A Novel Approach to Capitalize WITSML Data in Geospatial Platform for Realtime Monitoring and Risk Assessment

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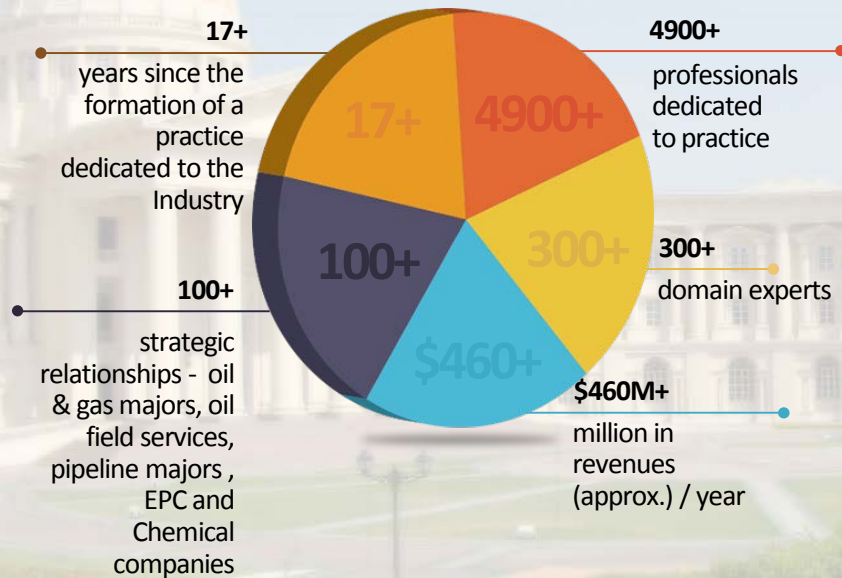
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Agenda

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Infosys – Fuelling Oil & Gas Enterprises Globally

17+
years since the formation of a practice dedicated to the Industry

100+
strategic relationships - oil & gas majors, oil field services, pipeline majors, EPC and Chemical companies

4900+
professionals dedicated to practice

300+
domain experts

$460M+
million in revenues (approx.) / year

Client Credentials

4 of the top 5
Integrated Oil and Gas Majors, worldwide

5 of the top 5
Oil Field Services Companies, worldwide

8 of the top 10
Independent Upstream Companies, worldwide

3 of the top 5
Pipeline Companies, worldwide

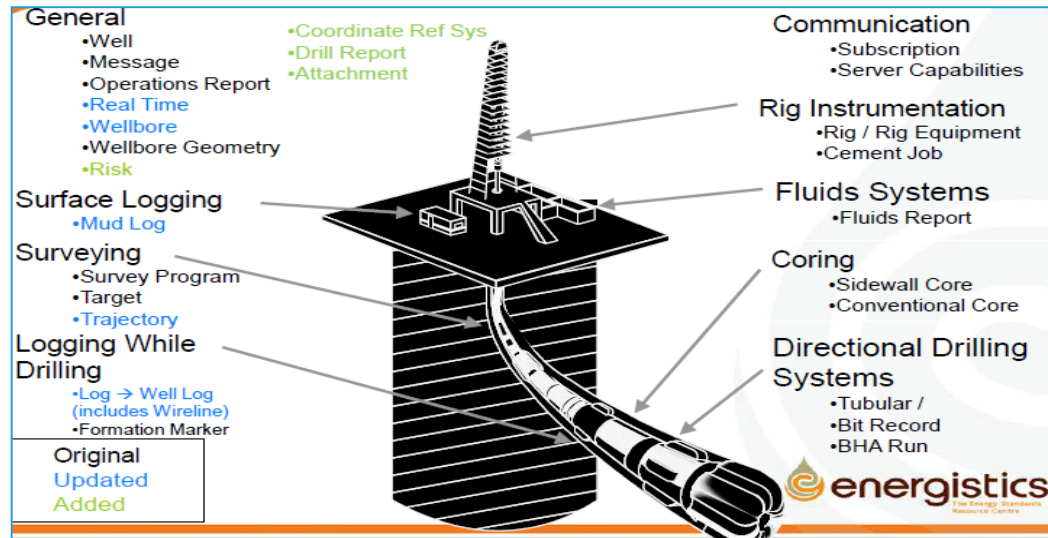# Problem Statement

✓ Realtime Drilling systems uses - WITSML, WITS & OPC for drilling efficiency, reduce NPT, etc.

✓ WITSML / WITS data has spatial components which is not being utilized for any geospatial analysis and are restricted within WITSML servers.

✓ Geospatial Platform supports in well planning & execution stages.

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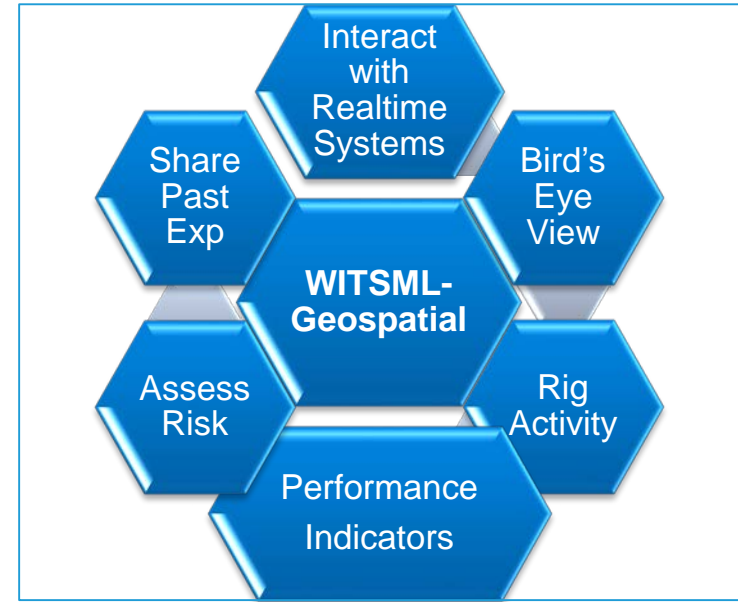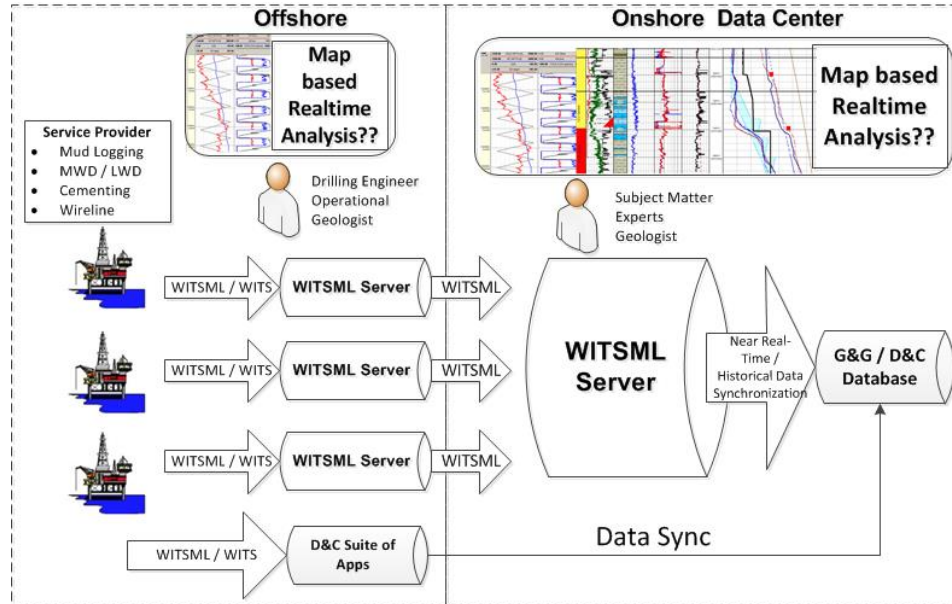
WITSML Schema & Spatial Components

- ✓ An open Information Transfer Standard,Supports drilling workflows.
- ✓ Well, Wellbore, Risk, Formation Markers, Log objects are utilized.
- ✓ Each object has one or more spatial attributes- Lat/ Long, Depth, Azimuth & Inclination.
- ✓ CoordinatesRefSys & WellCRS objects carries coordinate information.

General
- •Well
- •Message
- •Operations Report
- •Real Time
- •Wellbore
- •Wellbore Geometry
- •Risk
- •Coordinate Ref Sys
- •Drill Report
- •Attachment

Surface Logging
- •Mud Log

Surveying
- •Survey Program
- •Target
- •Trajectory

Logging While Drilling
- •Log → Well Log (includes Wireline)
- •Formation Marker

Original
Updated
Added

Communication
- •Subscription
- •Server Capabilities

Rig Instrumentation
- •Rig / Rig Equipment
- •Cement Job

Fluids Systems
- •Fluids Report

Coring
- •Sidewall Core
- •Conventional Core

Directional Drilling Systems
- •Tubular /
- •Bit Record
- •BHA Run

energistics™
The Energy Standards Resource Centre

- • Log, Mud Log
- • Cement Job, Risk
- • Formation Marker

- • Message
- • Fluids Report
- • Drilling Report

Subsurface   **Message / Report**

- • Well, Wellbore, Rig
- • Coordinate Ref Sys
- • Tubular, Trajectory, Wellbore Geometry

General / Contextual Objects

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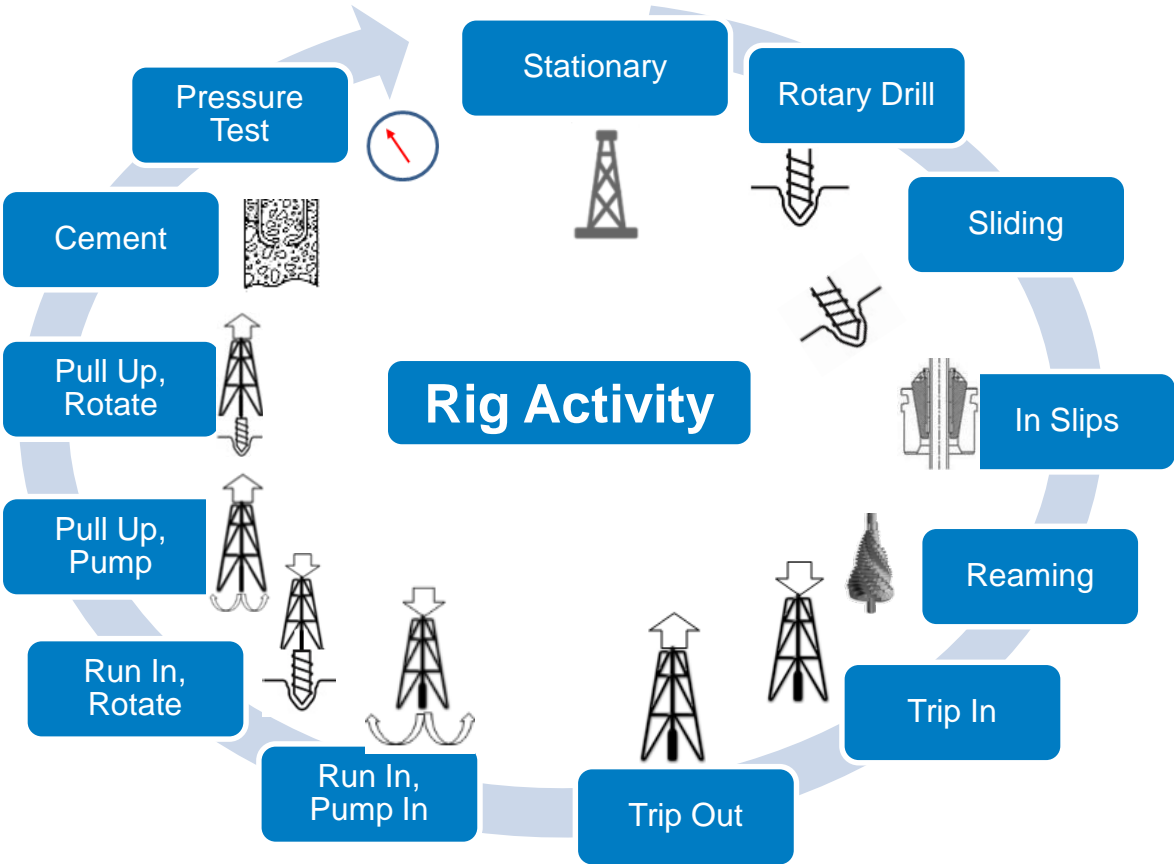
Geospatial Component in Real time Drilling Systems
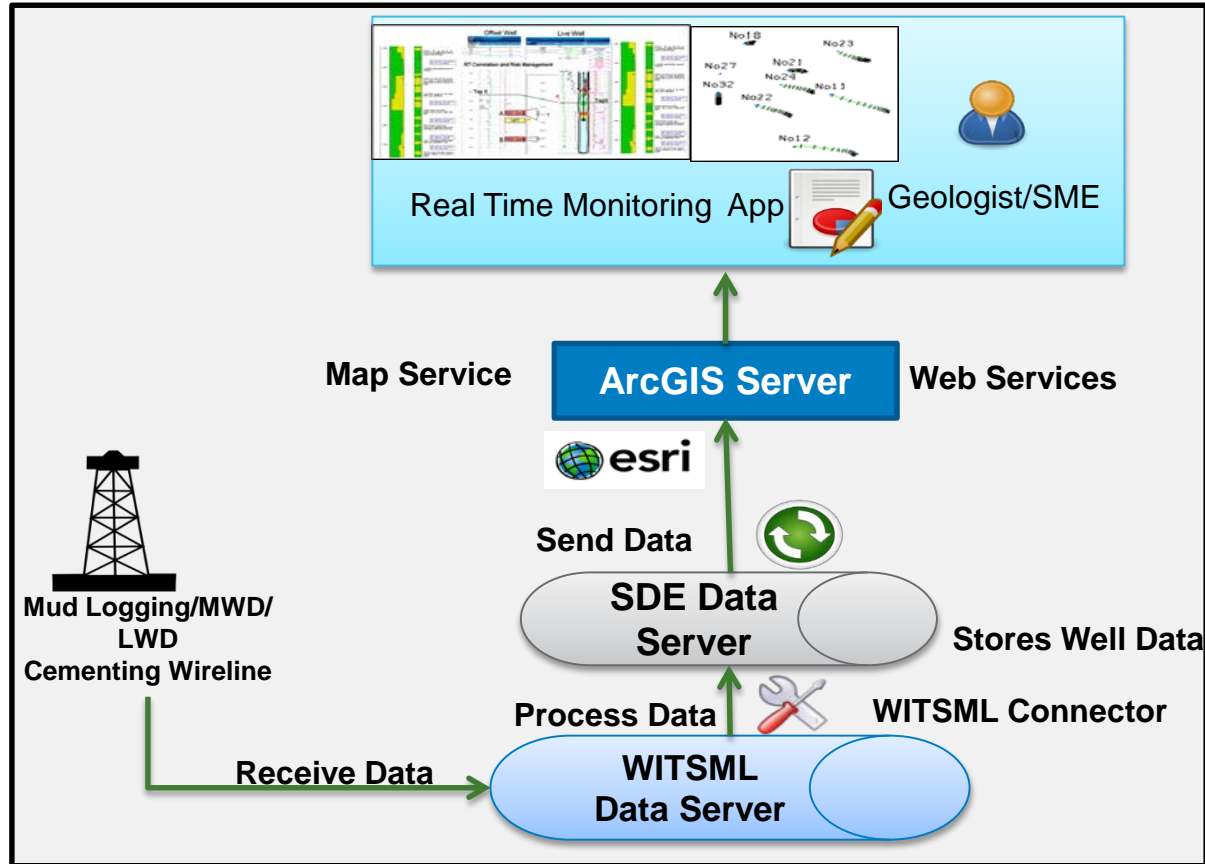
- ✓ WITSML Server will be integrated with Arc SDE using WITSML Connector.
- ✓ Spatial objects such well, wellbore, trajectory, risk, formation markers will be stored at ArcSDE.
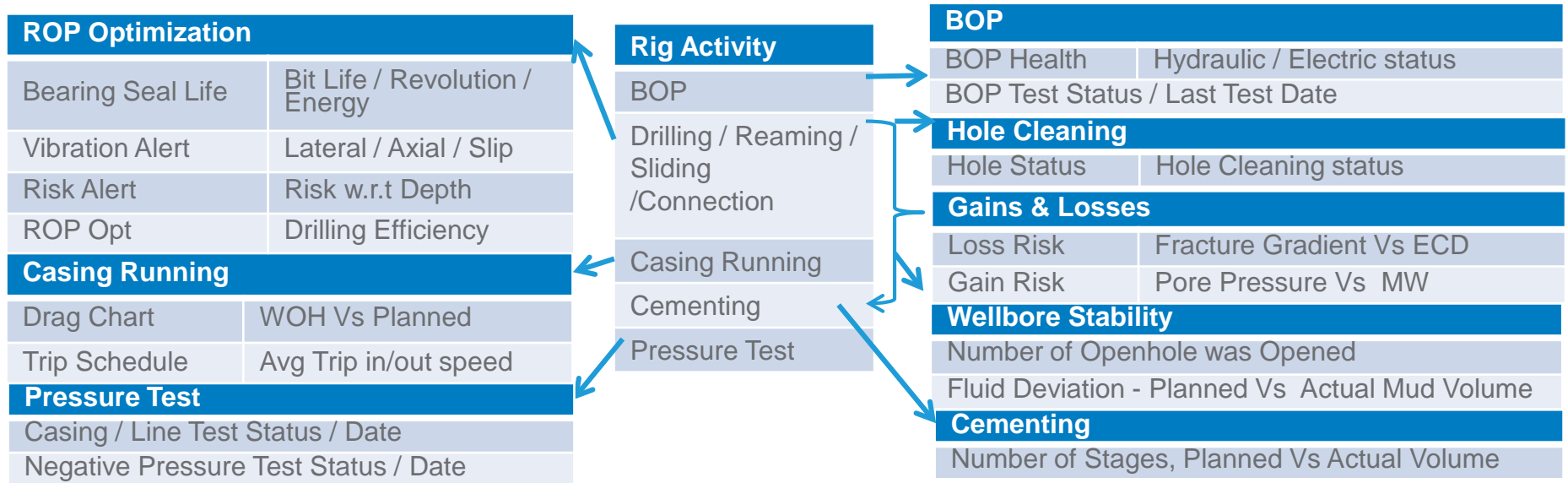- ✓ Time and depth indexed log data will not be duplicated.

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Monitor Rig Activity

Rig Activity cycle diagram: Stationary, Rotary Drill, Sliding, In Slips, Reaming, Trip In, Trip Out, Run In Pump In, Run In Rotate, Pull Up Pump, Pull Up Rotate, Cement, Pressure Test

5 Day Planner Report

Start Time	Main - Critical Path Operations	Est Time (hrs)
11:15 Fri 08 Jan 2016	Drill 12-1/4" Hole to TD	
11:15 Fri 08 Jan 2016	PU BHA	4.00
15:15 Fri 08 Jan 2016	RIH to above stack	1.50
16:45 Fri 08 Jan 2016	Shallow Test / Function Test BSR	1.00
17:45 Fri 08 Jan 2016	Trip	13.00
07:45 Sat 09 Jan 2016	Drill to 21,295' (TD)	24.00
07:45 Sun 10 Jan 2016	Circulate 2x BU	4.50
12:15 Sun 10 Jan 2016	Trip	20.00
08:15 Mon 11 Jan 2016	Test BOP (function)	1.00
02:45 Wed 13 Jan 2016	9-7/8" Casing	
02:45 Wed 13 Jan 2016	Pre-Job Meeting	0.50
03:15 Wed 13 Jan 2016	RU Run Casing	3.50
06:45 Wed 13 Jan 2016	Run Casing	9.50
16:15 Wed 13 Jan 2016	RD Run Casing / PU Hanger	3.50
19:45 Wed 13 Jan 2016	Trip / Convert Hyflo & Float	23.00
18:45 Thu 14 Jan 2016	9-7/8" Cement	
18:45 Thu 14 Jan 2016	Condition	1.75
20:30 Thu 14 Jan 2016	Cement	1.50
22:00 Thu 14 Jan 2016	Displace Cement	4.00
02:00 Fri 15 Jan 2016	Set Liner Hanger / Release	1.00
03:00 Fri 15 Jan 2016	Flush DP	1.00
04:00 Fri 15 Jan 2016	Trip	11.00
15:00 Fri 15 Jan 2016	Rig Service (Slip and Cut)	4.00

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Realtime Drilling Performance Indicators

ROP Optimization

Bearing Seal Life	Bit Life / Revolution / Energy
Vibration Alert	Lateral / Axial / Slip
Risk Alert	Risk w.r.t Depth
ROP Opt	Drilling Efficiency

Casing Running

Drag Chart	WOH Vs Planned
Trip Schedule	Avg Trip in/out speed

Pressure Test

Casing / Line Test Status / Date
Negative Pressure Test Status / Date

Rig Activity

BOP
Drilling / Reaming / Sliding /Connection
Casing Running
Cementing
Pressure Test

BOP

BOP Health	Hydraulic / Electric status
BOP Test Status / Last Test Date	

Hole Cleaning

Hole Status	Hole Cleaning status

Gains & Losses

Loss Risk	Fracture Gradient Vs ECD
Gain Risk	Pore Pressure Vs MW

Wellbore Stability

Number of Openhole was Opened
Fluid Deviation - Planned Vs Actual Mud Volume

Cementing

Number of Stages, Planned Vs Actual Volume

✓ Each workflow monitors the well using various performance indicators.

✓ Realtime drilling workflow outcomes will be represented as non-spatial attributes of the well.

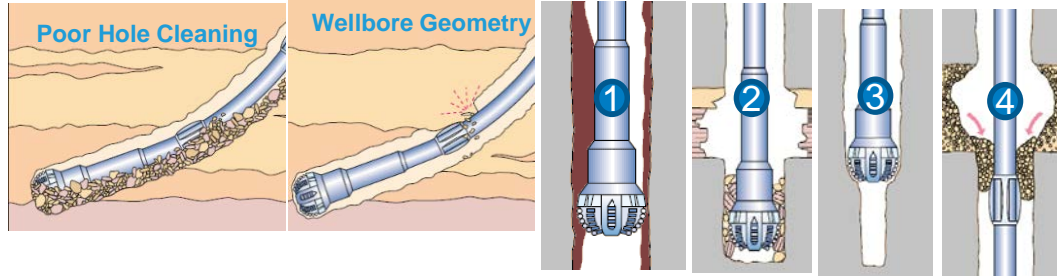✓ Non-Spatial attributes would be displayed in real-time based on change in time or depth index.

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Realtime Drilling Performance Indicators

Performance Indicator	Value	Unit
Gains & Losses		
Gains Risk	Green	Status
Loss Risk	Green	String
Wellbore Stability		
Openhole Opened	10	Day
Fluid Deviation	Green	Status
ROP Opt		
Bit Life	50	Day
Bit Revolution	100K	
Casing Running		
Trip Schedule	Green	Status
Pressure Test		
Last Test Date	4/12/16	Date
Status	Pass	Status
BOP Health		
Hydraulic	Green	Status
Electric	Green	Status

Rig Activity: Rotary Drill 48%, Rotate, Pump 16%, Pump 9%, Pull Up, Pump 5%, Ream 5%, Run In, Pump 5%, In Slips 7%, Sliding 5%
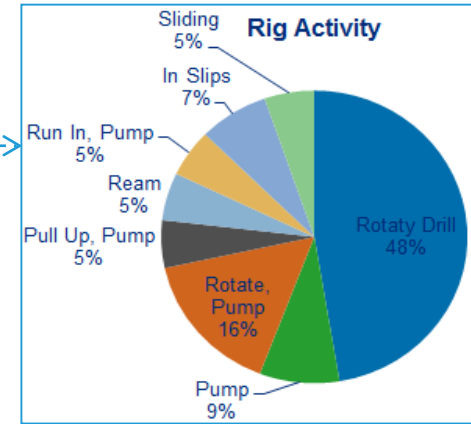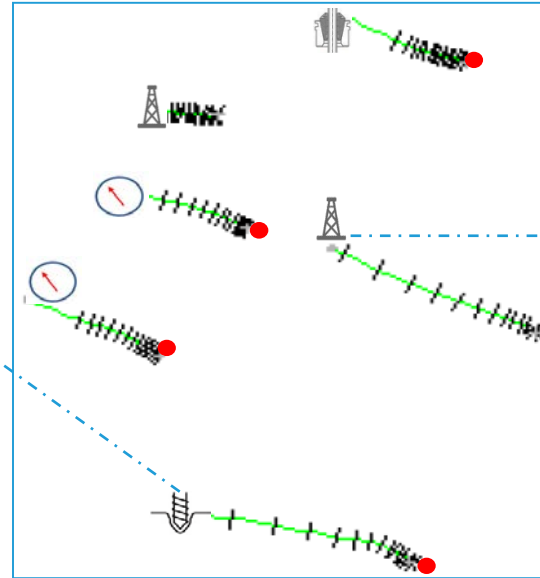
- ✓ Well profile will be rendered with trajectory stations.
- ✓ Current Bit depth will be rendered on the well profile. Movement of bit depth will be updated based on the realtime status.
- ✓ On the offset profile the formation markers and risk will be rendered.

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Risk Object
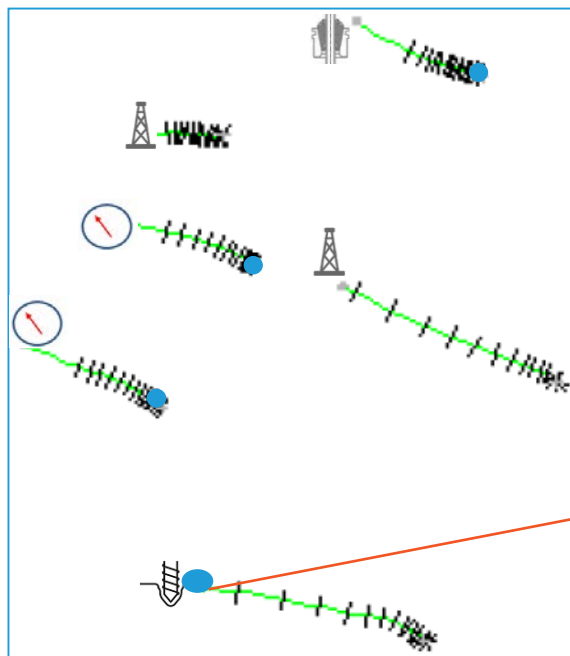

Poor Hole Cleaning

Wellbore Geometry

① ② ③ ④

1. Differential Sticking 2. Faulted Zone 3. Under gauge Hole 4. Unconsolidated Zone

✓ Risk is tied with formation Markers, depth range and Hole section.

✓ Each Risk is characterized by its Types, Category, Subcategory, Ext. Category, Severity, Probability, Affected Personnel & Mitigation.

✓ 4-5 offset wells & 100 risks may be considered during well planning.

Risk Object

```xml
<?xml version="1.0" encoding="utf-8" ?>
- <risk uidWell="TestWell" uidWellbore="TestWB"
uid="TestID"> <name>Losses</name>
  <type>risk</type>
  <category>hydraulics</category>
  <subCategory>loss circulation</subCategory>
  <extendCategory>loss circulation
</extendCategory>
  <mdHoleStart uom="m">2578</mdHoleStart>
  <mdHoleEnd uom="m">3345</mdHoleEnd>
  <tvdHoleStart uom="m">2578</tvdHoleStart>
  <tvdHoleEnd uom="m">3345</tvdHoleEnd>
  <severityLevel>0</severityLevel>
  <probabilityLevel>0</probabilityLevel>
  <summary>Issue with losses</summary>
  <identification>Drilling~</identification>
  <mitigation>Issue with losses</mitigation>
</risk> </risks
```

Risk Assessment

Risk Assessment – 23" Hole Size

Subsurface

Bit Balling
MD – 625 – 1065 ft

Carvings
MD – 1092 – 1773 ft

Stick Slip
MD – 2399 – 2444 ft

Losses
MD – 2578 – 3345 ft

Drilling

Poor Hole Cleaning
Cause - Long open hole
Consequence – Stuck Pipe

Swab, Surge
Cause – Tripping Speed
Consequence – WBS Issues

Wellbore Stability Issues
Cause – Losses
Consequence – Carvings

Upcoming forecasted Risk : Losses
MD Start Depth – 9 – MD End Depth - 512 ft
Current Bit Depth – 500 ft
Mitigation : Get in touch with Fluid team, Increase mud weight

✓ Run Spatial Analysis & Density Analysis to identify Risk based on Hole Size and Rig Activity.
✓ Display Risk ,consequence and mitigation steps.
✓ Alert users when bit is approaching the risk.

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Business Benefits

- ✓ Support both well planning and well execution stages

- ✓ Offer live map to monitor realtime drilling operations across the globe.

- ✓ Renders both realtime and future rig acgtivity ot well status.

- ✓ Not intended to replace any existing industry specific drilling and G&G apps.

- ✓ Useful for beginner to expert level personnel.

- ✓ Enable collaboration between experts.

THANK YOU

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