How Halliburton beat a client's drilling average by 43%, saving them more than $200,000.

Integrated bit, fluid and drilling services allowed Halliburton to model, measure and optimize continuously, saving 3.6 days.

OVERVIEW

In the U.S. Denver-Julesberg basin, Halliburton provides integrated drilling services for a major operator and has been setting drilling records there for years. From 2009 to 2011, Halliburton helped them reduce drilling days from 18-20 per well to less than nine. Now that the client's average is 8.6 days, Halliburton is drilling wells near five. Recently, Halliburton drilled one in 4.9 days and is approaching the technical limits of this drilling program.

Close collaboration between three Halliburton services – Drill Bits, Sperry Drilling, and Baroid Drilling Fluids and Surface Solutions – allowed each to optimize services for each other. Compared to working with a series of vendors, each pursuing its own self interest, this created exceptional efficiencies for the client. The ability to continuously model, measure and optimize these three services *for each other* resulted in saving 3.6 drilling days (worth more than $200,000) compared to the client's norm.

CHALLENGE	SOLUTION
Minimize sliding time To maximize efficiency, bits must be designed for both the geology and the bottom-hole assembly (BHA). If not, down-hole dynamics such as stick-slip, whirl and vibration (SSWV) can reduce reliability and directional control. Yet most drillers choose bits on past experience, not expected conditions.	**New bit design through DatCI℠ modeling process** Using its DatCI℠ (Design at the Customer Interface) process, Halliburton developed two new bit designs – custom-tuned for Denver-Julesberg geology and Sperry's BHA. They minimized SSWV at high rates of penetration and provided reliable directional control.
Maintain fluid parameters When drilling this fast, most centrifuges cannot keep up with the volume of mud that must be cleaned before it is recirculated back into the well. Therefore, surface treatment of solids often becomes a constraint on the rate of penetration (ROP).	**Integrating fluid services with surface treatment** All of the Halliburton groups worked with each other to model the volume of cuttings at maximum ROP. The Baroid Surface Solutions group then configured enough centrifuge capacity within footprint constraints to maintain fluid parameters and maximize ROP.
Maximize drilling efficiency In the rush to increase ROP, drillers often create SSWV that can damage the BHA and increase sliding time. Both can slow drilling and increase costs by making time-consuming repairs or course corrections necessary.	**Model, measure and optimize in real time** During drilling, real-time monitoring of drilling performance enabled each Halliburton group to measure and optimize tools to ensure that an action by one group did not create a problem for another. This cut rotating time by 43% or 3.6 days, saving between $200,000 and $250,000.

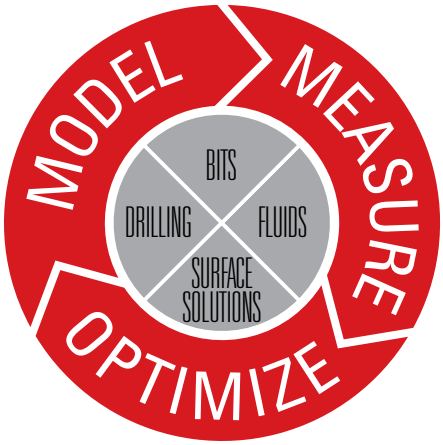
A CASE STUDY: *The power of integration reduces drilling costs in the Denver-Julesberg Basin*

During this period, rig spreads averaged $75,000 per day. By saving 3.6 days, Halliburton saved its client more than $200,000 in rotating time. This equated to about 20% of the average well's total cost.

8.5
CLIENT AVERAGE

4.9
DAYS FOR HALLIBURTON

By the third quarter of 2013, the average number of drilling days per well in the Denver-Julesberg basin for this operator was 8.5; at the end of that quarter, Halliburton was drilling them around 5 and drilled one in 4.9 days. That was 3.6 days below the program average.



Halliburton modeled, measured, and optimized continuously to improve the performance of bits, fluids, surface solutions and drilling. Each team worked closely with the others to monitor performance in real time and optimize overall team performance, not individual domains.

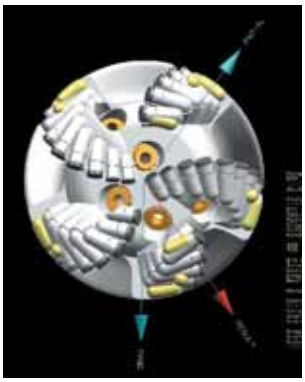
zero HSE INCIDENTS

Despite the speed, there were no HSE incidents during the drilling of either of these two wells. The speed came from higher ROPs, not eliminating any steps that could have compromised safety.

Solving challenges.™

HALLIBURTON

Integrated bit, fluid, surface and drilling services helped Halliburton model, measure and optimize continuously, saving 3.6 drilling days and more than $200,000 compared to norm.



Still improving after years of drilling in the Denver-Julesberg Basin

A typical horizontal well in the Denver-Julesberg (DJ) basin has a measured depth of approximately 11,000 feet. In the third quarter of 2013, drilling such a well took an average of eight days. Halliburton drilled one during that period that took just 4.9 days. That was 43 percent or 3.6 days faster than the client's average and saved the client between $200,000 and $250,000.

Optimizing for four variables produces extra efficiencies

This exceptional performance resulted from providing multiple integrated services. They included bits, fluids, drilling and surface solutions. Each service was optimized for all others, not just itself. As a result, the team produced efficiencies far beyond the average.

New bits designed after analyzing years of data

An Application Design Evaluation (ADE) specialist from Halliburton Drill Bits analyzed years of data using Halliburton's proprietary DatCI℠ (Design at the Customer Interface) process. This modeling software thoroughly examines the local lithology, performance histories from offset wells, and the customer's overall drilling plan/parameters.

This resulted in optimal drill-bit solutions designed to help achieve specific objectives. The vertical drill-out took only 11.2 on-bottom drilling hours, the curve took 10.4, and the lateral took 13.6. Bit performance tracked best in class.

BHA balanced with bit and rotary speeds to minimize SSWV

Sperry's drilling specialist used Halliburton's MaxBHA™ design software to optimize the bits and BHA for each other to create a tuned, neutral system. This minimized stick-slip, whirl and vibration (SSWV). And that minimized the need for time consuming slides to make course corrections.

Sperry Drilling Services also used MaxBHA™ design software to model optimal rotary speeds and understand harmonics. Whirl is a function of harmonics that produces stick-slip and vibration, which result in wasted energy and inefficient destruction of the rock by the bit.

During drilling, Sperry monitored vibration in real time and – when necessary – optimized rotary speed, weight on bit, pump flow rate, differential pressure, and torque to maximize drilling efficiency and bit engagement.

Engineered fluid solution maximizes wellbore value

Baroid ran six friction coefficient tests for this client while drilling previous wells and designed a mud lubricant specially optimized for drilling conditions in the Denver-Julesberg basin. By reducing friction, the lubricant enables higher rates of penetration that save far more than its cost.

Integrated bit, fluid, surface and drilling services helped Halliburton model, measure and optimize continuously, saving 3.6 drilling days and more than $200,000 compared to norm.

Baroid fluid and surface solutions teams help increase ROP even more

Halliburton Baroid provided both drilling fluids and surface solutions for this well. Integration of these two services improved de-watering performance, which reduced the client's chemical charges by 50 percent. Mud engineers worked closely with solids control to introduce new flocculants and coagulants that removed ultra-fine particles from fluids more efficiently.

As a result, fresh water could be returned to the rig for drilling; mud weight and other fluid parameters remained consistent; and the target ROP was achieved. The ability to reuse fluids in "good-as-new condition" not only reduced chemical costs, it reduced cleanup and disposal costs, too.

Integration of services produces more cost savings

Baroid, Sperry Drilling and Drill Bits worked with the client to predict the volume and rate of fluids and waste that would be coming from the well. During de-watering, insufficient centrifuge capacity can limit the rate of drilling. Modeling predicted that drilling with the new bit and BHA would produce 100 to 200 more gallons per minute than one centrifuge could handle. Baroid designed a surface solution with the required capacity that was easy to transport and had a small footprint on the drill site. It thus eliminated yet another constraint on ROP.

Zero HSE incidents

No HSE incidents were reported during the drilling of this well. All time savings came from achieving faster ROP, not eliminating any steps or taking any risks that would have compromised safety.

Integration enables cross-modeling, measuring, optimizing, saving

Halliburton has repeatedly shown that integrated services can consistently beat the drilling average for the Denver-Julesberg basin. Even though up-front costs for items like special lubricants and additional centrifuge capacity might be higher than normal, they can produce significant savings by reducing well-construction time.

Approaching the technical limits of drilling in the DJ Basin

The ability to continuously model, measure and optimize all services for each other produces higher efficiencies than when working with a series of standalone suppliers. Halliburton's integrated drilling services are approaching the technical limits of drilling performance and producing the most cost-effective, best-in-class wells in the Rockies.

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