NOV Automation

Efficient wellbore construction through optimized drilling and enhanced rig process control

Visualization (Remote/Local)

Automation-enabled control system

Drilling applications

HIGH-SPEED COMMUNICATIONS

HIGH-SPEED COMMUNICATIONS

WIRED DRILLPIPE

HIGH-SPEED DATA

HIGH-SPEED DATA

Automation for the industry. Performance for your wells.

The oil and gas industry is on the precipice of momentous change, making drastic improvements to productivity, performance, and efficiency more possible than ever before. NOV is delivering the technology of the future now, driving powerful innovation and positive change that will propel your drilling operation to new depths.

Managing the performance of downhole drilling dynamics and surface operations presents unique challenges and opportunities. An optimal drilling program successfully merges the downhole and surface drilling environments to achieve impactful, consistent results—high-quality wellbores delivered safely and efficiently.

At NOV, it's our job to understand the complex interfaces between the different components within the drilling and rig systems. We've combined high-speed downhole data with a comprehensive drilling model and a process controller to develop an advanced NOV Automation process. This provides the driller with an autopilot system that recognizes and adjusts to the downhole environment and consistently delivers an optimized well program. NOV Automation supports informed decisions that enhance on-bottom drilling performance, reduce invisible lost time and nonproductive time, and improve equipment reliability. This results in reduced well construction costs and consistent, repeatable performance without introducing risks to personnel or equipment.

HIGH-SPEED COMMUNICATIONS

HIGH-SPEED COMMUNICATIONS

OPTIMIZED BHA

HIGH-SPEED DATA

HIGH-SPEED DATA

Strengthen your rig fleet with more efficient drilling performance

The conventional drilling process is dependent on the experience of the driller. NOV Automation gives you the opportunity to capture lessons learned from well to well, apply improved processes and drilling parameters, and reduce the potential for human inconsistency in your drilling operations.

When our integrated automation system is deployed on your rig, the driller is free to coordinate and focus on the most important aspects of drilling—ensuring the safety of the crew and rig, maintaining an optimal downhole environment, and maximizing overall performance. Our advanced process controller automatically repeats the steps involved with manual drilling, but those steps are now completed faster and with more consistency.

The integrated system controls the drilling process and derives its setpoints from surface data, high-speed downhole data, and a comprehensive drilling model, using accurate information that reflects the true downhole environment and allows the system to be run with less conservative safety margins. Throughout the drilling process, our drilling applications and software interface with the control system, providing real-time downhole dynamics data such as weight on bit, toolface control, cuttings monitoring, and downhole pressure management.

When the well is completed, the lessons learned can be automatically captured and the optimized well program is uploaded to the system where it will repeat the process. Through NOV Automation, your rig can drill close to its technical limit, applying proven drilling processes for consistent, repeatable performance.

NOV Automation: The future of drilling built on a history of success

NOV has built a presence in the oilfield based on the reliability and innovation of our products and technologies. As a manufacturer of rig surface equipment, downhole tools and systems, and completions equipment, NOV is uniquely positioned to deliver a fully integrated automation solution…and we've done that.

Our closed-loop downhole drilling system feeds high-speed drilling data into state-of-the-art autonomous rig controls, which optimize and control the well construction process for a cost-effective solution on your rigs or in your operations.

> **For an operator, NOV Automation improves your decision making and allows you to get a higher level of performance and efficiency out of your entire rig fleet. For contractors, NOV Automation is the ultimate point of differentiation for your rig, giving you a distinct advantage over competitors and making you a preferred partner with the operator.**
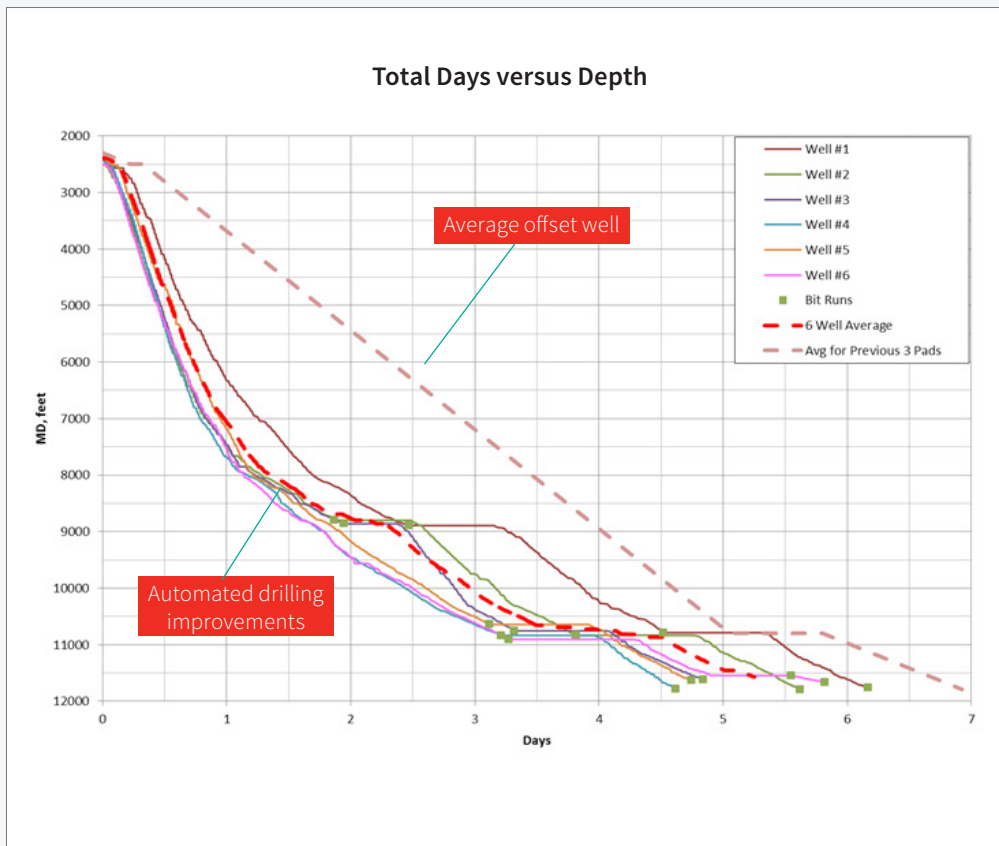
NOV control systems are engineered, designed, and manufactured by the same company that produces your OEM drilling equipment and systems. This ensures a seamless interface that displays functional, accurate information and allows simultaneous monitoring of multiple pieces of equipment with a high degree of redundancies and advanced diagnostics.

Total Days versus Depth

The days versus depth graph illustrates improved total time and consistency after implementation of NOV Automation. All six wells drilled faster than the average of the previous three pads, and three of the wells drilled the vertical section in one bit run.

Take advantage of your rig's full potential

NOV Automation allows you to safely extend your operating limits, which helps utilize the full capabilities of your rig and can deliver significant spud-to-TD performance improvements.

- Real-time pressure visualization helps to extend reservoir sections
- Topside and downhole environments can be controlled
- BHA and drillstring components last longer

Delivering efficiencies from bit to crown to improve your overall performance

Our automated system combines controls, drilling systems, and software applications from our **eVolve™ Optimization Service** and **NOV Operating System (NOVOS™)** to deliver proven results. From a **42%** reduction in spud-to-TD time in the Eagle Ford to an additional **15%** of reservoir access in Norway, NOV is setting the standard for automation systems around the world.

NOV controls are designed to be fully configurable, expandable, and scalable across your rig fleet, reducing the time and cost of automation implementation when compared with mixed third-party controls and non-OEM equipment. NOV controls provide the driller with more data and real-time readings than any other controls in the industry, allowing you to analyze, comprehend, and improve your drilling performance. We've further revolutionized drilling process control through **NOVOS**, which is our advanced rig equipment control interface and automated drilling platform that allows custom applications specific to your drilling needs.

During the drilling operation, our **eVolve** downhole tools acquire pressure, dynamics, and MWD information, transmitting real-time data via the **IntelliServ™** high-speed telemetry network. Our tools acquire data at multiple positions in the drillstring, providing internal and annular pressure, temperature, rotation, and three-axis vibration information to determine the most efficient drilling parameters. In addition, MWD data is streamed to the surface every second to help you achieve your directional drilling objectives.

In addition to the **NOVOS** benefits, the acquired downhole data supports specific drilling software applications, enabling you to further optimize the drilling operation. Our drilling software uses the data to enhance wellbore understanding—from recommendations and data visualization to closed-loop control—improving operational efficiencies and reducing manual interpretation of drilling data.

The combination of **NOVOS** and **eVolve** drilling software provides the driller with a real-time tool set they can use to automatically adjust drilling parameters and implement steps of the drilling process. NOV Automation provides well construction teams with the information they need to continuously improve drilling performance without losing focus on other critical responsibilities.

For more information about **NOV Automation**, contact us at **NOVautomation@nov.com**

nov.com/automation

Drill your well with confidence. Then do it again.

Imagine faster, safer, and more effective drilling operations at the touch of a button. Our NOVOS process control capabilities integrate drilling intelligence into your existing NOV control system to become the foundation for consistent, optimized well creation that's scalable across your rig fleet.

As a rig operating system, NOVOS manages hardware (rig equipment and sensors) and software (existing control system and applications) to provide a common platform—regardless of rig specifications—so that your decisions to control, monitor, and optimize your drilling operations are easily and consistently executed in one simple interface.

NOVOS automatically performs repetitive drilling activities, integrating the best of human and equipment capabilities to execute your well program. NOVOS-structured data and defined activities provide early performance gains in challenging assets, and then perpetuate lessons learned to deliver best practices for regions and clients, regardless of their location.

NOVOS features customized applications for specific drilling requirements, allowing the driller to reach the boundaries of equipment capabilities and drill more aggressively without increasing risks.

An application-programmable interface and software development kit (SDK) simplify the development of optimization applications that use sensor data to control rig machines. The NOVOS SDK provides third parties with safe access to a wide variety of functions within the NOVOS system. Applications can be layered, prioritized, and partitioned to provide flexibility of control and monitoring in a way the industry has never seen.

NOVOS
Faster, safer, and more effective drilling intelligence into your

Screen image simulated.

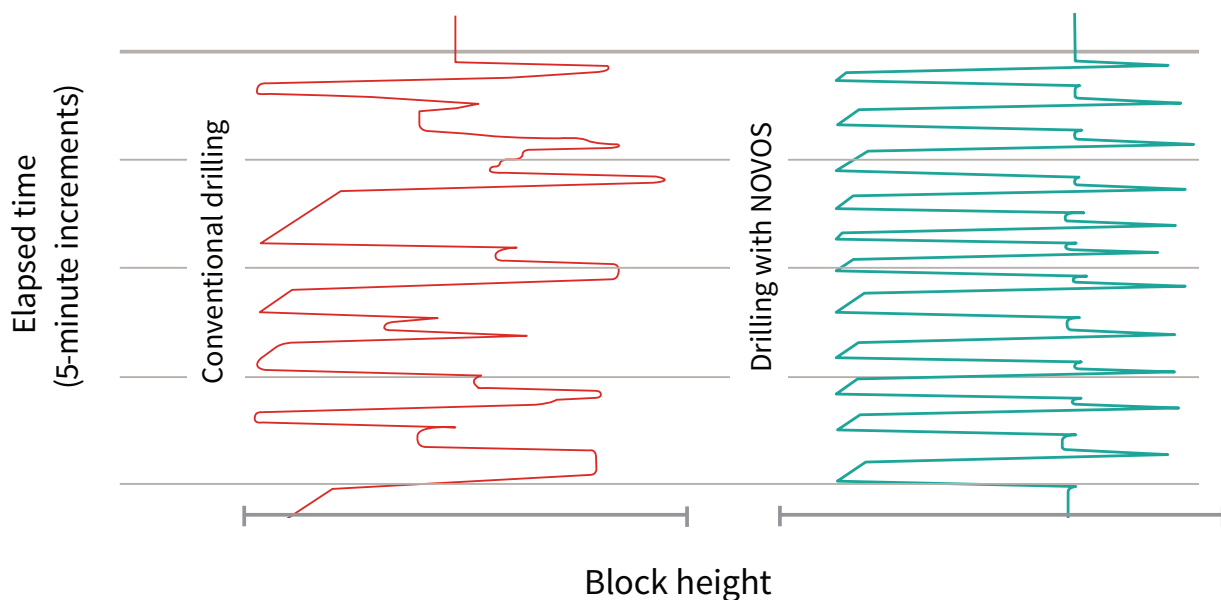## Develop and install your own applications on NOVOS

NOVOS offers developer packages that allow the creation of personalized applications. Operators, contractors, or service companies can apply optimization with their own applications while maintaining the proven safety and precision of NOV control systems.
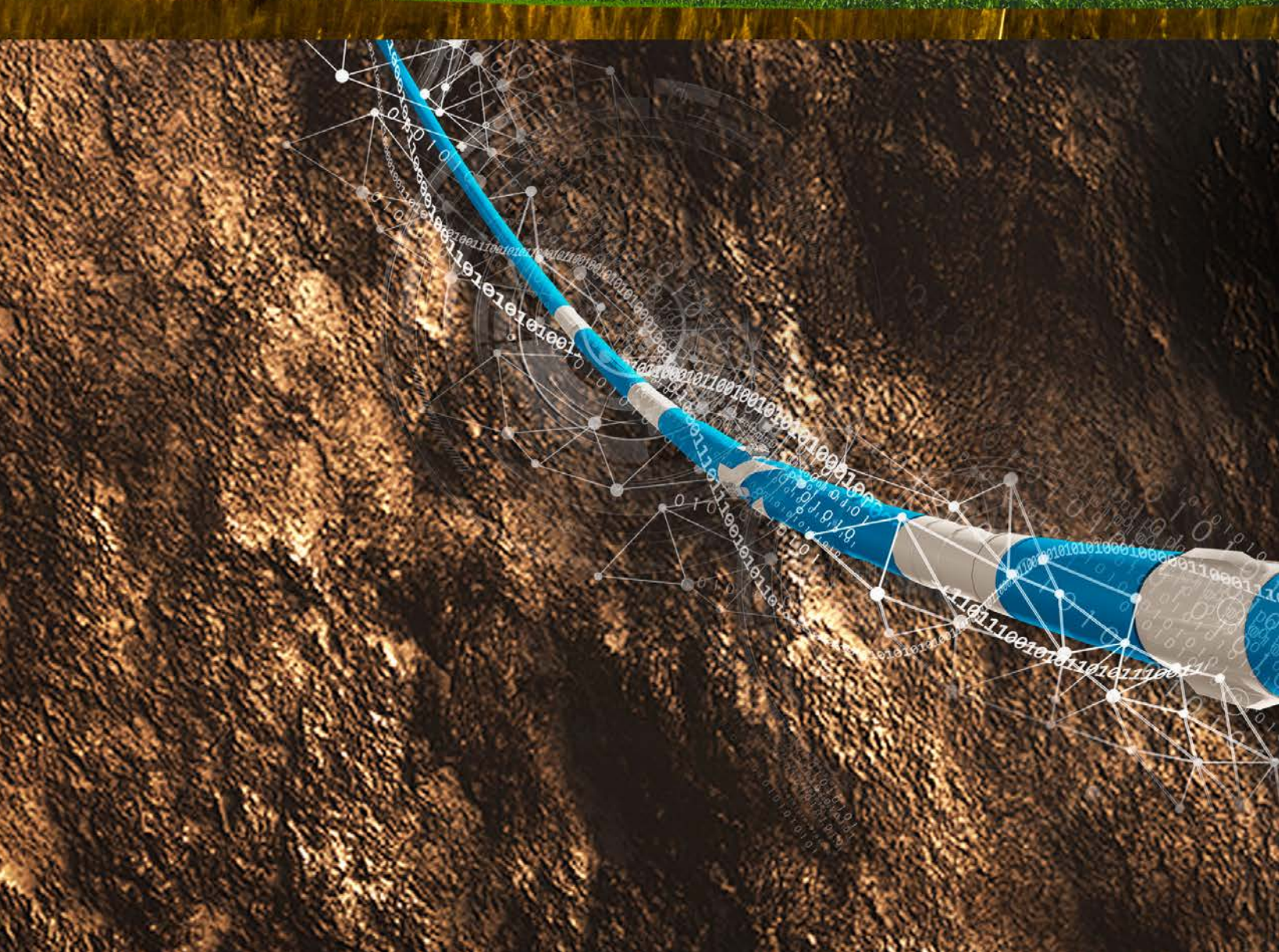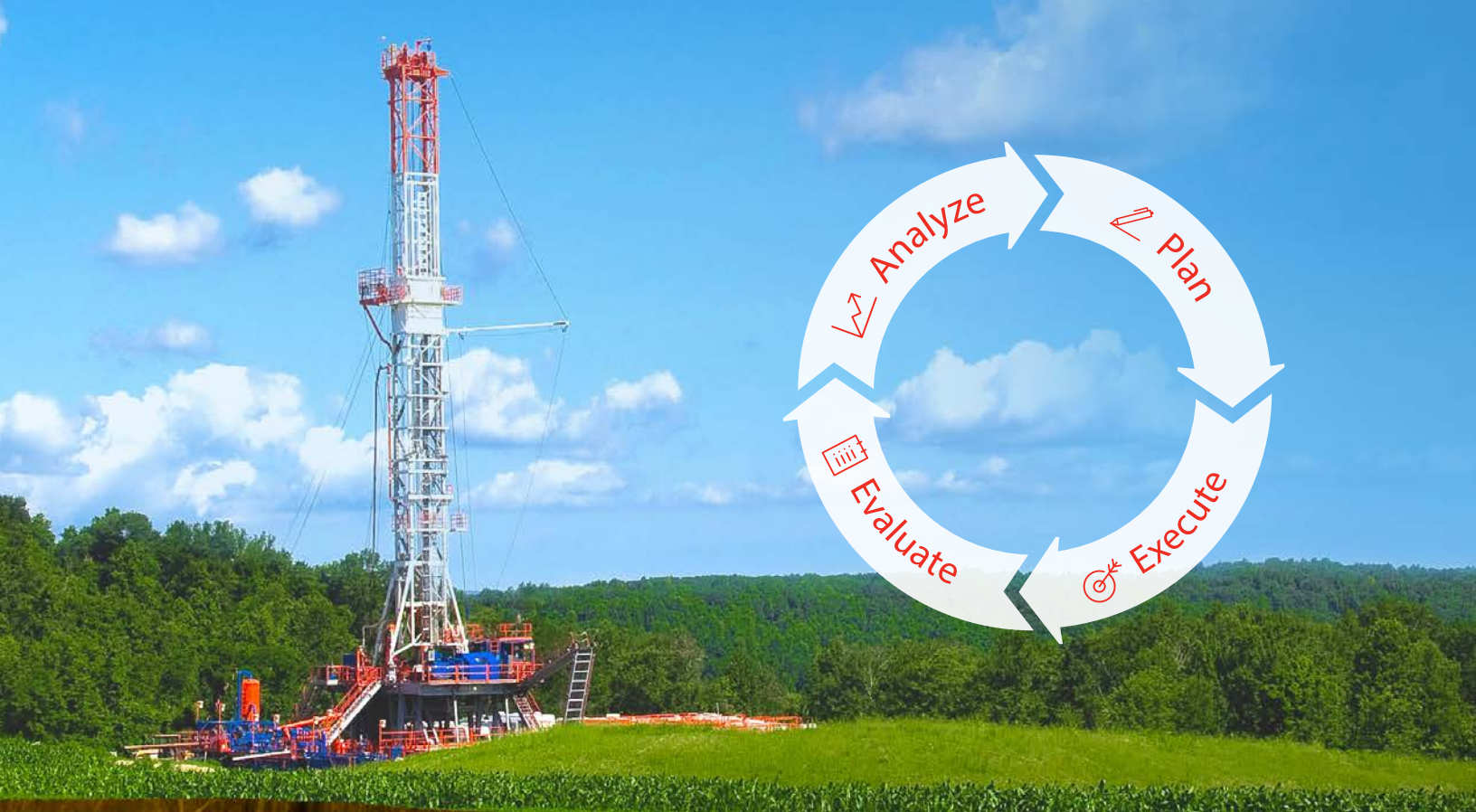
drilling operations using an operating system that integrates existing NOV control system

Automated processes to make drilling more consistent

Elapsed time (5-minute increments)

Conventional drilling

Drilling with NOVOS

Block height

*This graph shows a sample of actual traveling block height and illustrates the more consistent **NOVOS** drilling (right) in comparison to conventional drilling (left). **NOVOS** is able to complete twice as many cycles as conventional drilling, and delivers them more consistently in the same amount of time.*

Analyze · Plan · Execute · Evaluate

Patented, closed-loop control improves performance and generates real-time analytics to support your drilling decisions

Our **eVolve Optimization Service's AUTOMATE** tier equips existing rigs, rig crews, and engineers with an advanced toolkit that delivers performance, enhances real-time decision making, and provides analytics capability. Sensors in the drilling environment enable best-in-class performance with a control system finely tuned for any operation. The **eVolve** service uses innovative software to improve drilling performance and operational efficiencies in addition to reducing manual interpretation of drilling data.

Continuous improvement is the foundation of our optimized drilling process. We enhance your drilling performance throughout your project's life cycle using a four-phase approach—analyze, plan, execute, and evaluate.

We begin by critically reviewing key performance indicators and drilling data to understand how to improve drilling system performance. We analyze data to identify risk and opportunity, aiding in well planning. We then build a strategy for you. Using benchmarks and performance objectives, we plan and assist in BHA design and develop drilling parameter roadmaps, supported by our suite of software planning tools. After mobilizing our tools and systems to your rig, we execute the plan, including the acquisition of enhanced data in real-time, mudpulse, electromagnetic, or memory mode. Through a deeper understanding of your drilling environment and the continuous support of our **Real-Time Technology Center**, we continuously evaluate the drilling operation and make effective recommendations that optimize performance.

Real-Time Technology Center

Mitigating risks to ensure safe, reliable operations

Our stick-slip prevention service is an algorithm software that's loaded onto the topdrive controller where it mitigates and prevents stick-slip oscillations of the drillstring. The service automatically accelerates and decelerates the topdrive to dampen the harmonic response of the drillstring to improve performance over a broader range of conditions, including extremely long wells where competitive systems normally fail. The software constantly monitors the occurrence of stick-slip through the analysis of relevant parameters, indicating stick-slip severity on the HMI and alerting the operator when the system needs to be activated. An autotuning feature will automatically detect and mitigate stick-slip without manual tuning from the operator.

Throughout the drilling process, our condition-based monitoring and maintenance systems provide a predictive solution that foresees operational failures in equipment such as topside equipment and subsea blowout preventers.

Using a network of native and condition-monitoring sensors, we turn raw data into condition information that compares your rig with acceptable usage, wear, and fatigue models for a real-time snapshot of your topside equipment's health. Predictive analytic tools build upon our equipment monitoring service, providing proactive alerts that warn of potential breakdowns so you can address the problem before it becomes a costly event.

Our combination of equipment knowledge, operational data, and condition monitoring data helps you develop a condition-based

maintenance schedule that aligns with your operational plan. As the OEM, we have the most comprehensive knowledge of NOV equipment and systems, and we use that expertise to help you estimate when components or systems are nearing their endof life or when you should plan an equipment change-out or repair.

Modern efficiencies, accurate data, and reliable tools quickly integrated into your operations

Our NOV Automation investment and development plan has strategically aligned numerous advanced technologies to provide a tested, field-proven system that delivers safety, consistency, and confidence in your drilling operations.

Our automated system provides upgrades to existing drilling equipment, applies optimization software, and implements intuitive tools at a minimal cost with the least impact to productivity. The repeatability and consistency of our automation system also promotes a more efficient supply chain process, eliminating invisible lost time at the wellsite and providing easy-to-adopt performance standards across your fleets and regions.

We've developed a true closed-loop automation system that incorporates intelligent controls, preparing the industry for an era of unparalleled productivity and performance. But our vision doesn't stop here—we'll continue to create, to innovate, and to make the impossible a reality as we build the rig of the future.

nov.com/automation

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