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Directional Drilling Automation: Human Factors and Automated Decision-Making

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Abstract

Inconsistent directional drilling performance has cost the oil and gas industry billions of dollars in drilling costs, missed production potential, and increased lifting costs. While some directional drillers perform at a high-level, others often fail to properly compensate for multiple variables seen while drilling. Automation of the directional drilling service including automated decision-making is proving to be a viable solution to this problem and has been implemented in the drilling of thousands of wells in North America in recent years.

A joint industry project (JIP) affiliated with the IADC (International Association of Drilling Contractors), SPE DSATS (Society of Petroleum Engineers Drilling Systems Automation Technical Section), AUVSI (Association for Unmanned Vehicle Systems International), Southwest Research Institute, Energistics, and the OPC (Open Platform Communications) Foundation has created a Drilling Systems Automation (DSA) Roadmap to help the industry understand the direction of drilling systems automation. In this roadmap, the authors suggest that the transition from humans to automation in the general drilling space can occur across four cognitive functions: acquiring information, analyzing and displaying information, deciding action, and implementing action. They also suggest that there is value in partial automation.

This assessment is accurate when applied to directional drilling; over the past few years many individual directional drilling tasks have become either fully automated or partially automated, each bringing significant value to the operation. These individual automated tasks systematically link together, moving toward the fully automated rig.

Continuous real-time updating of the bit position is one of the many critical analysis steps that can be automated, driving steering decisions. The practice of accurately predicting bit position and trajectory is a skill that is artfully developed by expert directional drillers over many years. To demonstrate the value of partial automation, a specific example is presented where the continuous calculation of the real-time bit position and its trajectory is fully automated, showing that the analysis and decision-making performed by the automated system is faster and more accurate than performed by human directional drillers. Although the details of only a single automated task is the focus of the case study, it is important to realize that it is just one of many automated tasks currently implemented in the field on the path to full automation.

In the transition from human to automated processes, roles and responsibilities must change both on the rig and in the office in order to fully benefit from its value potential. With most of the heavy cognitive lifting performed by a machine, a single directional driller can now work remotely and manage the directional control of multiple wells simultaneously. This remote directional driler can perform data analysis in a structured scientific manner. Automation incorporates the science, integrates previously siloed best practices and individual knowledge, and allows for continual consideration of the economic consequences to the asset from each decision.