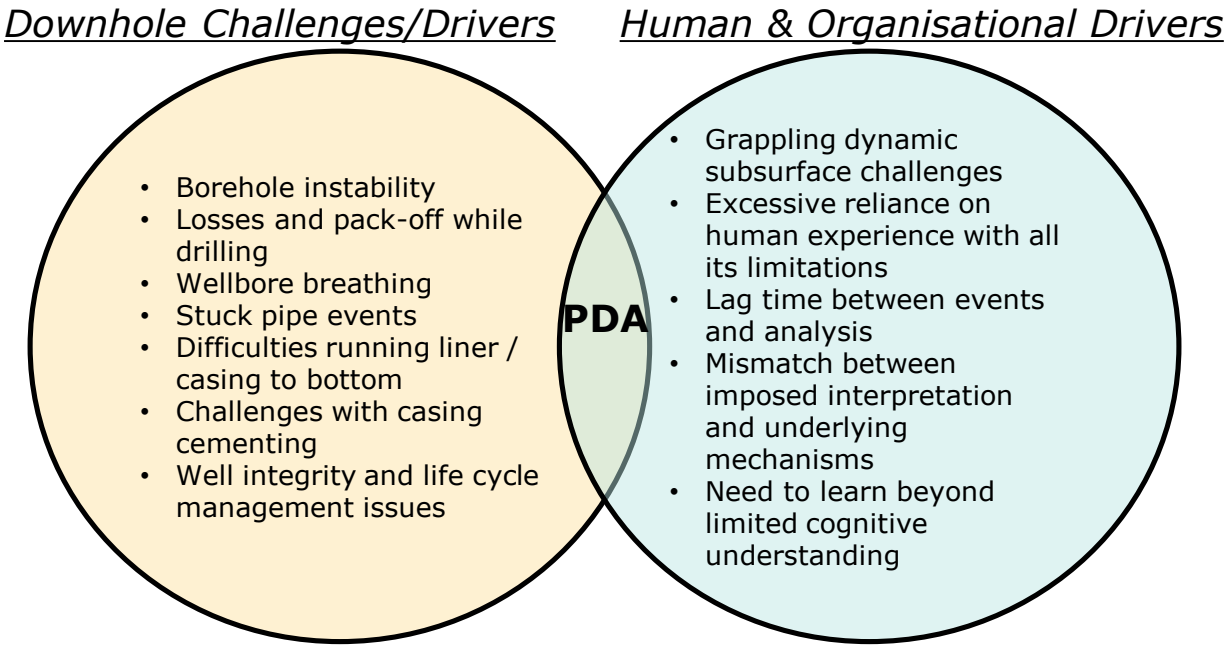
Predictive Drilling Analytics (PDA)

Improving Drilling Efficiency with Analytics

MAERSK OIL

Problem Description



The net results is that Wells team could not achieve consistent drilling performance between wells

Project Scope

- Develop an analytic model to:
  - Identify onset of borehole instability while drilling the overburden
  - Predict the likelihood of hole pack-off and stuck pipe during drilling operations
  - Assess risks associated with borehole condition prior to running casing/liner and cementing operations

- **Predictive Drilling Analytics (PDA) seen as a means of developing an "early warning system" to avoid significant non-productive time (NPT) events.**

Objectives of the PDA Project

Short-term objectives for the Field Trial

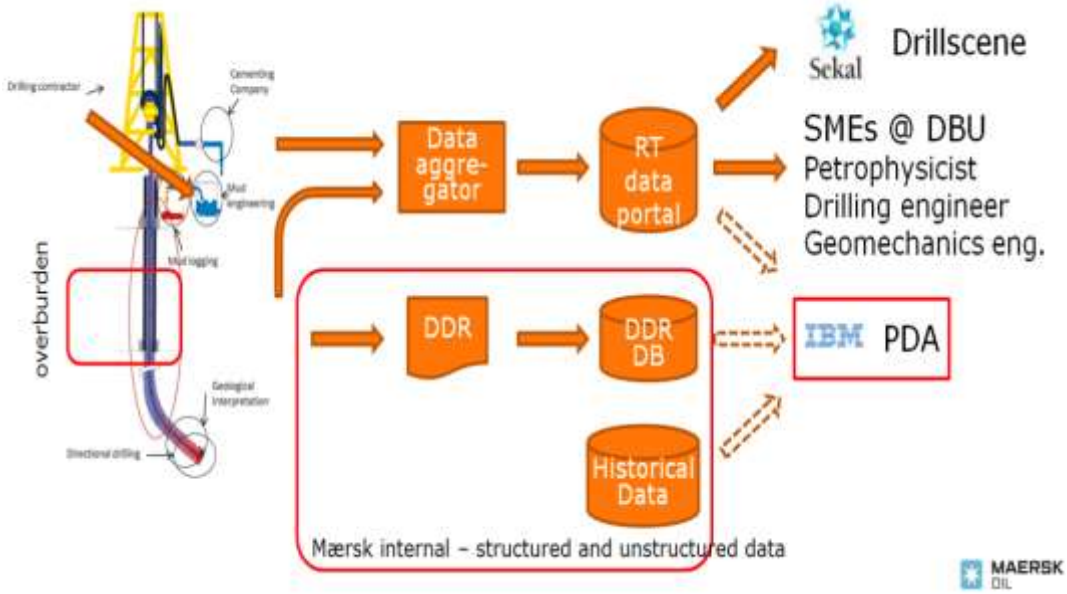
- Demonstrate that analytics models can be robust and support operations decision support
- Quantify warning time in RT for significant NPT events
- Demonstrate model self-learning capability under RT well conditions
- Disaggregate risk into principal components to help engineers engage with and improve model

Long-term objectives (beyond Field Trial)

- Improve understanding of downhole mechanism(s) driving wellbore instability in the overburden
- Demonstrate scalability of the model and speed of adaptation to new operating conditions/environment
- Provide the foundation for and path towards cognitive analytics

Data Requirements for Field Trial

- Dynamic Data (surface)
  - Weight on Bit (WOB)
  - Hook load
  - Torque
  - Flow rate (in/out)
  - String rotational speed (RPM)
  - Standpipe pressure
  - ECD
- Conditional (static) data
  - Lithology (formation tops)
  - Directional survey
  - Casing shoe depths
  - Bits and hole sizes
  - Risk matrix /EOWR / AAR
  - Geomechanics (to define shear and tensile fracture limits)



Conclusions from the Field Trial

- Combining advanced analytics with domain specific knowledge and expertise (hybrid model) created an effective ‘predictive drilling analytics’ solution
- Model ability to self-learn has huge potential but expanded data set required to further develop
- Model can predict NPT event with warning time but further work remains
- Model scalability demonstrated during the field trial
- Some of the longer term objectives could not be tested because of a limited field trial and insufficient number of events
- Borehole condition assessment could not be tested and proven during the field trial. Sufficient understanding developed to help guide the development of an effective sub-model