will be comprised of skills that are not yet considered crucial to the job today, said the World Economic Forum. Oil and gas stakeholders and workers must keep pace, regardless of their age, gender or technical background.

Speak the same language

Alignment lies at the heart of the sustainable growth of digital tools, including predictive analytics. Energy stakeholders along the value chain and in all geographies must be unified; across internal processes, internal and external partnerships and every link of communication and knowledge in between. All parties must speak a common language, roundtable participants emphasized.

They highlighted how using one method of predictive analytics for a pump and a different one for a compressor risks halving the value of the two data sets. Information has far greater worth when it is seamlessly combined to offer reliable insights, rather than an array of mismatched forecasts. A single method of data management will also help with 'asset decision support.' This gives the team working on that asset in a control room or on site all the tools required to make a good and real-time decision *(Page 5: Digging for data diamonds)*.

Digital twins herald a key step towards this coveted cohesion; they have the potential to offer 20/20 theoretical visibility. Digital twins are a digital manifestation of physical infrastructure and are crucial to strengthen

the accuracy of predictive analytics and reduce the industry's guesswork. A digital twin should have all the data that is or was required to build and operate the physical facility, so companies can safely conduct trial and error studies with no risk to the actual infrastructure. One example highlighted by roundtable participants was that a digital twin should be able to see how a theoretical change in sulfur in a refining operator's crude grade will affect the yield, corrosion on the pipe and paraffin build-up. This insight can then be applied to reducing risk, increasing efficiency and safeguarding costs on the real infrastructure.

Roundtable participants also recommended putting an identification tag on a piece of the value chain, such as a pump, which stays 'assigned' to that pump throughout its lifetime and changes in ownership. A control room anywhere in the world should be able to access the entire history of the technology and use predictive analytics to identify potential weak spots.

For example, if the tagged item had been purchased from a seller in a particularly hot or cold country, how will this likely affect the next round of maintenance requirements? Perhaps different tools to improve the

reliability of the part must be ordered in? If so, the heads up from predictive analytics mean the tools are ordered in advance of the maintenance slot and therefore avoid unnecessary delays. Such transparency into the 'lifetime' of data in one viewing will deepen the accuracy, depth and speed of predictive analytics and the wider digital toolbox against a backdrop of rising demand.

Follow the leader?

Predictive analytics are currently used most extensively upstream, in oil-field equipment and services and exploration and production (E&P). Roundtable participants suggest E&P stakeholders are best placed to spearhead the next chapter of progress due to their impressive and innovative track record in digital adoption. The complexity and scale of successes in E&P are comparable to the intellectual and practical capabilities that put a man on the moon i.e. pioneering R&D, roundtable participants said.

While drilling processes are largely unchanged over the last century, there have been significant improvements in the wider E&P ecosystem. This encompasses scalability, health and safety, navigating tricky geographies and environmental protection. Roundtable participants discussed how E&P stakeholders already engage with other industries, such as aerospace (including engineers from NASA), healthcare and retail to fine tune the applicability of predictive analytics. Such knowledge sharing and crossover technologies are essential to cutting risk and enabling the Middle East to sustain its position as the global epicenter of oil and gas production and exports amid intensifying competition, notably from the US. Equally, great care is required to ensure that the technologies and policies harvested from other industries adhere to the strict safety standards upheld by the oil and gas industry.

"Two years down the road, if we are talking about how a digital revolution will make a difference to our lives, then we have failed. The conversation needs to move on. It's not about walking the walk – we should already be jogging!"

The risks are too high and the consequences too severe for there to be any weak spots.

Midstream and downstream can also significantly benefit, especially since the Middle East took the aged refining reins from Europe to establish one of the world's most sophisticated and flexible hubs. Imagine how predictive analytics at the UAE's 800,000 b/d Ruwais refinery or Kuwait's 615,000 b/d refinery – online in 2020 – would translate into savings and efficiencies on balance sheets. This has durable value, as the International Energy Agency (IEA) expects the region to have the world's biggest growth in

refining capacity up to 2023. Over the next five years, predictive analytics can bolster production while streamlining costs and cutting risks – good timing for those willing to grab the opportunity.

Within the industry's vast capabilities for troubleshooting lies a challenge, according to roundtable participants. Plans to migrate solutions from one project to another or other parts of the value chain often fall short due to fragmented management. The result? Bricks are unintentionally added to the wall hindering knowledge-sharing and efforts are duplicated in solving problems that have

"In Oman, the increase of automation and other tools in recent years means the the average number of staff on an oil rig has fallen by approximately 80% – from 100 people to 20 people. Less people in a hazardous environment makes sense!"

$933.6bn

Smart Internet of Things (IoT) technologies, which fall under the umbrella of the 4th Industrial Revolution, will witness $933.6 billion of investments by 2025, according to Grand View Research. The revolution is summarized by the World Economic Forum (WEF) as a fusion of technologies that is blurring the lines between the physical, digital and biological spheres – a line that oil and gas companies must master.

$600bn

Opportunity rarely comes without risk. The digital revolution is a haven for the growth of the world's newest and largely invisible mafia; cyber hackers. Cybercrime cost the world almost $600 billion, or 0.8% of global GDP, last year.

x10

The global data sphere will grow to 163 zettabytes (ZB) by 2025. This is a trillion gigabytes and ten times the 16.1ZB of data generated in 2016, according to the International Data Corporation (IDC).

33%+

By 2020, more than a third of the desired core skill sets of most occupations will be comprised of skills that are not yet considered crucial to the job today, according to the WEF.

already been fixed. Roundtable participants suggested identifying one individual or team to be wholly responsible for communicating a solution across the immediate and wider value chain would give greater accountability and longevity to a much-needed flow of knowledge.

Embrace positive disruption

Energy stakeholders must control their fear of change and what they may not yet understand. To maintain the oil and gas industry's rigorous safety levels, every piece of equipment comes with "bells and whistles" to reduce risk. Sometimes, the measures to protect a control room result in the control room being inundated with alarms *(Page 4: The risk is real)*.

But not all alarms are bad; on investigation, some can reveal useful and underutilized data. Roundtable participants highlighted the value of learning how to filter out the critical and high-risk alarms from those flagging an unrecognized data opportunity is integral to broadening companies' knowledge banks and therefore, the maturity of their predictive analytics. Essentially, industry players must control their 'chimp brain': the reactionary part of the human brain that strives for survival and is often overactive during periods of change.

Fear of the unknown could funnel useful data into companies' back drawers, allowing insights to gather dust and competitive edges to wither.

Leveraging predictive analytics enables the oil and gas industry in the Middle East and beyond to shrug off the critical cloak of slow adoption that it has worn for decades, and stride boldly into the centre stage of the global energy revolution. Managing risk in unchartered digital territory can be daunting, but one fear should trump all others: that of being left behind. All hands to the pump! ■

Lloyd's Register (LR)

LR started out in 1760 as a marine classification society. Today, it is one of the world's leading providers of professional services for engineering and technology – improving safety and increasing the performance of critical infrastructures for clients in more than 75 countries worldwide. The profits generated fund the Lloyd's Register Foundation, a charity which supports science and engineering-related research, education and public engagement around everything the company does. All of this helps stand by the purpose that drives the company every single day: working together for a safer world. LR considers customers' needs with diligence and empathy, then uses the company's expertise and over 250 years' experience to deliver the smart solution for everyone. After all, there are some things technology can't replace.

The Technology Radar Series

Global research, sector insights and in-country reports and industry surveys form part of the Technology Radar series managed by the energy business of LR. The reports combine LR's expert knowledge with third-party insights, to provide data-driven findings on the role of innovation, technology, safety and sustainability in the current and future energy industry. Through interviews with senior industry practitioners and surveys of energy professionals, the Technology Radar series provides a compelling insight on latest industry thinking, trends and insights.

Lloyd's Register

List of Attendees – Lloyd's Register Roundtable

Anders Marvik, Manager Competitive Intelligence Economics and Competitive Intelligence Unit, ADNOC

Chawki Dabbouk, Sr. Manager R&D and Technology, ADNOC

Mohamed Al Mutawa, Manager Operations Excellence- Production Unit, ADNOC

Pedro Carreiras, Senior Mechanical Engineer, ADNOC

Stephen T. Brown, Technical Advisor, Operations Excellence Department, ADNOC Upstream Directorate, Production Unit

Mohammed Awad, Regional Executive Middle East and Africa, AVEVA

Ketil Been, Managing Partner, Boxley Group

Fareed Al Hashmi, Drilling & Production Director, Dragon Oil

Benjamin Nobbs, Drilling Engineer, DrillScan

Ludovic Macresy, ME & Asia CEO, DrillScan

Sean Evers, Managing Director, Gulf Intelligence

Dr. Mohammed Haroun, Associate Professor, Khalifa University

Dr. Peter Rodgers, Interim Senior Director of the Petroleum Institute (PI) and Professor of Mechanical Engineering at Khalifa University (KU)

Dr. Steve Griffiths,Senior Vice President for Research Professor of Practice, Khalifa University

Ben Krutzen, Partner, Risk Consulting, KPMG

Joost de Bakker, Regional Wells Manager, Lloyd's Register

Peter Richards, Vice President - Marketing & Communications, Lloyd's Register

Phil Rice, Managing Director Consultancy - Middle East & India, Lloyd's Register

Tristan Chapman, Vice President - Innovation & Product Development, Lloyd's Register

Andrew Calderwood, Vice President Key Accounts, Lloyd's Register

Gareth Kirkwood, Managing Director for Middle East and India, Lloyd's Register

Ghalib Bhrahimi, Sales Director - EAMEI – Software, Lloyd's Register

James Drummond, Global Vice President Asset Integrity and Maintenance Optimisation, Lloyd's Register

Teril Smith, Global Director, Energy Operations, Lloyd's Register

Neil Gunnion, Senior Vice President, McDermott

Vaseem Khan, Global VP of Engineering, McDermott

Georg Harwalik, Head of Exploration, Development & Production Middle East & Africa (MEA), OMV Middle East & Africa

Philip Harbidge, General Manager Middle East & Asia, Path Control

Tetsuro Kuwabara, Senior Business Advisor, Petronor

Eric Vidal, General Manager, Rigflower

Victor Baxter, Advisor – Local Content Business Development Unit, SABIC

Isam M.S. El Asad, Executive Advisor, Sharjah National Oil Corporation (SNOC)

Masoud Al Hamadi, Exploration & Production Manager, Sharjah National Oil Corporation (SNOC)

Eng. Nabil Saado Al Najjar, Executive Director Business Support Project & Operation, Sharjah National Oil Corporation (SNOC)

Daniel Blanco, SkyPower

Dr. Dirk Radies, Subsurface Manager, Wintershall Middle East GmbH