Distinguished Lecturer Program

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Drilling Automation: New Prospects and Prospectors?

Fred Florence
National Oilwell Varco
Drilling Automation

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?
• Mechanization and automation
• New roles and responsibilities
• Land rigs too?
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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: Schlumberger – IRIS Conference 2009

Source: Research Council of Norway – IRIS Conference 2008
Remote  Surface  Downhole
Each machine has its own control

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

Comms Method

Surface
Downhole
Remote Monitoring & Support

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

Geologist Drilling Eng

Offsite Monitoring & Support
Each machine has its own control

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

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

Geologist
Drilling Eng

Driller

Offsite Monitoring & Support

Comms Method

Distributed Sensors

At Bit Meas
Steering Equip.
Survey Meas.
Formation Evaluation
Drilling Mechanics Measurements
The “Magic Box”

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

- BHA Downlinking
The “Magic Box”

- Envelope protection

Tripping limits control

Pipe velocity

Machine limits

Fracture pressure constrained

Time
The “Magic Box”

• Closed loop control

Autodriller controls payout based on boundary conditions

Parameter A

Parameter B
The “Magic Box”

• What else?
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?
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• What comes next?
Mechanization? Automation?

- **Mechanization**
  - move more
  - move faster
  - move safer

- **Automation**
  - make repeatable
  - move even faster
  - minimize errors

- **Drilling Automation**
  - surface and downhole
Mechanization? Automation?

- **Mechanization**
  - move more
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- **Automation**
  - make repeatable
  - move even faster
  - minimize errors

- **Drilling Automation**
  - surface and downhole

- Companies are already doing this with surface machines for pipe handling

- Only a few are adjusting surface parameters to affect downhole processes
- IRIS with models-to-controls in Norway via “Drilltronics”
- ATCE SPE/IADC Amsterdam 2011
  - Two SPE papers showing ROP enhancement of about 30%
- Also JPT series of articles of Sept 2011
Mechanization & Automation

- Mechanization via tools like power slips and iron roughnecks
- Low level automation emulated repetitive motions such as an autodriller.
Mechanization & Automation

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

• Its is different
• All need to know how the difference affects the program
• Human factors as much or more than technology
• Why automated drilling?
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• 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?
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What Is The Latest?

• Automation systems to date

• SPE Drilling Systems Automation Technical Section (DSATS)

• IADC Advanced Rig Technology Committee (IADC ART)
What Is The Latest?

• Current experience: automation systems
  • Analog controllers
  • Digital controllers
  • Model controlling rig machines
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
What Is The Latest - DSATS?

- Issues
  - Interchangeable but proprietary
  - Open front end; rig-specific back end
  - Build off of WITSML and IEEE
  - Make it work
  - Make money
What Is The Latest - DSATS?

• Recent events
  • Most comprehensive
    *Galveston workshop April 2010*
  • Numerous short sessions at main SPE events
  • IEEE/DSATS in Denver, Oct 2011
  • ATCE in Denver, Nov 2011

See website for reference material

http://connect.spe.org/dsats
What Is The Latest - DSATS?

• Coming soon
  • 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
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?

• Asia Pacific Oil & Gas Conference and Exhibition 20 – 22 Sep 2011

• Monthly Drilling Control Systems Subcommittee Meetings
What Is The Latest - IADC?

ART Drilling Controls Subcommittee

IADEC 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?
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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/