Well Construction Process Modeling and Simulation

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Offshore Drill Ship
Offshore Well Construction Process and Well Profile

- Drill Ship
- Riser
- BOP
- Wellhead
- Cement
- Casing
- Drill Pipe
- Drill Bit
- Zones
- Pay Zone
Tripping Process

Reference: Center for Deep Earth Exploration
Tripping Process – Drill Floor

Reference: Aberdeen Drilling Consultants
Well Duration and Invisible Lost Time

Reference: Drilling Systems Automation Roadmap
http://dsaroadmap.org/
Mapping Machine Signals To Machine Stats and Activities

Tripping Process Gantt Chart

Machine Signals
State Machine Models
Discrete Event Machine Process
Aggregation of State Machine and Discrete Event Processes
Machine Events Analytics Application

Machine Data

Application

State Machine Engine
Discrete Event Engine

Activities

Efficiency Dashboard
Activity & Machine Statistics and Charts

Activity Identification

Critical Path Classification

SQL Database

Activity CP and PS Classification
Activity Combination

Activity Distribution

Machine States

Crew Performance

Activities

State Machine Engine
Discrete Event Engine

SQL Database

Activity CP and PS Classification
Activity Combination

Activity Distribution

Crew Performance
Run the Model
Results: Single Activity Variation Over 6 Months

Statistics:
- Avg: 50 s
- Median: 32 s
- Min: 15 s
- Max: 300 s
Results: Median Activity Comparison Per Rig

<table>
<thead>
<tr>
<th>Machine</th>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine 1</td>
<td>Blue</td>
<td>Green</td>
<td>Blue</td>
<td>Green</td>
</tr>
<tr>
<td>Machine 2</td>
<td>Green</td>
<td>Blue</td>
<td>Green</td>
<td>Blue</td>
</tr>
<tr>
<td>Machine 3</td>
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</tr>
</tbody>
</table>
Results: Median Activity CP Impact Comparison Per Crew
Results: Hours of Invisible Lost Time Per Month
Pulling it all together
Forward Work
Questions?

Upcoming Events:
INCOSE in O&G - Houston, May 3
TinyURL.com/18INCOSE
INCOSE Symposium - DC, July 7-12

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