



## Real Time Drilling Intelligence



### NO SHOOTING FROM THE HEB

*Real time drilling intelligent tools currently under development by DSI is focused on early detection of well behavior anomalies. In case of detection, root cause analysis follows to diagnosis the most likely scenario, which paves the way for an expert system to recommend proper first action strategy.*

*DSI currently advancing an automated system for early detection, diagnose, resolution, and elimination of drilling hole problems as they occur while drilling. The system will also serve as an advisor should hole problems occur.*

*DSI is seeking industry funding for this developments of state of the art predictive simulator aiming to detect, diagnose and resolve or eliminate hole problems. On a world wide scale, hole problems currently constitute between 20-25% of total well costs. These problems have both high costs implications and safety implications. For an average well cost of \$10 million USD, the cost of the down time is very large especially when translated to the total number of well drilled worldwide, in excess of 2000 wells. This project will have significant impact on reducing hole problems events and limits its consequences from stuck pipe to loss of circulation. These problems represent a significant cost to the well construction expenditure.*

*DSI and its partners have developed a huge database of hole problems from drilling operations in the North Sea and worldwide. We also developed software and technologies to predict and eliminate hole problems. In particular, DSI technology which utilizes neural network and other means to diagnose hole problems early on before becoming an issue (Diagnostics Drilling Type Curve). The project aims to link these packages/modules with a robust software package, test it using our static database and then test the package using real-time data. The developed software will work in real time and will use changes in trends in drilling data to detect hole problems as they occur.*

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## Outline of RTI Tools

### Conventional:

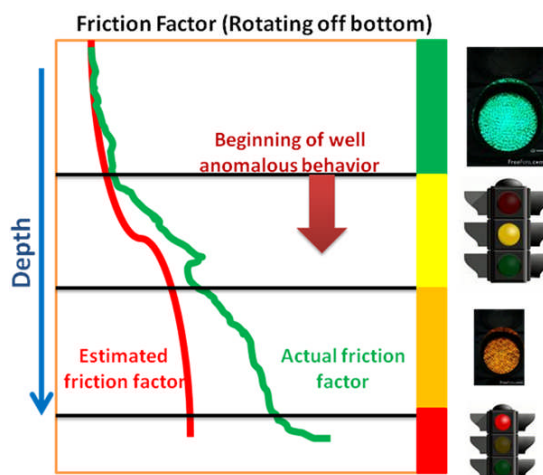
- ✓ **Real Time Data Acquisition**
  - Surface data (mud, hook load, hook speed, pumps, pits volume, etc)
  - Subsurface data (LWD/MWD)
  - Daily drilling report
  - Manual input
- ✓ **Logistics Module**
  - Real time data acquisition using WITSML protocol
  - Reading daily drilling reports
  - Perform data filtering
  - Data viewing in time and depth
  - Perform event recognition
  - Recognize the status of the operation (drilling, tripping, circulating, etc)
  - Time book keeping on time spent on each hole section and for each category of operation
- ✓ **Drilling Data Analysis**
  - Wellbore stability analysis to determine mud weight window and pore pressure profile
  - Hydraulics analysis: Conventional hydraulic analysis is performed to determine the pressure profile in the open hole, ECD at shoe and at bit (as well as at any other location), % pressure losses at different location in the circulating system, as well as surface pressure. Default and user select parameters and options for mud rheology models, etc.
  - Hole cleaning model

- Swab and surge prediction (based on computed pipe velocity)
- Well friction: Computation of forces throughout the well. This is a fully 3-dimensional analysis, both for the well path and for the tubular. It includes all mechanical and hydraulic forces. Also jar analysis is included as well as buckling.

### Non Conventional

- ✓ Drilling type curve analysis
- ✓ Free point analysis
- ✓ Resolution modules of trouble events (losses, stuck pipe, excessive torque and drag)
- ✓ Knowledge transfer
- ✓ Knowledge capture and databases
- ✓ Alarm system

#### Example of Wellbore Friction Analysis



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