

# Next-level automation to go beyond discrete processes, linking data and workflows with digital technologies

To advance drilling efficiencies and ensure profitability for entire supply chain, industry also must shift toward outcome-based contracts on a larger scale

BY KELLI AINSWORTH ROBINSON, ASSOCIATE EDITOR

ARINDAM BHATTACHARYA IS PRESIDENT of Schlumberger Land Rigs.

*What do you see as the most critical challenges facing oilfield service companies in the current environment?*

The most fundamental challenge that we continue to face is helping operators reduce their finding and development costs. Over the years, that has not changed; what has changed is our external environment. The oil price has gone through a big shock due to the downturn. We have been at \$50 to \$60 oil for the past two years, and there is a consensus that we have to adapt to this environment.

Thriving in this environment means that the entire supply chain involved in drilling must be sustainable and profitable. To achieve this, we must work differently from the past – in a more collaborative way with the customers and across the supply chain. That will enable us to break down the existing barriers and interfaces, which will reduce the overall cost of delivering a barrel of oil. When we're able to do that, we can sustain operations at lower oil prices much better as an industry.

Another challenge is that the industry has lost a lot of experienced personnel during this downturn. As we start to come out of the downturn and build up our workforce, we'll have to work hard to attract new entrants into the oil and gas industry. At the same time, as we adopt more digital technologies and automation, the profile of people we hire and train needs to be different, so they can not only fit in but also succeed in this new environment.

*You said that we'll need to work in different ways in order to thrive in this environment. What would these new ways of working look like?*

More collaboration, openness and focus on performance are necessary. We need to look at the commercial engagements that are more performance- or outcome-based. As drilling technologies become more advanced and operational capabilities more mature, the service providers must learn to better manage technical and operational risks. If we take on more risk, we can expect a premium when we outperform.

We are already engaging with the customers in various parts of the world through these types of commercial models that have proven to be successful. I believe that these new engagements will propagate, and as they do, the industry will be better placed to drive efficiency.

*Are you seeing growing interest in the sort of outcome-based contracts you mentioned?*

We believe that there will be more outcome-based contracts, and that's definitely needed. However, it's not a brand-new approach. About 50% of the activity in our drilling and measurements business in Schlumberger is executed under performance-based contracts. Compared with a few years ago, we are running more performance-based footage contracts and fewer dayrate contracts for directional drilling, and this trend looks set to continue.



Arindam Bhattacharya, President, Schlumberger Land Rigs

Drilling contractors still predominantly work on a dayrate basis. Nevertheless, we could see some drilling contractors taking on more risk on performance as we go forward.

*Were there barriers that had prevented the industry from operating under more outcome-based contracts in previous years?*

There are no barriers as such. In Mexico, we have been doing outcome-based contracts for

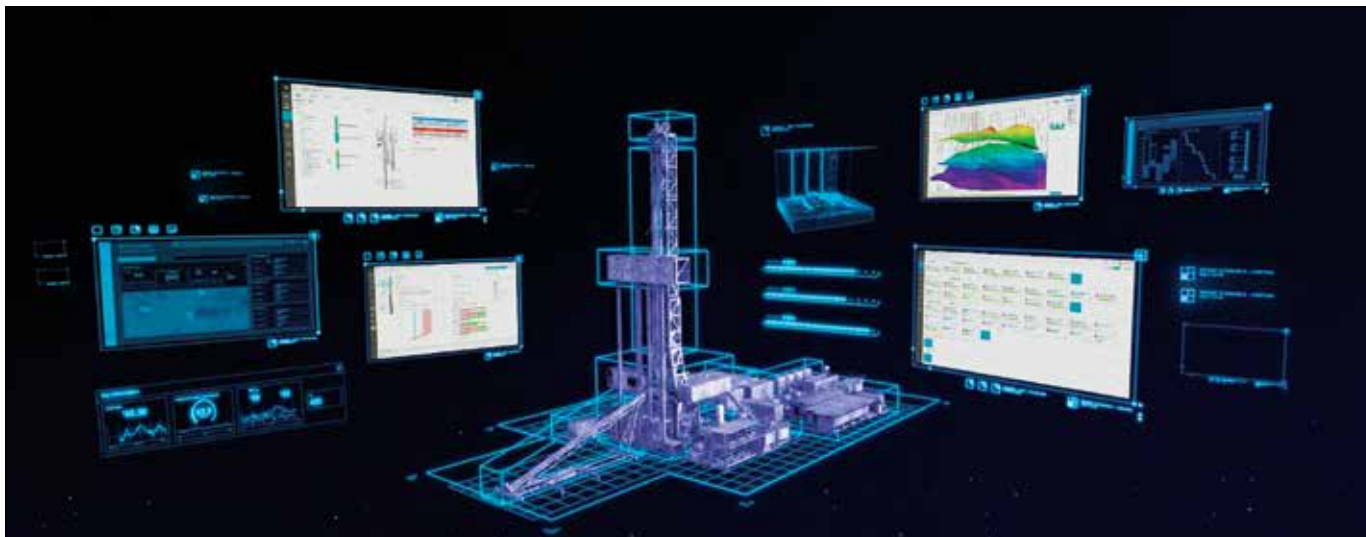


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The DrillPlan digital well construction planning solution brings together multiple users, irrespective of their locations, to work on a single live well plan in real time. It also helps to automate repetitive tasks for increased efficiency.

drilling since the early 2000s. Today, we also work on outcome-based projects throughout the Middle East – in Saudi Arabia, Iraq and Kuwait, for example. This approach has taken off in places where operators have realized that there is a big opportunity for performance improvement leading to cost savings.

In the US, we haven't seen outcome-based contracts on a large scale for overall well delivery. There have been performance-based contracts for discrete services, such as footage-based contracts for directional drilling. The conditions are right for that to change. If we want to achieve the next step-change in performance improvement and cost reduction, we should seriously consider performance-based models for upcoming well delivery projects.

*At industry events, you've said that the North American shale market needs disruptive innovation, not incremental innovation. Do you see disruptive technologies gaining greater acceptance in the industry?*

There are many examples of innovative technologies being applied within specific scopes in oil and gas, whether it's drilling or production; and there are some positive developments on this front. However, we need to impact the overall well construction process if we are to have a meaningful impact on well costs. To accomplish that, disruptive innovation has to occur on a holistic level, in terms of both technology and commercial models.

From what I've observed, if an innovative technology proves itself, there aren't any barriers to its acceptance by the industry.

*What are some opportunities for automation in the drilling industry that you think could be realized in the next decade?*

Let me put this in context of what we are doing in Schlumberger. We introduced the DELFI cognitive E&P environment in September 2017. This is a secure, cognitive, cloud-based collaborative environment that integrates data and workflows with digital technologies, such as artificial intelligence and machine learning. Within this environment, the first platform we launched was a cognitive drilling platform for high-volume land operations.

As part of this development, we commercialized the DrillPlan digital well construction planning solution, which brings together multiple users, irrespective of their location, to work on a single live well plan in real time and with access to all the relevant data, well planning engines and workflows. The solution provides full traceability and validation during the well planning process and accountability for the plan and subsequent management of change. Embedded automation of repetitive tasks delivers efficiency and, together, the solution drives coherency of the entire well planning process.

The next step is to transfer this plan into an operations execution technology, where we can automate the orchestration of drilling activities. We can also automate certain

elements of the drilling process itself – for example, ROP, weight on bit, trajectory control and stick-slip mitigation. All these parts are automated today on a discrete level, but we're bringing all of that together into a single solution, in context of the plan.

From there, we can gradually pursue higher levels of integration by combining well planning and execution with enterprise resource planning systems. We can start automating elements of inventory management, logistics and the supply chain; this brings the back office into the automation process. The end game is to profoundly impact the way we run our business. We believe that we'll see these progressive levels of automation across the industry in the next 10 years.

*How does software like DrillPlan help users learn from one well to the next?*

The digital well construction solution allows us to plan in the context of our offset knowledge gained through operational recording and learning to deliver a continuous improvement cycle. We plan our wells based on past data and inputs that we provided, and then we execute that plan through orchestration and automation, while constantly recording all the data. On the Schlumberger cognitive drilling rig, the rig of the future, we have a sensor layout that records almost everything that takes place on the rig. That data then becomes integrated into the learning process.

When the next well is being designed, operators can take advantage of the data from

the last well because it is already aggregated in the software. The cycle time to do that is cut so that it's almost in real time.

*How did Schlumberger leverage both internal software expertise, along with the expertise of tech companies, to develop your cognitive solutions?*

We're relying on companies like Microsoft and Google for their hosting and cloud infrastructure. Other benefits that this gives us are scalability and security. On top of this, we are doing proprietary development, for which we are collaborating with multiple established organizations, as well as startups.

We have more than 250 software engineers working on the drilling software development between our centers in the US, Norway and China. At the Schlumberger Software Technology Innovation Center in Menlo Park, Calif., our technical experts and data scientists focus on a wide array of software technologies, including high-performance computing, cloud, big data, analytics, internet of things (IoT), industrial internet, visualization and user experience.

The automation professionals in our industrial internet center in Sugar Land, Texas, utilize the IoT and industrial automation technologies to bring about the digital enablement to the Schlumberger service offerings, further improving efficiency and productivity. These centers are set up to draw on industry experience, as well as to collaborate with universities and academia.

*Will partnerships with tech companies continue to be important as the industry pursues advancements in digitization?*

These relationships are essential as our industry starts embracing digital technologies to improve performance. Tech companies already have significant experience handling big data and using machine learning across a range of industries, including automotive, retail and manufacturing. We need to tap into that experience if we want to accelerate the learning curve in our industry.

*Schlumberger's rig of the future targets the North American unconventional market. Are there plans to apply this concept to the offshore market?*

Currently, the full system deployment is targeted for the North America land environment. In the future, we plan to introduce the system to other onshore and offshore mar-

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kets. It is important to understand the specific workflows that allow us to automate the orchestration of the well plan and activities.

The solutions can be implemented offshore without barriers. For the rig of the future, we have worked very closely with our in-house original equipment manufacturer (OEM) product line, Drilling Systems, to ensure the hardware that has been developed for the rig of the future is digitally enabled with an interface to the software. When we decide to deploy the software solution on an offshore asset, we will focus on the most advanced assets with the best technology available. The hardware should be digitally enabled to gain the full benefit of the technology.

*Collaboration has perhaps never been as important as it is now. What examples can you share on how Schlumberger has worked to drive collaboration, either with operators or within your supply chain?*

Collaboration is a daily priority for us. We've collaborated extensively with the operators and suppliers on both technology development and operations.

For example, we worked with three of our major customers, Chevron, ENI and Total, to develop the INTERSECT high-resolution reservoir simulator. Today, the simulator is used commercially across the world. On the DrillPlan solution, we collaborate with several customers codeveloping applications for DrillPlan to ensure they're customized to their requirements.

We also collaborate with our suppliers on technology development. For seismic processing, which can take months due to the volume of data involved, we have worked

with the California-based technology company Nvidia to develop high-performance computing on its graphics processing unit device. This has significantly reduced the time required to process huge volumes of seismic data.

On the operations side, the success of our outcome-based contracts depends on our collaboration with the operator. Most of the time, we mitigate risks with technology and processes, and for this reason, we need to set specific goals in collaboration with our customers.

If it's a drilling contract, the goals are set in terms of drilling days or costs; if it's a production contract, the goals are set in terms of how much incremental production we aim to deliver. When we deliver on those goals, we have a premium-based pricing model that is tied to the risk. This way of working requires a significant amount of collaboration to create a win-win environment.

*As the uptake of digital technologies and data analytics ramps up in the industry, what can we learn from other industries that are further along this path?*

We can learn a lot from the automotive industry about automation and human machine interaction. The way a car interacts with the driver today is different than even five years ago. When you sit in your car, your devices seamlessly integrate with the car. That seamless integration is what I mean when I talk about breaking down interfaces with automation and digitization.

The manufacturing industry has also applied a significant amount of automation and mechanization. Besides the obvious benefit of driving productivity on the shop floor, automation also enables complete integration with the back office, such as supply chain, logistics and inventory management. This has a big impact on the way manufacturing companies work, with just-in-time planning of supply chains.

In the drilling space, we work with the organizations that have experience with aerospace projects. For example, we have collaborated with a startup founded by former NASA engineers. They bring vast experience on projects where they're providing remote support, such as supporting an astronaut on a space station.

Finally, we can learn a lot from the sports industry. There is a staggering amount of data collected during an NFL game, and that data is then used for making decisions on strategy or team selection.

*Cell phones can now integrate with other devices, from cars to watches. However, we often see that one provider's cell phone won't sync with another provider's tablet. Do you think we might face similar challenges in the drilling industry?*

You'd be hard pressed to find an existing rig where every piece of equipment comes from a single OEM. Because of that, it's a necessity in our industry to build platforms that can connect to multiple providers' equipment.

Openness is an important characteristic of the software we're developing. We understand that customers want to have choices when it comes to equipment and integration. With our cognitive drilling solution, we're not planning to integrate only Schlumberger systems. The interfaces at the wellsite, as well as between the wellsite and the office, are not defined as Schlumberger interfaces – the solution will work with both our and others' tools and technologies.

*There's been a lot of focus to push performance in drilling, but what is being done to push performance in completions?*

We have developed systems to improve our control of the fracture geometry. This includes advanced diverter techniques to ensure the right amount of proppant reaches the targeted place in the completion and achieves the right geometry per design.

In North Dakota, we used the BroadBand Shield fracture-geometry control service for Whiting Petroleum to stimulate wells, three of which are among the top 10 producing wells completed in the second and third quarters of 2017 in the Bakken Shale.

The BroadBand Shield service uses multimodal diverter particles to control fracture geometry, minimizing the risk of fracturing into undesirable zones. The wells treated with this technology use smaller fracture treatment designs, optimizing cost and enabling the customer to accelerate hydrocarbon production.

Another example is the Schlumberger OneStim offering for North America land unconventional operations. Through greater scale and vertical integration of products and services, the offering streamlines the completion-to-production cycle for customers. An operator in the Midland Basin has achieved consistent increases in stages delivered per day by using the OneStim offering for their

hydraulic fracturing services. Moreover, the operator broke the previous record for stages per day twice in its first month of operation. An operator in the Rockies achieved between six to seven stages per day, where the previous daily performance averaged four. OneStim enabled these operators to stay on schedule and deliver assets to market more quickly.

Soon, we'll introduce new enhancements to the automated stimulation delivery plat-

form, which improves reliability and reduces the footprint associated with fracturing jobs. Most importantly, the platform automates process control contributing to the increase of operational productivity. Overall, the new service delivers a more smooth and seamless stimulation operation. **dc**

*DELFI, DrillPlan, BroadBand Shield and OneStim are marks of Schlumberger.*