SPE / IADC 163422
Drilling Systems Automation
Preparing for the Big Jump Forward

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“Hume”
SPE Well Construction Automation Workshop
Vail, Colorado  18 July 2012
Drilling Systems Automation
a major force in capability development

• Automation in drilling systems coming quickly
  – Will you be left behind?
• Capability to deliver safety, quality, reliability, performance with interoperability
• Proven improvement
• Industrial automation and robotics offer solutions
• Vision of the Future
Unique combination for the workshop

- Experience from other industries
- Update on latest advancements
- Robotics, machine learning and autonomous task performance
- Major participation non oilfield
- Academia and Defense Advanced Research Projects Agency (DARPA)
Reasons DSATS organized the workshop

• Promote rapid adoption of drilling automation.
• Share knowledge of drilling automation activities.
• Understand the shift in skills and competencies that come with automation.
• Connect individuals and companies employing automation, industrializing components for automation, and researchers with those working on the forefront of automation in our industry.
It is not a new idea

1971 – Singles Rig

Hydraulic power based

Computer control – long before PC’s

Drilled for Major in Texas as R&D project

RIP
Industry challenges automation can solve them

• Reducing HSE exposure for those working at the rig site.
• Offsetting the limited capacity of the workforce.
• Improving levels of performance
  – reduce overall well times and safely impact well costs.
• Reducing costs of large numbers of similar wells.
• Enabling the exploitation of shales, coal bed methane and similar unconventional reserves.
• Advanced and intelligent technologies
  – at the range of the drilling envelope on a regular basis.
Why Automate?

- Don’t exceed maximum weight on the bit
- Don’t exceed the maximum RPM of the bit
- Avoid lateral vibrations
- Drill faster
- Don’t exceed make-up torque of the drill string
- Drill efficient
- Stay on target
- Clean the hole
- Drill this section without tripping; i.e. with one bit
- Time is money
- Avoid stick-slip vibrations
- Don’t stall the top drive
- Condition the hole
- Don’t buckle the pipe
- Don’t stall the downhole motor
- Go back to bottom fast and safely
- Connect a new pipe fast and safely

Courtesy Shell

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Proof – out perform the human driller

Combination of best performance and consistency

Courtesy Schlumberger
The various levels of automation being pursued were shown to fall into three primary categories:

- **Tier 1** – Advise driller allowing him to choose which recommendations to use and when;
- **Tier 2** – Semi-autonomous, where the driller retains control through consent or veto;
- **Tier 3** – Autonomous where the system decides and takes actions without the driller’s input.
Platform available to apply own apps
DARPA has some lessons

- Humans can’t intervene at highest rates
- Supervised automation, solve problems that defy basic models (navigation)
- Not a question of human or robot, its both

Courtesy Boston Dynamics
Automation can reduce human fatigue issues

Accident rate and shift duration

40 / million man hours

100

0
Human Systems Integration

- Optimal performance between low workload (autonomous) and high workload (low level automation) levels
- Train for new technology and to maintain skills
- Lower automation
  - Perform tasks with automated system as back up
- Higher automation
  - Simulation to maintain skills
- Including ergonomic assessment
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Human Automation Performance - methodology

• Measure human-automation performance automatically during operations
  – Monitor actions as they are performed to compute performance measures in real-time
  – Make performance data available remotely via web

• Use performance measures to assess and adjust human-automation team
  – Establish baseline performance
  – Detect and correct significant departures from baseline
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Executable language for authoring procedures for automation

Procedure (PRL)

Procedure Automation Server

Procedure Display

Execution Logs

Mobile Display

Software architecture that supports remote operations
Human Factors in Automation

- Real time performance monitoring of human and automated actions
  - Developed for space flight
  - Applicable to drilling systems automation
- Monitor via the web
  - Assess and adjust the human / automation team
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Remote access to ops effectiveness and personnel proficiency

At a glance performance data and automatic handover reports

Real-time metrics for human-automation performance

Courtesy Trac Labs
Interoperability is key

- Applicable industry standards are available
  - multi-vendor interoperability
  - data transfer of information
  - OPC UA
- Islands of automation will stifle development
  - Proprietary systems unable to communicate

- Field Bus Wars – 1990’s
  - Interoperable or die?
Vision – the future of drilling systems automation

- Land - Multiple work center machines
- Improved sensors
- Autonomous – with Mission Control
- Adaptive – manage uncertainty
- Plug and play interoperability

**Vision timeline:**
- 5 years - 35 votes
- 10 years - 32 votes
- 15 years - 3 votes
- 20 years and > - 0 votes
Observations

- Automation drilling systems gaining pace
  - Rate dependent on integration of data and control transfers
  - Interoperability standards will drive this
- Automation requires sufficient and suitable sensors
  - Upgraded sensors required – will be incorporated
- Industrial automation has solutions
- Advanced robotics and control system provide solutions
- Autonomous land drilling is coming fast
Acknowledgements

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The workshop report has been added to OnePetro at www.onepetro.org with SPE number 163146.

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