

Harvesting Knowledge –

Real-Time Drilling Performance Improvement

Reusing past experience – recalling similar situations and making use of decision steps made earlier – is a common and effective way people use to handle new situations. A method called case-based reasoning (CBR) has increasingly been applied to use the same process in real-world industrial settings. Using this method, human experience can be collected in a company case base, linked to observed data, and automatically brought forward when it is again relevant.

BY FRODE SØRMO

A new technology developed to assist oil-well personnel during drilling operations in order to improve the quality and efficiency of operations has been developed by Verdande Technology, a Norwegian technology company. Although many oil companies have implemented state-of-the-art real-time operations centres (RTOCs) in order to continuously monitor streams of data from field operations, there exists no truly instantaneous, automated delivery of relevant historical knowledge of how to solve problems indicated by the data. RTOCs are an elegant way to concentrate expertise and efficient decision-making to reduce risk, but despite this, non-productive time (NPT) remains at around 15 to 35 percent. There is ample incentive to address NPT, particularly in current times, as the industry continues to lose its base of expertise.

Bridging Data and Experience

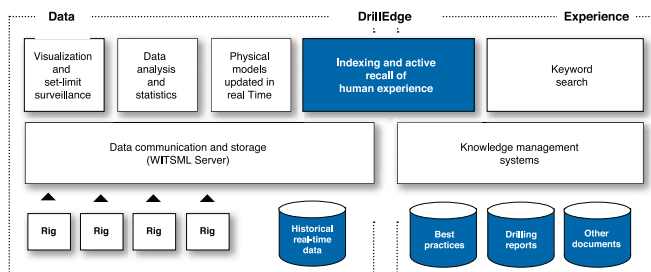
Exploration, drilling and production activities are inherently data intensive, and as the amount of available data increases, the need for tools to extract, or filter out, the relevant information in a given situation increases correspondingly. Standard drilling and geotechnical software tools and protocols such as Wellsite Information Transfer Standard Markup Language (WITSML) are coming into wide adoption to make data acquisition,

integration and storage seamless. In addition, knowledge management systems collecting human experience such as best practices, activity reports, lessons learned and industry standards are commonly used.

However, there is a missing link that is required to bridge the gap between the data and the knowledge. On one hand, it requires experience and constant attention to understand and correctly interpret the data from an operation. On the other, the relevant experience and lessons learned must actively be sought, possibly using methods such as keyword search where it can be hard to express the situation at hand. It is this crucial gap – interpreting the data and identifying the relevant knowledge that is filled by Verdande Technology's DrillEdge. DrillEdge is designed to aid humans to easily recall previous experiences in the heat of a crisis and help engineers craft a solution. More importantly, and beyond reasonable human capabilities, is the ability to recall other people's experiences and profit from them as well.

The DrillEdge Solution

The DrillEdge application has been developed to avoid unwanted events that lead to downtime or a slower than expected drilling progression. Human experience from problems, such as poor hole cleaning incidents, is gathered in a case

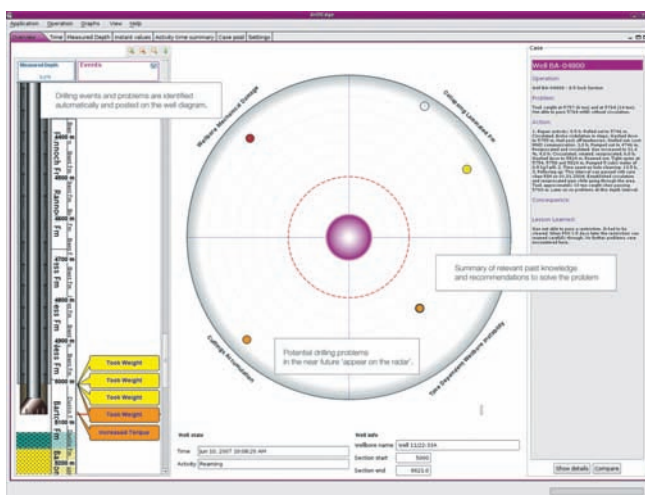


DrillEdge software bridges drilling data and experience systems by using real-time drilling data to automatically index and recall human experience (illustration: Verdande Technology)

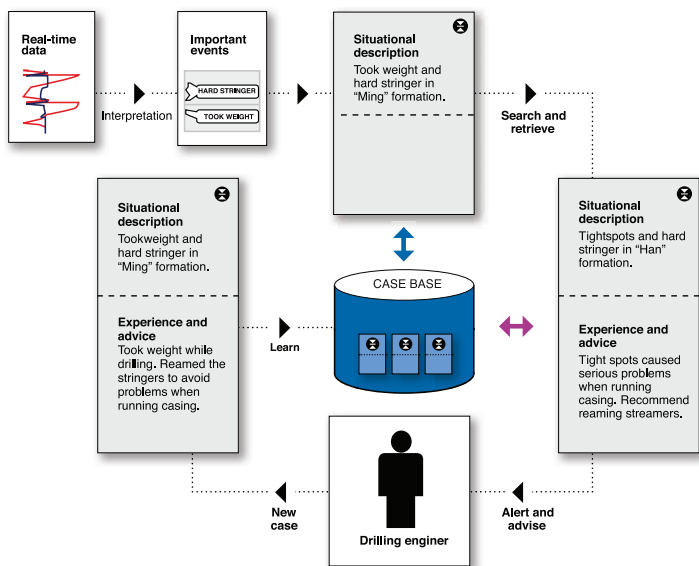
base. Unlike traditional approaches, DrillEdge uses the real-time sensor data gathered during the operation to index each incident. The index allows DrillEdge, when connected to an ongoing operation, to use the current state of the drilling process to search for similar situations for the past and bring forward the advice about

how to proceed to avoid a possible unwanted event.

The case-based reasoning engine in DrillEdge can be characterised as a systematic way to recognise and weigh similarities between today's events and yesterday's problem scenarios. Unlike static databases that require lengthy searches



DrillEdge in action – drilling events and problems are identified and posted at left; at centre, “radar” visualises potential problems; while a summary of relevant past knowledge appears at right (illustration: Verdande Technology)



Real-time data from the ongoing operation is continuously interpreted and forms a situational description of the ongoing operation. This description is used to search for similar situations from the past, which are retrieved and presented to the drilling engineer along with the experience and advice attached to these situations. If a new situation occurs, the situational description is captured automatically by DrillEdge, and the drilling engineer can attach experience and advice and store it in the case base for retrieval when relevant in the future (illustration: Verdande Technology)

to mine relevant information, the DrillEdge system runs continuously in the background as operations are conducted. It constantly matches what's happening to previous scenarios stored in the case base, creating a prioritised list of relevant scenarios. If a problem arises, the user is instantly and automatically presented with the most relevant case and the previously successful solution.

It is like giving field operatives total recall of every relevant event and its solution. If a new problem occurs during operation, DrillEdge provides an easy way for users to capture the lessons learned and store it as a new case in its existing case base. In that way, the competence of the system grows through active use. The system can also be loaded with historical logs of real-time data, lessons learned and best practices to create cases from particularly relevant offset wells during well planning.

The Case-Based Reasoning Cycle

The DrillEdge case-based reasoning process operates in a cycle that can be characterised by the "Four R's" – retrieve, reuse, revise and retain. In the retrieval phase – the task of finding the most similar cases to the situation at hand – features and descriptors of the current activities are analysed and related to similar qualities of previously experienced cases. Moreover, the retrieval phase includes comparison, matching and relevance-weighting of past cases, and finally placing the most relevant cases on the DrillEdge case radar where they can be quickly accessed. It is important to note that this continuous process updates itself using the real-time data stream from the drilling operation. As the current situation changes, the system adapts by continually searching for cases with greater congruence to the present. When a problem is encountered, the reuse phase is initiated to decide if the solution of

the most appropriate cases can be adopted as-is, or after some minor adaptation, which may involve modifying the solution itself or the solution's application methodology.

In the next phase, revision, once a problem has been identified and matched with a solution from past experiences, it may be necessary to evaluate the solution and repair any faults that may have been uncovered. DrillEdge software does not on its own construct new solutions – that is left to the drilling engineers and the rig crew, but this step is key as it is at this point that a unique new solution is created and the learnings added to the case base. The retain phase describes how the problem and its newly evaluated solution are prepared for integration into the case base and for subsequent extraction as needed when a similar problem occur in the future. Importantly, the steps between problem recognition and best solution presentation take place automatically and almost instantly. In many cases, as common problem scenarios start to develop, they can trigger warning alarms that indicate a potentially dangerous situation, allowing remedial action to take place before the problem actually occurs.

CBR systems have proved to be successful across many applications. Examples of fielded applications include customer call-centre systems, applications for diagnosis and preventive maintenance of aircraft engines, selection of valves in pipeline systems, layout of mechanical parts for autoclaving, colour pigmentation in paint, cost estimation and corporate knowledge management. In the oil and gas industry, variations of CBR have been used for well design, reservoir assessment, estimating missing geological data values, and as repositories of experience in general.

Locking in Repeatable Benefits and Value

This year, Verdande Technology will select up to six assets to advance the technology, refine the service model and document business cases for key drilling challenges. Three flexible phases will be tailored to each asset. First, one to two weeks will be used to understand challenges, identify and prioritise problems, and develop key performance indicators (KPIs) for a business case based on reducing NPT, improving ROP, etc. Second, two to eight weeks are needed for analysis of historical data and existing knowledge management. In the final phase, DrillEdge is applied to live drilling operations in an ongoing process of capturing, learning and applying experience in real time to improve performance. During this phase, KPIs are tracked and the business case is updated to demonstrate economic impact on total cost of operations. The results for 2009 will be discussed at a global DrillEdge Forum in 2010, including networking sessions with industry experts to establish best practices and standards for CBR and implementation of new programs to link real time data and knowledge. ■

The Author:



Frode Sørmo is one of the founders of Verdande Technology, and holds a PhD from NTNU, The Norwegian University of Science and Technology.