

ARTIFICIAL INTELLIGENCE

Artificial intelligence and machine learning, in concert with Big Data, offer significant opportunities for improved decision making and business optimisation in the oil and gas sector. But it's the start of the journey, reports Brian Davis.

AI focus on real solutions

Digital transformation offers significant opportunities to capture, analyse and transform raw data into automated/digital insights for better decision making, production optimisation and improved business performance across the entire value chain. Artificial intelligence (AI), machine learning and other advanced technologies (like neural networks) hold tremendous promise. But it's still early days.

A broad definition

Shell is using technology from C3.ai and an AI platform running on Microsoft's Azure platform for predictive maintenance on critical infrastructure – including compressors, valves and other equipment; as well as other AI-powered applications. The AI system cuts time spent on complex data interpretation and is to be deployed for maintenance of upstream equipment worldwide.

Daniel Jeavons, General Manager, Data Science, Advanced Analytics COE, Shell Projects and Technology, told *Petroleum Review*: 'Shell has introduced AI as a sub-brand, with Shell.ai. We have chosen to keep the definition very broad. Though at the core

of AI, you can argue that it is the development of cognitive services or robotics that simulate the behaviour of human beings. I look at it more broadly as anything that replicates what traditionally could have been a function performed by humans.'

He continues: 'AI is about extrapolating advanced decision making from large data sets which typically have been made in the human environment.' Jeavons admits this can sound a bit 'fuzzy'. Shell has actually used AI-related technology for decades for scenario planning, statistical analysis and reservoir simulation. But advances in computation can solve a far broader range of problems using models that are data driven.

The Shell.ai programme started in 2013 and now has over 200 data scientists engaged in over 150 projects.

Jeavons recognises that AI and digitalisation can be very disruptive. 'It's a holistic change programme which is changing the way we work. That's why it has been difficult to adopt quickly in the oil and gas industry, because we have long running, very complex, interdependent work processes. We have to work hard on the change to ensure we can

deliver digital transformation effectively.'

He emphasises that the key to effective change management is 'learning by doing'. 'Some things deliver great value, others don't. Part of the process is to understand what works, what didn't, and learn from them.' Generally, what works are use cases where there are common/generic activities which can be replicated and scaled quickly.

For example, Shell has been working on a series of projects in the subsurface to accelerate seismic processing, using similar approaches to the one Facebook uses to process facial imagery. FaultCrawler applies this to seismic data to identify subsurface faults. This approach has reduced the time to identify faults by 80%. These techniques have been extended to salt bodies and seismic de-noising, taking about nine weeks out of seismic processing projects in the Gulf of Mexico.

'We've learned that adding AI to existing processes, to make the process simpler, better and faster is the low hanging fruit,' says Jeavons. 'Maintenance is a good example, because we can integrate AI with existing surveillance processes and simply add another

Artificial intelligence is set to impact the whole oil and gas value chain, upstream, midstream and downstream; impacting predictive maintenance and analytics, production and business optimisation

Photo: Pixabay

set of alerts, which are more precise because we have a repeat pattern for the engineer to use.'

For example, on the Shearwater field, a typical loper (pressure failure) could cost 20,000 b/d, about \$1.5mn at current oil prices. Within the first couple of weeks, Shell was able to prevent a 'trip'. Similar technology is being deployed to model the behaviour of control valves at the Pernis refinery in The Netherlands. Within a fortnight of deployment, serious trips were avoided, saving an estimated \$2mn. This approach is being rolled out to provide a new layer of intelligence for proactive technical monitoring at over 23 assets across the business, in partnership with Microsoft and C3.ai for global scale-up.

Other key partners in AI initiatives include Alteryx for analytics and Databricks.

Shell recently launched the AI Residency Programme in The Netherlands and the US, with the UK and India to follow, as a way of bringing AI talent into the industry. Shell AI Futures (see Shell Gamechanger website) is a bid to harness the power of start-ups and academics in AI ecosystems. Shell also has an AI-related upskilling programme in partnership with Udacity. To help people understand

AI technology and process thinking on real problems, Shell has run a hackathon programme of about 40 events and is scaling this initiative.

Jeavons maintains that AI will also help leverage the energy transition. 'We try to ensure that AI deployment has a direct bottom line impact, as well as benefit from an energy transition perspective. We have a new, emerging energy system with wind turbines and lots of new assets in the mobility space, developing charging networks through New Motion, Green Lots and Limejump, an IOT-based trading outfit with a virtual power network integrated with AI for optimisation.'

Shell is focused on embedding AI in existing processes, to make them more effective or efficient across the value chain, including CO₂ reduction. The company is also using AI to support new initiatives like the GO+ loyalty programme in its retail network.

Speeding up analysis

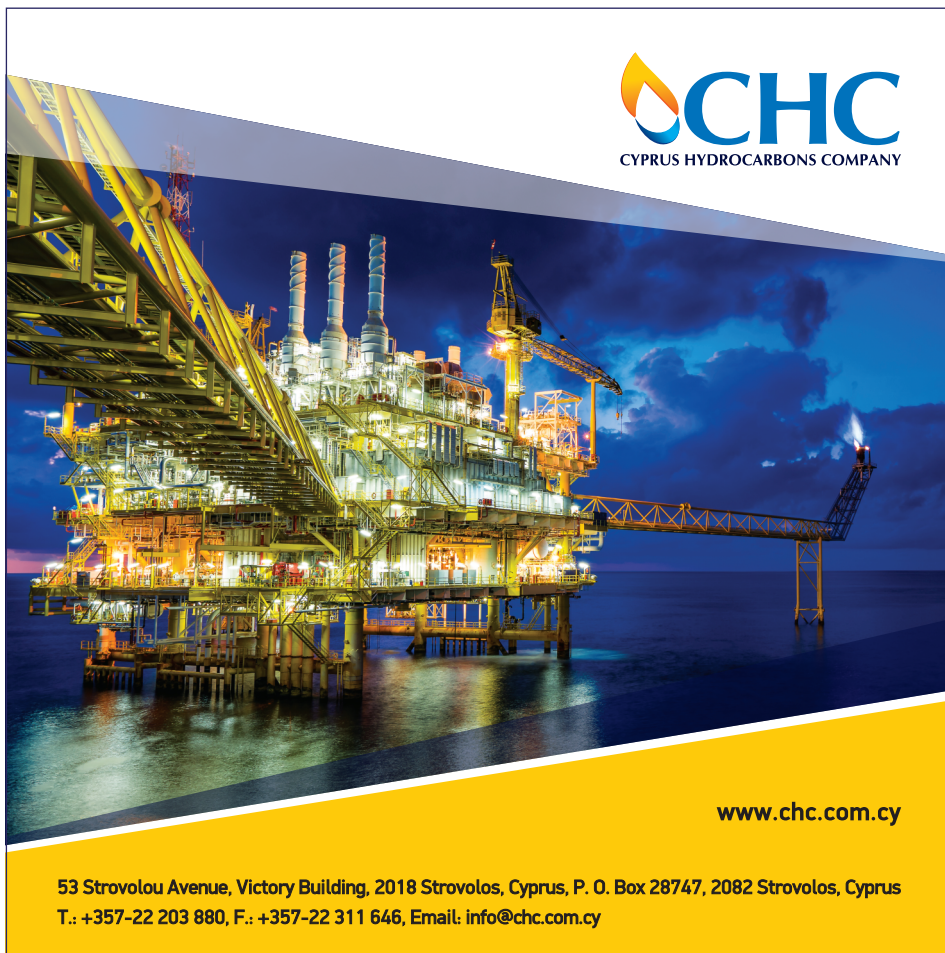
Chrysaor's Operations Director Bob Fennell maintains: 'AI can enhance the way an oil company analyses the vast amounts of subsurface, operating, business and HSEQ (health, safety and environmental quality) data, we gather on a daily basis. AI speeds up analysis and


helps us make key operational decisions on a data-led basis in real time to improve business performance.'

Chrysaor collects data for AI application in predictive analytics, workflow automation, automated process control, for better seismic interpretation and drilling performance via real time, closed loop predictions. AI enhancements in the analysis of critical plant data have helped increase the company's production efficiency and improved drilling performance.

Fennell admits the biggest challenge is cultural change and the lack of standard industry solutions. 'To be effective, AI applications have to be managed by the primary beneficiaries – those at the front end, with forward-thinking minds in senior industry positions. Benefits are being gained around mature reserves and enhanced production efficiency. The utilisation of third parties to provide real-time AI analysis of critical plant data is relatively new, but one of our core values is innovation.'

Looking forward, asset integrity developments are underway in the delivery of a fully interactive, real-time digital twin which will deliver data-led decisions and improved





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Aspentech's adaptive process control system uses AI for planning and scheduling in refineries; hybrid modelling and design optimisation; to help get economic value from an asset

Photo: Aspentech

business performance. Other areas such as wired drill-pipe, cyber security, prescriptive maintenance and better collaboration will be boosted by application of AI to large volumes of data.

Massive change

Meanwhile, Ron Beck, Director of Marketing Strategy, Aspentech, suggests massive change is underway because of the impact of digitalisation. 'AI is going to have more impact than most people imagine, particularly for predictive maintenance and analytics.'

He recognises AI roll-out is about change management, not simply recruitment of data scientists. 'AI is about solving problems without having to give complete prescriptive instructions to computers about what you want, to achieve insights so people can work faster and more accurately.'

Aspentech offers an adaptive process control system for upstream and downstream operations; for planning and to help get economic value from an asset; to design systems and optimise them. The aim is to increase refinery uptime by applying AI to the process using real-time streams of data, cleaned up fast and intelligently, to add value across the business.

The company works heavily in an area called hybrid modelling.

This takes conventional (first principle) models for engineering design, process control, refinery planning and scheduling, and combines them with data science and predictive analytics to find new relationships and insights.

Beck believes that within a foreseeable time horizon digital transformation will see development of autonomous plant 'once safety of the plant and people is assured as well as environmental sustainability'. The plant must also be designed for 'low touch AI' – so a normal person can use the AI system and understand what it is telling you. Low touch machine learning can provide accurate warning of asset failures and enables a new set of collaborative workflows to be planned. However, he insists: 'The end goal is not to eliminate people, but to have people doing value-added things in the right places and working more safely.'

Augmented intelligence

InEight employs AI and machine learning, along with risk analysis capabilities to establish 'more realistic' plans and schedules for upstream oil and gas projects. Drawing from historical data, InEight's AI-powered inference engine generates scenarios for review by project teams. This approach claims to cut project planning time by 40% and reduce by 75% the time spent in gathering team member feedback.

Daniel Patterson, Chief Design Officer of InEight, believes the application of AI is straightforward. 'Prior to AI, software tools that helped capex projects in oil and gas required a human to provide information for planning and scheduling to a computer to carry out a calculation. AI turns that on its head. For the first time, the computer interacts with a human bi-directionally (with risk-adjusted forecasts), using unstructured as well as structured data, to make suggestions for the project.'

Patterson suggests today's AI should be called 'augmented intelligence' rather than 'artificial intelligence'. 'Whilst the computer is able to understand context and information and starts to make suggestions, albeit not necessarily making decisions for humans, the suggestions augment the project management best practices that an organisation has in place, rather than replacing them.'

Machine learning and AI

Halliburton has also developed advanced AI capabilities for multiple areas, using data science

across exploration, drilling and production workflows. Algorithms have been developed for pattern matching for faults and seismic, modelling NPT (non-productive time), stuck pipe predictions and condition-based monitoring for digital E&P, based on the DecisionSpace® platform.

'AI plays two roles,' explains Sara Queen, Industry Solution Provider at Halliburton Landmark. 'One is the role in digital optimisation, where AI can help us achieve cost efficiencies by doing routine tasks, like planning, scheduling and maintenance, in a more automated way. The other is digital transformation – achieving better efficiencies and optimisation of what we currently do, using new and different business models.'

A host of new products are being introduced. DecisionSpace® 365 was launched in August 2019 for cloud-based applications. One application, Seismic Engine, runs AI geophysical algorithms and attribute analysis on terabytes of 3D seismic data, to automatically identify faults which would otherwise take weeks of a geophysicist's time.

In production, for example, DecisionSpace® 365 applications can connect with sensors downhole to identify and analyse completion issues, like flowback. In the Bakken formations in Montana, AI is used for pump diagnosis, analysing current and historic data for patterns that could be used to predict future failures.

Queen suggests that a key lesson is the need to start with agile scrum teams with multiple companies involved. 'You have to co-innovate. The technology is evolving daily and most operators have unique architectural and data management considerations. The Open Subsurface Data Universe, for example, is a new development in the mix that's going to change how companies make their data available for AI.'

Halliburton Landmark's software is built with open architecture as it is vital for new cloud-based technology to be interoperable with an operator's existing investments.

'Today, AI is being used in a number of domains, but it will not have a transformative business impact until most of a company's data, regardless of where it resides, is trusted and accessible across silos,' says Queen. ●