INNOVATION

Things to come – drilling towards 2030

The oil field of the future will be highly automated with remote drill rigs potentially run by robots rather than roughnecks, according to the latest report* by Lux Research analyst Colleen Kennedy. *Brian Davis* reports.

Faced with low oil prices and a bitterly competitive market, a revolution is underway in terms of oilfield technology. Despite the hype around the 'digital oil field', Lux Research analyst Colleen Kennedy is convinced that new technology players will win significant market share with innovative concepts that overturn traditional drill rig and service models.

Today she points to the success of the shale frenzy and production from unconventional wells. 'The shale boom in the US has resulted in thousands of wells being brought online thanks to advances in horizontal drill rigs, which brought more and more wells online to meet production in the Bakken until 2014. At this stage the market became oversupplied and drilling decreased significantly,' she says.

However, the average return on assets had already been declining prior to the price crash. About two-thirds of industry mega-projects have been delayed or are running over-budget. In order to combat this scenario, operators had already been focused on reducing the cost of drilling and completing wells. Figures from the US Energy Information Administration (EIA) show how competing companies managed to reduce the costs for services as well as optimising drilling and completion.

Unfortunately, this was only a short-term trend. Around 2015, the EIA figures showed costs leveling off and increasing again (see **Figure 1**). So companies have sought to buck this trend in order to stay competitive in a tightening industry. Kennedy explains: 'In order to remain competitive operators are going to have to do something significant to decrease costs even more.' Part of the solution lies in new technology.

Lux Research has been tracking how oil companies invest in new technology. Interestingly, prior to 2015 there was a 'mixed' approach, with focus on investments in renewable power and alternative feedstocks (such as biofuel) as well as new drilling and production technology. 'But since the price of oil has declined, operators are pivoting back to their core businesses and investing in oil and gas focused technologies to help their operations, increase production and drive down cost,' says Kennedy.

Moreover, the service company landscape is also shifting, with major lay-offs and mergers and a lot of restructuring. There are also new, small service companies who are eager to change the service model, and are providing a threat to incumbent service companies.

Basically, the future oil field needs to look different. Shale wells and expensive major projects are 'killing' the average return on assets; the cost of drilling per foot is at risk of plateauing; and lower oil prices are causing oil and gas operators to shift back to investment in core technologies. The service market is also broadening but will need better technology to break a stagnant cost per foot of drilling and completion.

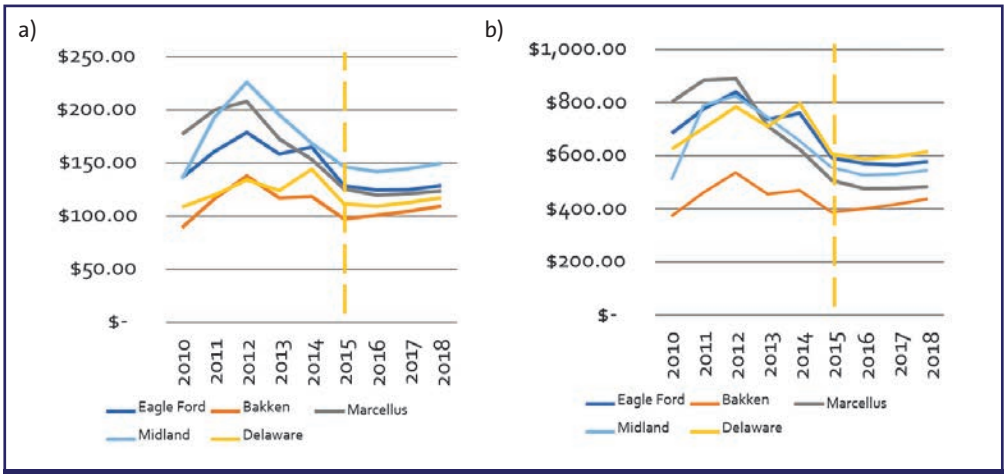

Figure 1: Lowering upstream costs to beat the competition – a) drilling cost per total depth, in $/ft; b) completion cost per total depth, in $/ft

Source: Lux Research/EIA

A new roadmap

So what does the roadmap to drilling by 2030 look like?

Kennedy believes: 'The "intelligent oil field" or "digital oil field" is one of the biggest hype phrases that the industry has seen in the past few years.' One of the problems with the digital oil field is that companies are still often collecting data with old tools and expensive methods of deployment, in areas such as remote monitoring and control, measurement while drilling (MWD), logging while drilling (LWD), real-time or remote seismic acquisition.

It is important for operators to find new solutions.

A Lux Research report on *Big Data and oil and gas* identified

dozens of different technology start-ups in this area. However, Kennedy notes: 'It is still very difficult to identify who are the successful players in this space and which [ones] operators should be engaging with.' Technology developers need to concentrate on finding more efficient ways to do operations that drive down costs, ie developing data analytics, new geophysical methods and software tools, wireless sensors to improve connectivity, and autonomous vehicle technologies for operations that are normally performed by humans.

Considering there are so many companies working in this area, how do you pick the potential winners? 'Typically companies should be innovative and address several important problem areas, with solutions that cut costs and ideally provide a significant paradigm shift in performance compared to well established, incumbent oilfield technology,' suggests Kennedy.

Lux Research highlights developers of wireless sensors like Ambyint, Intelligent Dots, Coldbore, Fluidion and Well-Sense; and autonomous vehicle technologists OFG, BluHaptics and AbyssalOS. But this is by no means a complete list.

Interesting start-ups

Some, but not all, have reached the commercial development stage.

Canadian company Ocean Floor Geophysics (OFG), for example, was founded in 2007 to develop geophysical acquisition and analysis tools for deepsea exploration. The company provides data acquisition and analysis tools for marine geophysical surveys using magnetic, electromagnetic (EM), controlled electromagnetic/magnetotelluric (CSEM/MT), vertical cable seismic (VCS), gravity and hydrographic sensors. The systems are deployed on remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs).

'OFG takes advantage of several different technology trends and packages it into one AUV for deep marine exploration. 'They provide the sensors, imaging tools and a vehicle that can be deployed off any ship,' explains Kennedy. The incumbent providers of this type of marine data require huge ships, lots of equipment and personnel.

Another interesting company is Aberdeen-based Well-Sense, founded in 2015, which has developed a novel biodegradable intervention tool for well completion, as an alternative to a conventional surface spooling wireline. It is claimed this approach can cut costs dramatically. The Fibre Line Intervention (FLI) is composed of a miniature fibre optic spool housed in a biodegradable polymer or water-soluble metal alloy casing. The conventional approach to completions uses multi-million dollar tools that are deployed downhole on costly five-year rentals and then have to be retrieved.

'The FLI is a step change in the approach to well interventions,' comments Kennedy. The system can only be used once and biodegrades, so there are no costly retrieval operations. Well-Sense is also offering a service package, which facilitates the low cost approach.

A French start-up called Fluidion is developing microfluidic sensors that detect sound created by the collapse of tiny acoustic microseismic emitters in a nearby well using an ultra-sensitive fibreoptic sensor array. The microsensors will be mass-produced using 3D print technology. The sensor is several years away from commercialisation. But the technology is notable because it will allow operators to understand the extent of fractures in a province, for regulatory purposes.

Kennedy anticipates that by 2020, better sensor technology will have developed with more integrated systems to get more information from downhole and optimise the way we drill.

Moving forward, Kennedy predicts that robotic rig floor systems will become more mainstream by 2025 'though there are still a lot of pain points to be addressed'. A Norwegian company called Robotic Drilling Systems (RDS) currently leads the field in terms of developing a robotic drilling rig for unmanned land and deepwater drilling operations. RDS has created an automated drilling floor with four all-electric robots replacing up to 13 unmanned positions.

Although robots are still considered 'risky and capital intensive' for the oil and gas sector, Lux Research points out that the potential savings of the automated drilling systems has attracted the attention of major oil and gas players including Shell, Statoil, Conoco/Philips and Odjfell Drilling.

Typically, work by roughnecks on the rig floor can be very dangerous and inconsistent. Replacing drillers with robots promises to cut non-productive time (NPT) and offer a safer, more consistent approach. RDS recently sold their first product to an American company.

A small Canadian company, Raptor Rig, is developing a prototype automated tool for the drill floor with a dual top drive and simultaneous connection system, to minimise time spent connecting casing joints. Raptor Rig is trying to raise $17mn seed funding for the project, and is convinced they will be able to replace older rigs which rely on manual labour.

'By 2025 we hope to see a reduction of humans in the drilling process, taking advantage of new sensor developments, robotics and autonomous systems,' says Kennedy. 'However, the biggest problem with robotics in the oilfield sector is the limited number of developers and a lot of different pain points. It has taken 10 years for RDS to sell their first robotic product and they are still working towards a fully robotic rig floor.'

By 2030 Lux Research expects to see all these pieces come together. Kennedy forecasts: 'The oil field could be almost completely remotely operated with risk driven down by advances in the intelligent oilfield, using sensors and improvements in data analytics to remotely control a completely robotic rig in truly digital oilfields.'

As mentioned, choosing the right technology development partner will depend on several factors. First, the company should drive innovation from several different aspects, using technology that is already integrating several of these problems, whether it is analysing the data being collected or reducing cost. By 2025, we should expect to see more automation on the rig floor and elsewhere. 'There are still a lot of opportunities to eliminate the role of roughnecks using automation and oilfield robots,' says Kennedy. Finally, the oil field of the future will be remotely operated. 'If the technology can't be remotely operated, it isn't worth focusing on,' she maintains.

Lux Research forecasts: 'By 2030 the oil field will be almost completely remotely operated with risk driven down by advances in the intelligent oil field.' This is a big vision. The robots are coming – admittedly somewhat later than most other manufacturing sectors. ●

**The future oilfield: Drilling in 2030*, published by Lux Research.