Maximizing Value from Massive Amounts of Data

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Abstract

It is widely known that the Oil and Gas industry has always had an abundance of data. The vast majority of drilling rigs host a variety of electronic data collection systems. However, a major challenge that continues in the industry is the lag time between capturing and analyzing the data, and then executing a decision based on the data analysis results. The big question is…how can an operator maximize the value from this massive amount of data collected?

Verdande Technology's DrillEdge™ software is helping operators to leverage real-time data to immediately help detect wellbore instability and other problem signatures, and provide instant expert advice on how to prevent and correct potential costly drilling reactions leading to non-productive time (NPT). Using an artificial intelligence method called Case-Based Reasoning (CBR), it is designed on the principle that present situations are often similar to situations in the past. The DrillEdge software harvests data in real time delivering the ability to rapidly recognize patterns by utilizing historical experiences to capture what lessons were learned, implementing client's own best practices and providing known solutions to mitigate the problem in order to be proactive.

DrillEdge technology integrates WITSML (Wellsite Information Transfer Standard Markup Language) data streams to provide a real-time decision support tool for ongoing daily drilling operations to help avoid the high cost of NPT. The user-friendly radar interface is an instantaneous and interactive viewer that allows an end user to immediately review a potential situation to prevent NPT. Applying a CBR system helps retrieve and understand how yesterday's problems can provide solutions today.

Introduction

As the Oil and Gas industry strives towards technical innovation, automation, and meeting new regulations, operators are increasingly being required to collect and archive massive amounts of data. This data includes everything from daily drilling reports (DDR's) and tour sheets to high density digital data. Yet much of this information is under-utilized in delivering real-time value. That's where the question of how can we leverage this data to benefit operations in real time comes into play.

Some operators are now using a form of Artificial Intelligence (AI) called Case-Based Reasoning (CBR) to take advantage of the massive amounts data available. A CBR system compares real-time data with known problems that have had their symptoms fully documented. The use of such a system provides operators with real-time decision support to help prevent non-productive time (NPT).

Case-Based Reasoning

Case-Based Reasoning (CBR) is the process of solving new problems based on the solutions of similar past problems[1].

Figure 1: Case-Based Reasoning Model

CBR is a type of Artificial Intelligence that was developed in the 1980's and has been used prominently in the business industry since the 1990's. Today, operators are using CBR on rigs globally to prevent NPT.

The CBR System

The CBR system involves collecting relevant data from archives to fully document occurrences of NPT situations. This documentation includes static parameters, a series of symptoms or events that led up to the NPT, and text outlining the details of the problem area and recommended best practices in order to build a case. Mining through this massive amount of data, problem areas from various wells and formations and/or lithologies can be identified through common symptoms. Problem areas include twists-offs, lost circulation, well restriction, and hole cleaning and stuck pipe. These cases can be used to build a robust case library which is applicable across regions.

The CBR engine compares the similarity of the symptoms generated by the incoming data with cases stored in its library. A unique radar interface displays relevant cases alerting the user of a potential problem. When the symptoms in the data pass a threshold of 50%, an icon representing a case from the library will appear on the radar. As the similarity increases, the case on the radar will move closer to the center signifying the current operation is approaching high similarity to a

previous NPT event. Automatic alerts to the rig crew and engineers are sent out at specified thresholds. This enables them to review the case details, which provide industry standard best practices or company defined recommended guidelines before deciding whether or not action is required.

The CBR system can be implemented in real time using data streamed via WITSML or can be used on historical data, leveraging the use of archived data (LAS, CSV, XML, etc.). Analyzing historical data is often used in blind studies to show the value of the CBR system. The following case study gives one example of how a case in the library from the Middle East was able to detect a problem area in a drilling operation on US Land.

Case History

A major operator was experiencing significant NPT from twist-offs while drilling in the Haynesville shale. The operator wanted to test if the CBR system had the ability to identify drilling problems in advance by analyzing a library of past well data[2].

The case library included cases built from the operator's archived data. These included two cases built on twist-off incidents from the Middle East. During the historical analysis, each of these cases appeared on the radar several hours in advance of the twist-off occurrence. Two twist-offs occurred in this test well. When the first twist-off happened, a case from that test well was built to demonstrate stronger case matching due to similar conditions. This case is highlighted in Figure 2.

Figure 2 shows three snapshots of the radar displaying increasing movement of the case(s) towards the center of the radar. The twist-off was reported around 7:30 AM. The first snapshot was recorded at 3:15 AM. At this time a twist-off case was just above the 50% similarity. Fifteen minutes later, two more cases appeared on the radar which also indicated a possible twist-off. At 4:04 AM, one of the cases was approaching the 75% threshold (represented by the dotted circle). This illustrates there was over 4 hours of advanced warning to mitigate a potential problem.
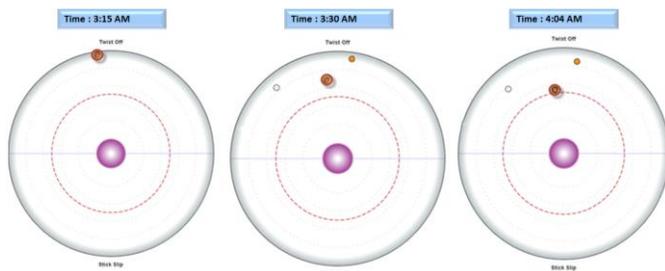

Figure 2: Radar screens showing twist-off cases

The test proved that the CBR system was able to provide early warning of a twist-off. In addition, the results show that cases in one geographic location can be used to predict similar drilling problems in other regions. This early detection provides the rig crew and engineers sufficient time to resolve the situation before it becomes an actual NPT. Due to the positive results, the operator implemented the CBR system for real-time monitoring of live operations.

Conclusions

Digital information has become the standard in providing instant communication worldwide. The industry has been able to successfully capture massive amounts of data. From real-time data fed by the WITSML stream to historical DDR's and archived data, this data can be turned into actionable intelligence. A CBR system takes the archived data to build a case library and compares it to real-time data. When this comparison results in a similar match of a past case or problematic situation, alerts are immediately sent. This allows an operator to identify the impending problem and thus present their relevant best practices and procedures to people at the rig or first line management. This CBR system has been proven as a real-time decision support tool to make better, faster, and smarter decisions.

Acknowledgments

Nomenclature

CBR	*= Case-Based Reasoning*
CSV	*= Comma-separated values*
LAS	*= Log ASCII Standard*
NPT	*= Non-productive time*
WITSML	*= Wellsite Information Transfer Standard Markup Language*
XML	*= Extensible Markup Language*

References

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2. Van Oort, E., Brady, K.: "Cased-Based Reasoning System Predicts Twist-off in Louisiana Well Based on Mideast Analog." World Oil, April 2011, 41 – 45.