Getting the right Placement

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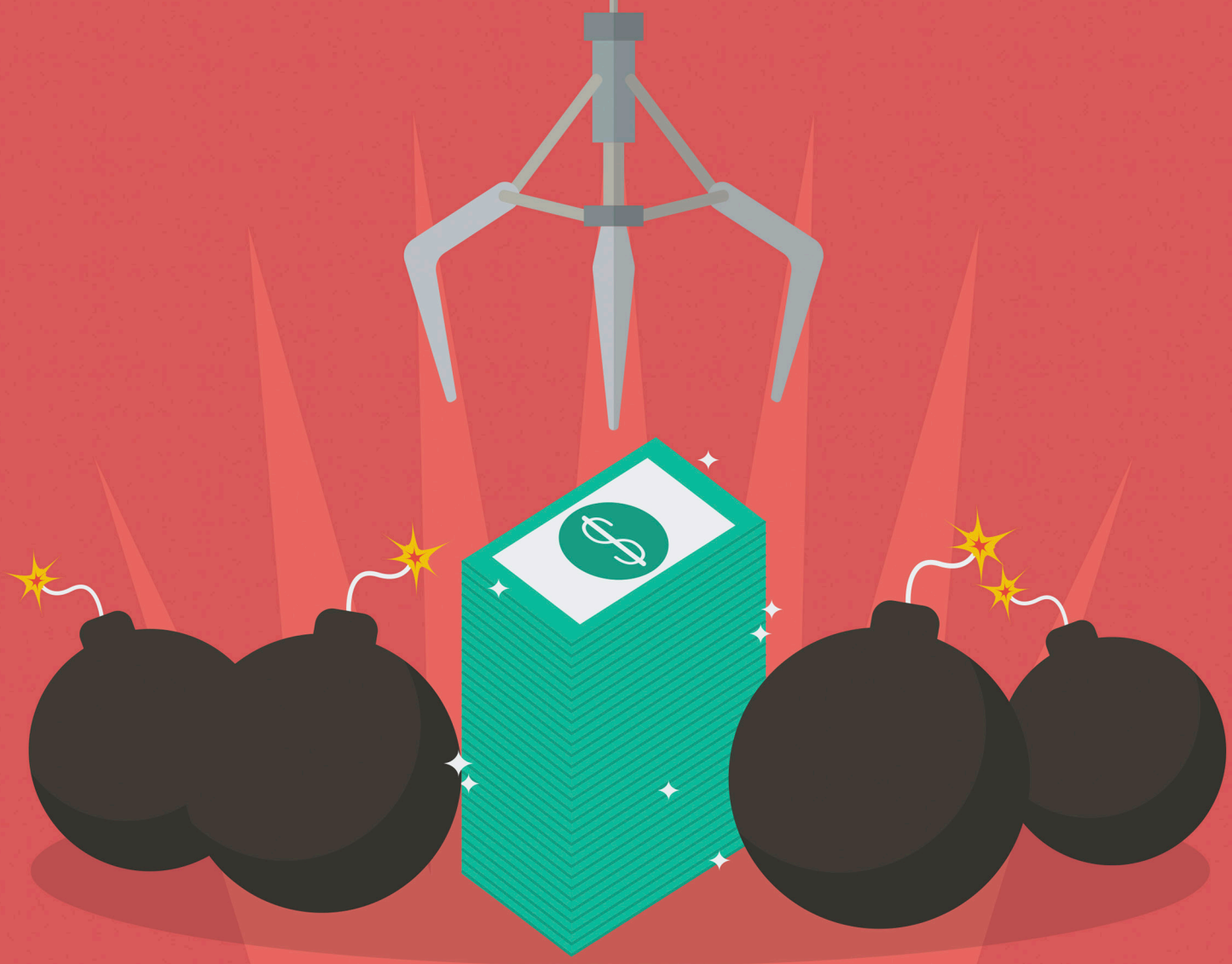
explore how gyro while drilling technology can improve wellbore collision risk mitigation and well placement in challenging projects.

The role of wellbore placement in oil and gas operations has evolved in step with the industry itself over the last decade. Given the current economic challenges of operating in a pandemic and facing stagnant commodity prices, the focus has shifted to drilling wells that are more accurately placed and can quickly be completed and produced to begin the road to profitability. Fortunately, technology innovations through the years have brought the industry far in this domain, with one such advancement being in the area of gyro while drilling (GWD) systems. There is an undeniable and direct link between high-accuracy wellbore surveying and better wellbore placement, and GWD technology provides a host of benefits not typically available with measurement while drilling (MWD) tools. With wells getting more complex, despite seeing decreased authority for expenditure (AFE) levels, a surveying system that can collect data of superior accuracy and precision in real-time while drilling has cleared the way for operators to achieve a level of performance not previously possible.



Technology

GWD technology collects real-time survey data to allow for more accurate wellbore placement and improved operational safety, with Gyrodata's GWD systems enabling the collection of real-time data at all inclinations and any direction. The system provides continuous inclination and toolface from vertical while sliding and directional surveys on demand. In scenarios where magnetic interference would compromise the data from MWD tools, a GWD system can typically provide improved survey accuracy and more flexible and cost-effective bottomhole assembly (BHA) design.

GWD70™ and GWD90™ are Gyrodata systems that operate at maximum inclination angles of 70° and 90°, respectively. The system is chosen based on the operator's highest planned survey inclination, complete drilling plan, well type, and compatibility with other BHA technologies. When running a GWD system, an operator no longer has to use wireline gyros to orient or steer the drilling assemblies, and the precise wellbore guidance made possible by the system helps mitigate the risk of wellbore collision and ensure the well trajectory is correct. Understanding real-time wellbore position can make a large difference in a project's operational and financial success.

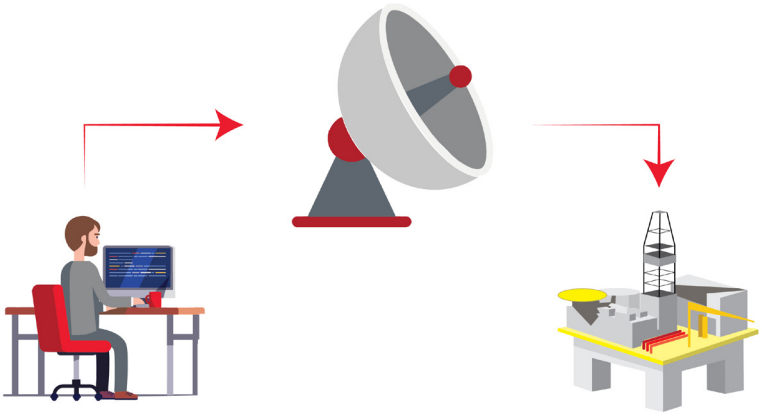


Figure 1. *Unmanned GWD operations are made possible by survey specialists onshore supporting rig personnel offshore.*

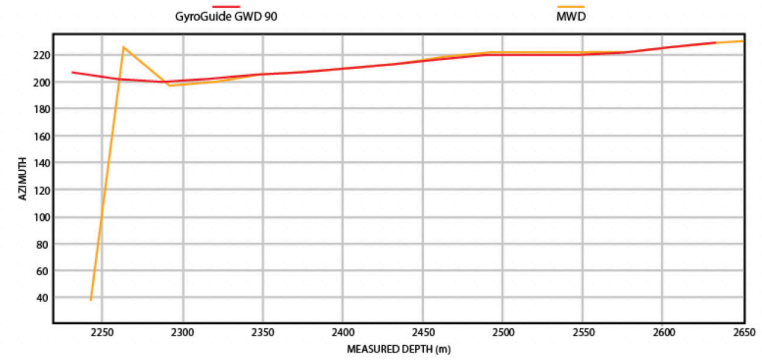


Figure 2. *The GWD surveys showed improved directional survey accuracy vs the MWD data while exiting the parent well.*

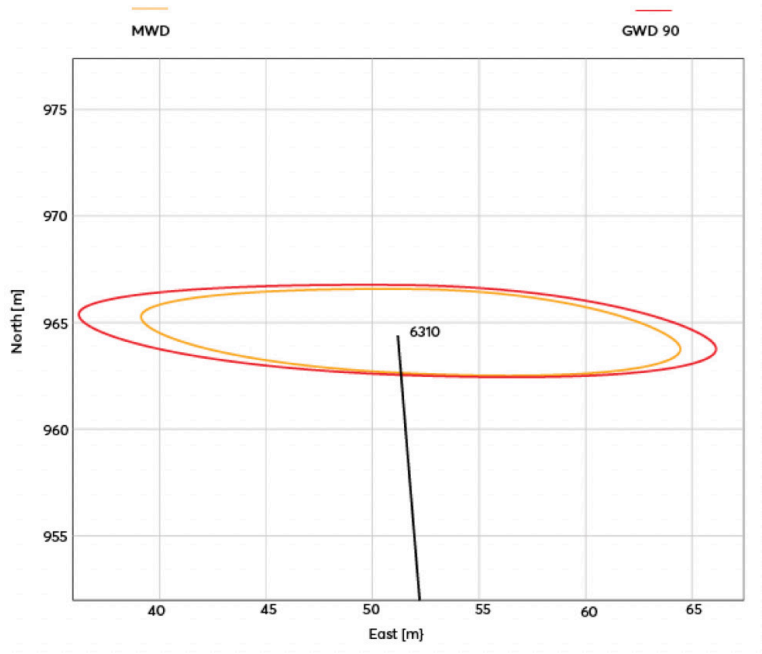


Figure 3. *Comparable ellipses of uncertainty from both systems validated the original MWD data and verified that the well was accurately placed.*

Case study 1

An operator in the North Sea needed to conduct GWD operations on two offshore rigs to reduce the risk of wellbore collision, ensure precise directional control, and avoid adjacent wells in the congested field. Due to ongoing travel restrictions and personnel mobilisation challenges associated with the COVID-19 pandemic, it was not possible to deploy additional resources to the rigs or to the remote operating centre in Stavanger, Norway. As such, the operator needed to carry out the entire operation remotely, with GWD survey specialists interfacing with onshore and offshore colleagues from their home offices (Figure 1).

GWD survey specialists used a third-party service company's data visualisation and analysis platform, coupled with remote presentation from the remote operations centre in Stavanger, to continuously monitor all aspects of the operation. One component that was especially critical was the correct programming of the GWD toolface offset, as this would affect the entire operation if not done properly. On the first rig, the onsite MWD engineer shared their screen with the company's remote survey specialist, who oversaw all programming as though they were physically present on the rig. On the second rig, the MWD engineer gave control of their screen to the Gyrodata specialist to allow them to successfully programme the tool remotely. This streamlined the process and reduced the overall time necessary for this part of the operation.

The GWD70 system was then deployed to assist with drilling the wells, guiding the motor BHA from the kickoff point until the switchover angle was achieved for MWD gravity toolface and until the MWD data was clear from interference. Using the unmanned GWD solution reduced the interval of GWD surveys and enabled proper directional control to be achieved, with both wells successfully kicked off in the intended direction and wellbore trajectory ensured. Through diligent risk analysis and effective mitigation, all remote operations were executed without incurring any lost time. The operator eliminated the expense of mobilising personnel offshore by using the remote solution, which had the added benefit of reducing onboard personnel and thus reducing the risk of COVID-19 transmission. Communication between Gyrodata, the third-party service company, and

the operator resulted in all survey procedures being followed correctly, eliminating any extra rig time that would have been associated with retaking surveys due to error.

Case study 2

In another project, an operator in the North Sea was drilling a sidetrack from an existing well with a whipstock set at close to 90˚. The 6300 m horizontal section, which the operator was drilling with a rotary steerable system (RSS), had an initial zone of approximately 365 m where magnetic interference was expected to be an issue. Without valid survey data in this zone, achieving accurate wellbore positioning in the reservoir would have been challenging due to the length of the section. Cognisant of these concerns, the operator opted to use the GWD90 system to obtain higher quality surveys that would be unaffected by the magnetic interference from the motherbore and offset wells.

The GWD90 system provided the operator with all-attitude, high-accuracy surveys in real-time as drilling progressed through the zone of magnetic interference. The system also offered collision risk mitigation when the BHA had a potential close call with any offset wells. The third-party service company had an 'automatic pumps off' function that allowed surveys to be collected during connections, which reduced the amount of necessary rig time for the operation. All GWD operations were carried out entirely remotely, with no delays or problems when confirming survey quality.

Using the unmanned solution eliminated onsite personnel and mobilisation costs, saving tens of thousands of dollars. The GWD90 system provided improved survey accuracy vs the initial MWD surveys while establishing clear separation from the parent well (Figure 2), thus achieving the operator's objectives. If the section had been surveyed by doing a pump-down wireline survey during drilling instead of using the system, it would have taken a minimum of 12 additional hours of rig time. This would have resulted in at least US$240 000 of charges based on an assumed daily rig rate cost of US$483 000, not including operating costs. Finally, using the system removed the risk of stuck pipe while completing the surveying operations, further validating the economics of running GWD in this scenario.

Case study 3

An operator working offshore Malaysia was conducting a drilling campaign using managed pressure drilling (MPD) to deal with a highly unstable formation. Because this drilling technique required the pumps to be turned on and off in stages before taking a survey or breaking a drillpipe connection, the operator faced the challenge of the survey tools' sequences being interrupted. The operator requested a GWD system that would allow them to address wellbore collision risks and take high-accuracy surveys in a manner that would not affect the MPD pumping sequence.

The GWD70 system provided data for advanced collision avoidance and real-time knowledge of wellbore position, enhancing performance and safety. Any flow within the pipe would have invalidated the data, as the GWD system required zero flow or complete BHA-string stationary time to record a survey. In this application, the customisability of the system was also a critical differentiator. By working with the operator to develop and implement the exact tool settings necessary to accommodate the irregular MPD pumping sequences, the company was able to ensure that the surveying and MPD aspects of the operation would not interfere with one another.

Before beginning the project and deploying the GWD system, the company conducted a comprehensive review with the operator to address project-specific MPD challenges so that they would not become an issue. In this case, two of the GWD70 system's functions – survey delays and tool shutdown time – were customised to adapt to the MPD operations. Gyrodata successfully ran 24 surveys from 1855 – 2522 m at a maximum inclination of 66˚. As predicted, the surveys were taken without issue and without any interference between the MPD and survey sequences. Using GWD also eliminated the risk of stuck pipe and the need to run a standard wireline gyro, saving the operator on mobilisation costs, wireline unit service, and rig time for running the wireline. These savings were estimated to be at least US$75 000.

Case study 4

In another project, an operator in the North Sea needed to drill and geosteer a reservoir producing well from a platform using a jackup rig. The reservoir consisted of fine-grained chalk approximately 2400 m below the seabed. The operator indicated accurate wellbore placement and collision avoidance were their main objectives on this job, as there were several other wells in close proximity. Gyrodata recommended running the GWD90 system, which was customised to integrate with the service company's MWD tool and BHA configuration.

The compact GWD system was able to be run in a shorter, smaller-outer diameter (OD) collar than typically used, and the assembly was placed as close to the bit as possible to assist in collision avoidance if interference from nearby wells was observed. A standard collar length GWD assembly would have pushed the logging while drilling (LWD) tools further back in the drilling assembly, resulting in a negative impact on reservoir placement. The compact GWD system design also made tool preparation much easier and faster due to its shortened length.

The system provided real-time gross error checks of the MWD tool while drilling the section. Magnetic interference was expected between 6050 and 6300 m, but there was less interference than originally predicted. Despite this, the system still provided accurate surveys throughout the 6 ½ in. wellbore to total depth (TD), which were used for comparison to validate the accuracy of the MWD data. Comparable ellipses of uncertainty were encountered in both sets of data, achieving the operator's objective of wellbore accuracy (Figure 3). If magnetic interference had been as severe as predicted, however, the GWD90 system would have still performed to its error model's accuracy; additionally, the system would have saved rig time compared with taking directional surveys with conventional wireline tools.

Conclusion

Wellbore placement is one of the defining metrics of a drilling project's success. If placed accurately, a well can better hit hydrocarbon-producing zones in the reservoir, while drilling with an optimised trajectory makes completion activities simpler and less fraught with error. In a world where commodity prices are not set to dramatically increase anytime soon, operators are learning to do more with less. Using a GWD system is a proven method of achieving wellbore placement and directional objectives that will increase the profitability and total return of a project.