

Unique digital rig monitoring technology improves operational efficiencies and drilling performance

As the industry moves forward, producers are searching for ways to lower costs and reduce cycle times. Service providers must develop new technologies and sophisticated data analysis capabilities to better understand downhole conditions and rig performance, to improve drilling operations.

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The Covid-19 pandemic has changed the upstream industry, and the new normal means that producers expect more value and better performance from their oilfield service providers. Given the economic downturn, combined with a worldwide pandemic that has trampled energy demand, companies are forced to shift the way that they operate, with fewer crews, tighter budgets, and more efficiency at the well. Gone are the days of basing decisions on rule-of-thumb or prior experience; now, operators require concrete data to eliminate inefficient operations and downtime. Having data is no longer a bonus, but a necessity for efficient, effective production.

CORE TECHNOLOGY

High employee turnover is a chronic problem for the industry. When Axis Energy Services was formed in 2018, the company saw a need to develop internal personnel with a data-driven approach to coaching the next generation of crews, to improve efficiency for customers and reduce turnover. Axis CORE technology was born out of an industry need to provide real-time monitoring; help elevate crew performance; and drive continuous operational improvements. With its

comprehensive digital platform, CORE monitors, in real time, all of the critical measurements that operators need to ensure workovers, cleanouts, fishing jobs, and stick pipe drill-outs are accomplished safely and efficiently. In turn, this technology also creates key performance indicators (KPIs) and scorecards for customers to track their own company personnel and performance analysis.

“The idea of collecting critical digital data began with the development of an internal process of continuous improvement for our crews and operations that would be digital, accurate, and in real time,” says Dirk Lee, president and CEO of Axis. “We wanted a real-time view of what was happening at the rig during these critical operations, so we could identify problem areas and opportunities to allow us to coach our crews at the earliest possible moment. We also believed the information that would be useful internally would be valuable to our customers, so we designed the digital platform to allow for broad, real-time customer access.”

CORE systems have been applied in the Delaware and Midland basins of the Permian, in the Eagle Ford, Haynesville and Bakken shales, and in the Utica and Marcellus regions of the Northeast. In short, CORE technology is being utilized in every active U.S. oil producing basin.

As producers move forward and look for ways to lower costs and cycle times, it is essential to have a completion and workover company on location that has the technology to better understand downhole conditions and rig performance, to improve drilling operations. The CORE system, thus far, has performed 165 drill-outs with more than 50 clients, including drilling out more than 8,000 frac plugs from 20 plug vendors and approximately 20 downhole motor and bit vendors. CORE also has been utilized in 465 other jobs, ranging from fishing jobs and complex workovers to well maintenance. Through all of these various jobs, the company has gained unique knowledge about specific basin challenges; job planning to improve execution; and which types of plugs and downhole motors tend to be the most reliable and effective.

Real-time data through rig monitoring technology. Axis CORE technology utilizes wireless sensors embedded on critical parts of the rig and support equipment, which results in no additional rig-up or delay in moving locations. The sensors provide high-resolution data sampling rates that are displayed in real time to the rig operator and customers on phones, pads or computers, **Fig. 1**. The CORE digital platform is unique, because

Fig. 1. The rig data display and field monitor ensure that all relevant information is available to the rig operator and remote users.



of its ability to collect data on the rig and all the information generated by the ancillary equipment, including pumps, trip-pumps and tongs.

Through the system's software dashboard, graphs are built in real time as the job proceeds, **Fig. 2**. Analysis of each job is done, both in real time on a plug-by-plug basis and in a detailed post-job report. KPI reports are generated to give operators a quick status, at a glance, of the overall job health, providing a snapshot of all wellsite events happening at a particular moment in real time. KPI reports can be customized to reflect the elements that a customer is specifically interested in monitoring.

Some, but not all, of the critical data collected and sent to clients includes block height, a safety feature preventing blocks from dropping in order to protect employees and the rig floor and crown; BOP ram status, a safety feature ensuring that the rig cannot attempt to pull pipe into a closed BOP; average time to drill out a plug, a measure of crew productivity and brand of frac plug, in order to make continuous improvements and set expected times; average time to next plug, which is usually dictated by the amount of sand and debris in the well; frac plug vendor drill-out times, which are useful to operators when selecting a vendor; and flowback sensor data, to inform employees of the flow coming back from the wellbore and how much sand and plug parts are returning.

The digital system also collects data on depth in the well, weight on bit, rate of penetration, pump pressure, swivel torque, swivel RPM, tong torque, rig mobilization time, third-party downtime, all company downtime, and local

weather data, including wind speed and ambient temperature. Real-time job logs, with notes on events and issues entered by the rig crew, are also provided to help piece together the data and provide a continuous narrative to reflect what is happening at the rig site. If a client has multiple rigs working with Axis, a fleet management option is available, which allows the customer to schedule rigs and see the real-time progress of all rigs assigned to their jobs.

All data ecosystems are kept in secure cloud-based storage and can be provided to the customer for their own analysis and post-job processing. Real-time data through automatic KPI reports allow operators the ability to review, analyze and control their operation as the job proceeds, without the need to be on location every second.

Reducing costs and mitigating NPT.

The CORE data system not only provides a real-time view of all activities at the rig, but it also produces a rich set of data so that operations can be executed faster, reducing costs and helping to eliminate downtime.

Monitoring tongs, swivels, and all moving equipment on the rigs enables engineers to track how efficiently Axis crews are interfacing with each piece of equipment. Training needs have been tailored to focus on areas where crews are outside of the measured norms, and those who have not met the average connection times are notified in real time, when they are outside of the desired "green" zone. Measured best practice is then applied to that rig.

As CORE's technology monitors all moving equipment on the rigs and support equipment, the system automati-

cally sends a notice directly to the rig and field management, if any desired parameters fall outside of the target. If average plug milling time, for example, falls outside the target for a well, a notice is sent out to explore the underlying causes. Likewise, block weight is monitored to inform management in real time of maximum pull getting close, in order to ensure no over-pull beyond the programmed limits. Operators using a service provider with a digital system that sends alerts, as a way to stay ahead of potential or real challenges on location, is more effective than constantly checking the wellsite for status updates.

Axis builds custom notifications for any type of equipment, event, or KPI in the CORE system. Alerts are assigned to a specific rig or user, and when notifications are sent, an issue is created, which has to be closed by management personnel to complete a job or task. As Axis collects more data, the predictive data analytics will allow us to notify customers when we begin to detect equipment issues, downhole motor problems, flowback issues that might lead to incidents, or other unwanted conditions.

Additional savings through data-based decision-making. Further cost reductions can be achieved by using data-based decision-making in determining:

- When to do a pumping sweep of a well during drill-out of frac plugs. Often, the decision on the optimal time to do a pump sweep today is made based on a rule of thumb or prior experience, rather than looking at pump pressure, swivel torque, rate of penetration, and flowback return rates. Reducing the number of pump sweeps during a frac plug drill-out could save many hours on a job.
- When to dispense chemicals during a drill-out. Again, the decision as to what type of chemicals, how much, and when to release is often based on prior experience and not real-time data. Operators will be able to save money by using less chemicals and reducing pumping times, which lowers emissions.
- Whether the use of a rig swivel for plug milling is a better cost-savings approach than using a downhole motor to mill. The company is working with several clients to

Fig. 2. Each operational rig is displayed in a software dashboard. It can be viewed on any mobile, web-enabled device, to check the status of an operation or enter job data, to produce a centralized job record.

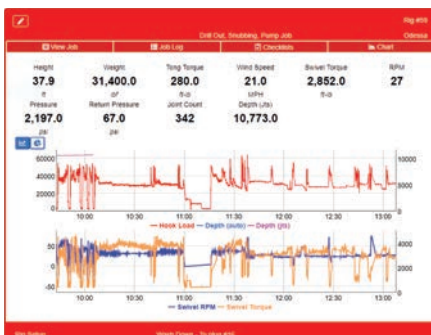
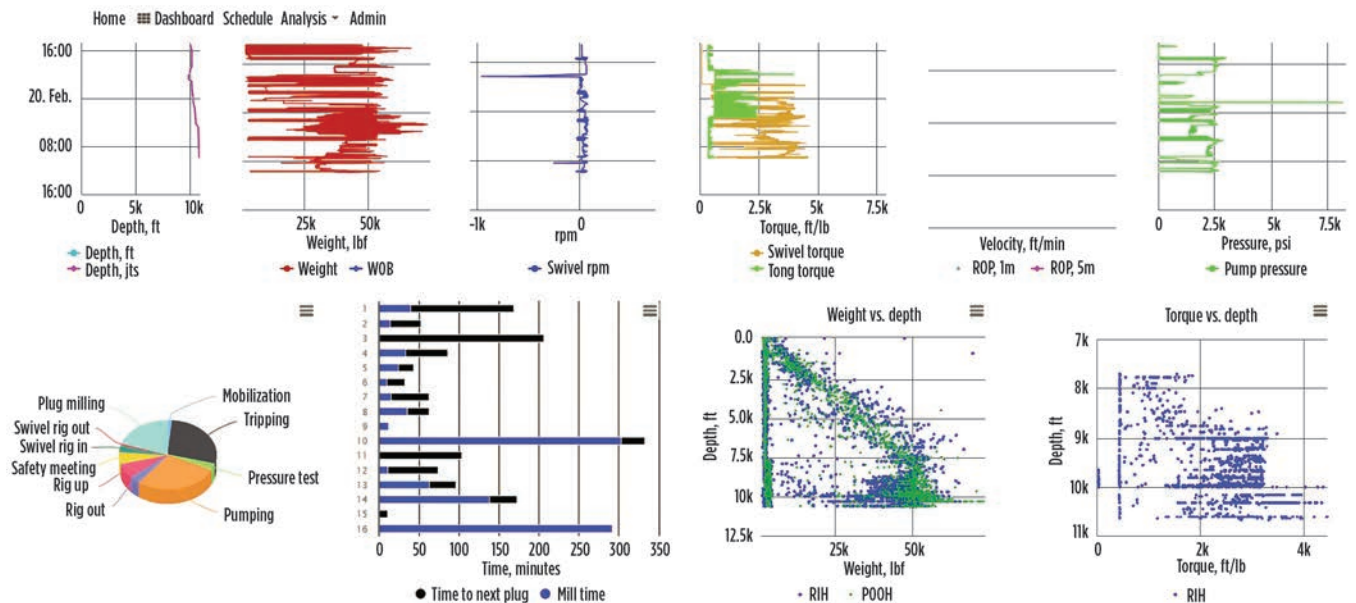


Fig. 3. Axis applies innovative monitoring technologies, to better understand downhole conditions and rig performance, to improve drilling operations.



Fig. 4. Analysis of a job is done in real time, on a plug-by-plug basis and in a post-job treatment report. This detailed output provides engineers with real time data, including weight, depth, torque, RPM, average running speed and plug times.



evaluate the cost-savings of this switch in operations; and so far, the data look encouraging, with only a small increase in milling while using the Axis rig swivel versus a motor. Eliminating a motor can save several thousand dollars per day for the operator.

Continuous improvements increase efficiencies. Axis is constantly making improvements to CORE's digital platform to improve efficiencies and continue to reduce cycle times for our clients. As an example, the company recently ran a downhole memory tool in the bottomhole assembly to confirm actual weight on bit, **Fig. 3**. Axis is not aware of any other well service company that has compared data from a memory tool to surface-measured data, doing stick pipe drill-outs. When it comes to filtering data through algorithms in the digital platform, in particular with weight on bit, knowing exact measurements is critical to the efficiency of drilling a plug.

When analyzing data from the memory tool, we were able to make substantial improvements to the system's algorithms, in order to provide reliable estimates of weight on bit downhole. Additionally, the company has used the downhole memory tools to improve torque measurements on the drill pipe and at the bit—measurements at surface compared

to measurements downhole. To minimize the chances of damage to the drill bit and, as a result, minimize downtime, operators need to partner with a service provider that has the technology to monitor that data.

As part of the latest improvements to CORE's digital system, a new KPI reporting tool was created to provide the necessary equations that improve data collection that the company needs to complete jobs and decrease downtime. KPI reports help dissect data in CORE and allow operators to print customizable post-job reports at the end of a job from metrics that they have chosen, to analyze data that are essential to their operations. The company uses the data it collects to help produce "A-players," so that all employees perform the same at every job, with the correct coaching. The flexibility of the CORE system to provide the specific key measurements requested by customers, to create customizable reports on rig activity, benefits operators when performing their own internal analysis of equipment and personnel.

Real-time wellsite access from anywhere. Field management and leadership have learned from recent events that wellsite data and having access to a digital platform, to check on operations from anywhere, are essential in today's oil field. With each operational rig displayed in

CORE's software dashboard and the use of cloud-based data storage, any mobile device or desktop can be used to check the status of an operation in real time or enter job data, allowing for a centralized job record, **Fig. 4**.

The Axis CORE system has been in the field working live for more than a year, and is a proven, reliable, and highly effective solution to achieve continuous improvement in operations, resulting in cost-savings for customers. CORE provides a smart, digital approach to managing well completions, workovers, and production tasks in today's cost-conscious oil field. **WO**



WENDELL R. BROOKS is chairman of the board of Axis Energy Services. Prior to joining Axis at the company's inception, Mr. Brooks previously served in multiple executive leadership roles, and on the boards of directors for multiple oil and gas companies, spanning more than 25 years. Prior to that, he served in leadership roles at companies in other industries.



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