Helping people understand what drilling data is telling them.

Frode Sørmo, Chief Technology Officer
Artificial Intelligence
Artificial Intelligence
The Key to Deploying Artificial Intelligence

Computers do what computers are good at.

People do what people are good at.
Artificial Intelligence in Drilling

1. Pattern Recognition
2. Case-Based Reasoning
Artificial Intelligence in Drilling

1. Pattern Recognition

2. Case-Based Reasoning
What is Pattern Recognition?

- Recognize symptoms as they occur in real-time drilling data.
- Automatically and consistently flag events and trends.
- Allows people to focus attention where it is required.
- Possible to monitor multiple wells efficiently and effectively.
## Patterns Currently Recognized

<table>
<thead>
<tr>
<th>Problem Area</th>
<th>Events / Graphs</th>
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<tr>
<td>Lost Circulation</td>
<td>Mud Losses, Flow Back</td>
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<td>Wellbore Restrictions</td>
<td>Overpull, Took Weight</td>
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<td>Stick Slip and Vibration</td>
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<td>Hole Cleaning and Stuck Pipe</td>
<td>Pack Off, High ECD</td>
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<td>Pore Pressure</td>
<td>Increased Pore Pressure, Increasing Connection Gas, Decreasing Connection Gas, Corrected D-Exponent</td>
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<td>ROP Optimization</td>
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<td>Formation Detection</td>
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<tr>
<td>Activity Detection</td>
<td>Rig Activities (Drilling, Connection, Tripping, Circulating, etc.)</td>
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<td>Washouts</td>
<td>Pressure Drops</td>
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</table>
Artificial Intelligence in Drilling

1. Pattern Recognition
2. Case-Based Reasoning
What is Case-Based Reasoning?

- Actively bring **relevant experience** to the attention of users.

- Can **predict problems** before they occur, and help **diagnose** and correct problems after the fact.

- Captures new experience in a **systematic** way.
Case

- Describes a real, concrete situation.

- For historical cases, it can include a diagnosis or prediction of what happened after this situation was observed.

- Includes advice and experience based on what the people on the ground saw.

We had pack offs while reaming in the Enconto shale formation.

The extended reaming damaged the formation so that we lost time whenever tripping and had problems getting the casing down.

Do not backream the Enconto formation – if there are hole cleaning issues, circulate instead.
Case

- Pack Off
- Increased Torque
- Pack Off
- Increased Torque
Drilling Fluid

Mud Weight: 1.6  
Type: OBM  
pV: 36  
Yp: 25

Bottom-Hole Assembly

Length: 90  
Stabilizers: 2  
Bit Type: PDC

Well Geometry

Section start: 4280 MD  
Target depth: 6310 MD  
Inclination: 42 deg
## Shared Experience

### Case Name
Pack Offs while Reaming in Encanto Shale

### Problem Area
Hole Cleaning

### Situational Description
While reaming the Encanto shale formation, experienced pack off tendencies ...

### Lessons Learned
Reaming in this formation can cause damage to the formation.
Instead of reaming, circulate ....

### Best Practice
In order to ensure good hole cleaning while drilling in circumstances where ...

### Drilling Fluid
...

### Bottom-Hole Assembly
...

### Well Geometry
...
Case Name: Pack Offs while Reaming in Encanto Shale

Problem Area: Hole Cleaning

Situational Description: While reaming the Encanto shale formation, experienced pack off tendencies...

Lessons Learned: Reaming in this formation can cause damage to the formation. Instead of reaming, circulate....

Best Practice: In order to ensure good hole cleaning while drilling in circumstances where...
Shared Experience

**Case Name**
Pack Offs while Reaming in Encanto Shale

**Problem Area**
Hole Cleaning

**Situational Description**
While reaming the Encanto shale formation, experienced pack off tendencies...

**Lessons Learned**
Reaming in this formation can cause damage to the formation.
Instead of reaming, circulate...

**Best Practice**
In order to ensure good hole cleaning while drilling in circumstances where...

**Current Situation**

- Drilling Fluid
  - 86%

- Bottom-Hole Assembly
  - 52%

- Well Geometry
  - 31%

**Case**

- Drilling Fluid
  - 78%

- Bottom-Hole Assembly
  - 52%

- Well Geometry
  - 31%

**64%**
While reaming the Encanto shale formation, experienced pack off tendencies …

Reaming in this formation can cause damage to the formation. Instead of reaming, circulate …

In order to ensure good hole cleaning while drilling in circumstances where …
Local Cases

vs.

Generic Cases

- DrillEdge comes with a set of Generic Cases – cases that do not contain customer-specific data but represent generic situations.

- These cases allow the system to recognize problems «out of the box».

- The can and should be adapted to the best practise of the organization – but this is low cost.

- During the operation of DrillEdge, new cases from the operator and the local field can be captured, expanding the library.
DrillEdge software - proven globally
“Our testing with DrillEdge technology produced compelling results and demonstrated that unscheduled events don’t happen immediately.

We learned that there are predictable and repeatable symptoms in advance of each event on the order of hours, or sometimes even days.

By applying DrillEdge technology, we hope to recognize these symptoms much sooner, allowing corrective action to be taken by leveraging Shell best practices to reduce their occurrence.”

Eric van Oort
Shell Well Performance Improvement Manager

“The DrillEdge platform is expected to help operators lower risk, increase their rate of penetration and reduce non-productive time while drilling.

The technology is expected to help our customers expand their understanding of their wells without increasing their workload as they continue to drill more demanding and technically challenging wells.”

Scott Schmidt
President of Drilling and Evaluation