Primary funding is provided by

The SPE Foundation through member donations and a contribution from Offshore Europe

The Society is grateful to those companies that allow their professionals to serve as lecturers

Additional support provided by AIME

Drilling Automation: New Prospects and Prospectors?

Fred Florence
National Oilwell Varco
Drilling Automation

• Why automated drilling?
• Mechanization and automation
• New roles and responsibilities
• Land rigs too?
• What is the latest?
• What comes next?

Will automation eliminate the need for a driller on the rig?

• Why automated drilling?
• Mechanization and automation
• New roles and responsibilities
• Land rigs too?
• What is the latest?
• What comes next?
Why Automated Drilling?

• Drilling  Safety and Performance
• Completions  Accuracy and time to deploy
• Production  Well placement and better well quality
• Reservoir  Getting logs reliably

Maybe you can think of other reasons.

Why Automated Drilling?

• Today drilling is a manual process
  – Rheostats
  – Levers
  – Steel bar
  – Gauges

Source: Schlumberger – SPE Conference
Why Automated Drilling?

• New control systems can mechanize surface activities

Why Automated Drilling?

• Improve Safety at well center and overall
• Reduce process variability of repetitive tasks
• Reduce wellbore risks
• High speed calculations and models can adapt to dynamic events
• Simultaneous activities go beyond human capabilities
Drilling Automation?

- Need to tie the surface machines to the downhole equipment and data
- Automate the **downhole** process

Source: Research Council of Norway – IRIS Conference 2008

Source: Schlumberger – IRIS Conference 2009
Each machine has its own control.

Surface:

- Magic Box
  - Closed Loop Control
  - Envelope Protection
  - BHA Downlinking
  - What Else?

- Comms Method

Downhole:

- At Bit Meas.
- Steering Equip.
- Survey Meas.
- Formation Evaluation
- Drilling Mechanics Measurements

Distributed Sensors
Remote

Offsite Monitoring & Support

3rd Parties
- Command/Limits
- No direct machine control

Geologist Drilling Eng

ON SITE

Each machine has its own control

Drilling

3rd Parties
- Command/Limits
- No direct machine control

Geologist Drilling Eng

OFF SITE
The “Magic Box”

• BHA Downlinking
• Envelope protection
• Closed loop control
• What else?
The “Magic Box”

• Closed loop control

Autodriller controls payout based on boundary conditions

Parameter A

Parameter B

The “Magic Box”

• What else?
• IRIS with models-to-controls in Norway via “Drilltronics”
• SPE/IADC Amsterdam 2011
  Two SPE papers showing ROP enhancement of about 30%
• Also JPT series of articles of Sept 2011

SPE/IADC 139849

Real-Time Optimization of Drilling Parameters by Autonomous Empirical Methods
W. L. Koedrantz, SPE, and W. E. Johnson, SPE, National Oilwell Varco

SPE/IADC 139897

Increased Rate of Penetration Through Automation

The “Magic Box”

• BHA Downlinking
• Envelope protection
• Closed loop control
• What else?

• Commercial today
• “Limits Management”
• For limited tasks
• A few already in field-testing
• Why automated drilling?
• Mechanization and automation
• New roles and responsibilities
• Land rigs too?
• What is the latest?
• What comes next?

Mechanization & Automation

• First designs allowed for manual back up.
• Newer designs allow more options for faster performance.
• Why automated drilling?
• Mechanization and automation

• New roles and responsibilities
• Land rigs too?
• What is the latest?
• What comes next?

New Roles and Responsibilities

• Drill crew
  • On / off switch, but needs to understand impact of others
  • Still in charge of the process
• Company representative
  • Use as a tool, but need ability to make changes to suit new conditions
  • Use case/safety case
New Roles and Responsibilities

• For service company personnel
  • New access to rig machinery
  • What will they do with it
  • Fewer personnel at rigsite
  • More value downhole? offsite?

New Roles and Responsibilities

• Off-site
  • Well planning changes
  • Advisory versus more rapid local control
  • More multi-functional, but how to manage it?
  • What happens when communications go down?
New Roles and Responsibilities

• May need an extra technician, but similar to adding a subsea engineer offshore
  • Depends on value

New Roles and Responsibilities

• It's different
• All need to know how the difference affects the program
• Human factors as much or more than technology
• Why automated drilling?
• Mechanization and automation
• New roles and responsibilities
• Land rigs too?
• What is the latest?
• What comes next?

Land Rigs, Too?

• High value for deepwater rigs
• Also for conventional and non-conventional land
  – Well placement
  – ROP enhancement
  – Reduction in NPT
  – Fewer service personnel and associated travel costs
  – Capture lessons learned
  – Some say “well manufacturing”
• Why automated drilling?
• Mechanization and automation
• New roles and responsibilities
• Land rigs too?
• What is the latest?
• What comes next?

What Is The Latest?

• SPE Drilling Systems Automation Technical Section (DSATS)

• IADC Advanced Rig Technology Committee (IADC ART)
What Is The Latest?
Drilling Systems Automation Technical Section (DSATS)

- SPE Conferences and Forums
- Sub-committees
  - Standard Protocol and Language
  - Reliability
  - Road Map
- New Issues and Developments

http://connect.spe.org/dsats

What Is The Latest - DSATS?

- San Diego, CA, USA
  SPE/IADC Drilling Conference - DSATS Panel Session
  5 Mar 2012
- Graz, Austria
  IEEE International Instrumentation and Measurement Technology Conference
  13-16 May 2012
- Vail, CO, USA
  SPE Workshop “Drilling System Automation - The Next Big Jump”
  16-18 July 2012
- International Drilling Competition 2012/2013
- Field data for Universities?
What Is The Latest?
International Association of Drilling Contractors (IADC)

• Advanced Rig Technology (ART)
  Drilling Controls Subcommittee
  • Control philosophy of contractors
  • Business case
  • Rig interface

---

What Is The Latest - IADC?

ART Drilling Controls Subcommittee

IADC DCS Deliverables

The most recent DCS subcommittee meeting developed the following breakdown of Task Specific Work-Groups:

<table>
<thead>
<tr>
<th>TASK/WORK-GROUP</th>
<th>DOMAIN OF EXPERTISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer of Tool Ownership</td>
<td>DRL SRV MFG</td>
</tr>
<tr>
<td>User Interface Standardization</td>
<td>DRL SRV MFG TPY</td>
</tr>
<tr>
<td>Well State/Phase Definition</td>
<td>OPR DRL SRV MFG</td>
</tr>
<tr>
<td>Cascade Effect of Control</td>
<td>DRL SRV MFG</td>
</tr>
</tbody>
</table>

OPR – Operator
DRL – Drilling Contractor
SRV – Service Company
MFG – Equipment Manufacturer
TPY – Third-Party Consultant/Contractor
What Is The Latest – Concerns?

• Security
• Reliability
• Performance
• IP protection

Why automated drilling?
• Mechanization and automation
• New roles and responsibilities
• Land rigs too?
• What is the latest?
• What comes next?
What comes next?

- New technologies allow integration of surface and downhole on advanced rigs
- Migration to conventional rigs to improve performance depends on local issues

What comes next?

- What change can we tolerate?
- What value does it bring?
Conclusions

• Operators and contractors see the value of providing automated systems applied to the drilling process, not just pipe handling
• Guidelines are being developed that may be adopted as industry standards
• Implementation issues are being resolved

Conclusions

• New models are emerging and they now have a means to connect to the rig equipment
• The connection of models and/or remote controls to the drilling machines is proven and beneficial
• Drilling automation continues to evolve and will require new organizations and business models
Thank you for your time and attention.

I also wish to thank my employer, National Oilwell Varco, for allowing me to participate in this program, and many thanks to the SPE for the invitation to visit its sections and meet so many interesting people.

The future of drilling automation will likely affect most of us.
Your participation is encouraged. Join us.

http://connect.spe.org/dsats/