SPE/IADC Conference and Exhibition drilling
5–7 MARCH 2013
AMSTERDAM, THE NETHERLANDS
RAI CONGRESS CENTRE

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

John de Wardt, DE WARDT AND COMPANY

SPE International
Drilling Systems Automation Technical Section

International Association of Drilling Contractors
Society of Petroleum Engineers
SPE International

Thanks Committee

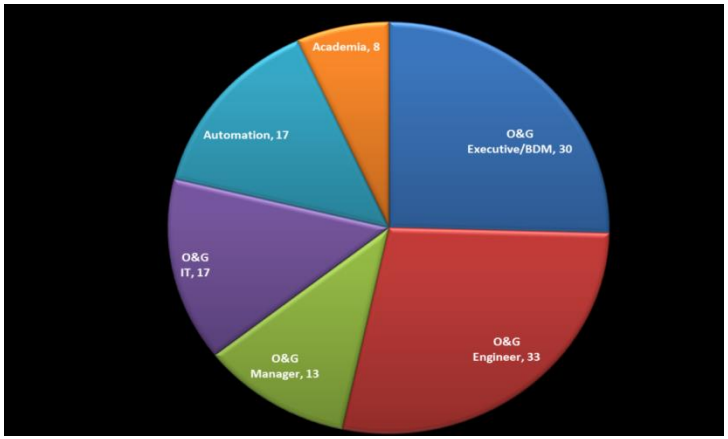
John de Wardt
Clinton Chapman
Michael Behounek
Adrian Vuyk
Brett Browning
Clay Flannigan
Devi Putra
Ed Tovar
Eric van Oort
Jim Rogers
Mario Zamora
Moray Laing
Roger Thompson
Thomas Burke

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

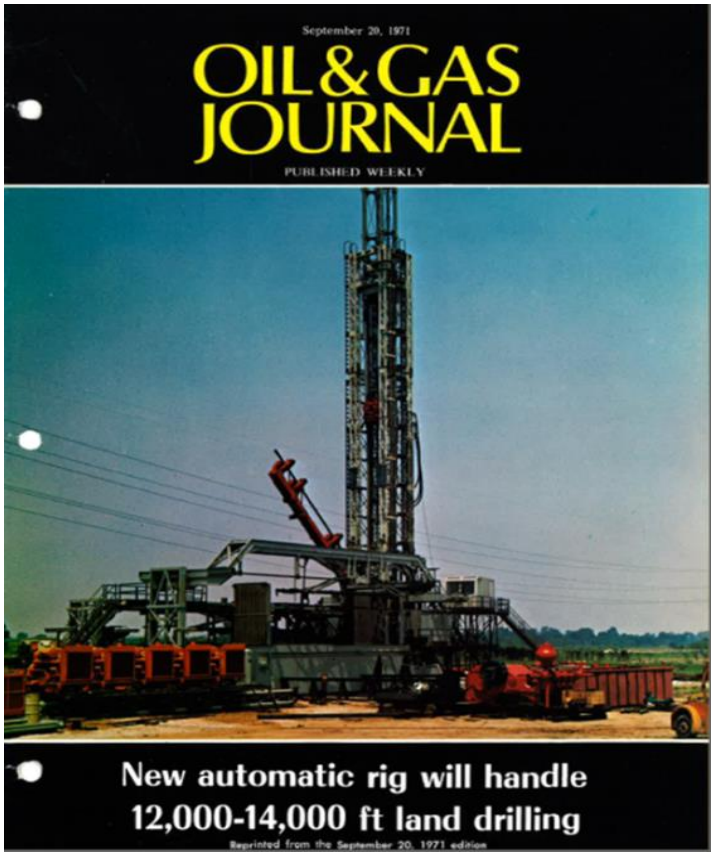
- Experience from other industries
- Update on latest advancements
- Robotics, machine learning and autonomous task performance
- Major participation non oilfield
- Academia and Defense Advanced Research Projects Agency (DARPA)



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

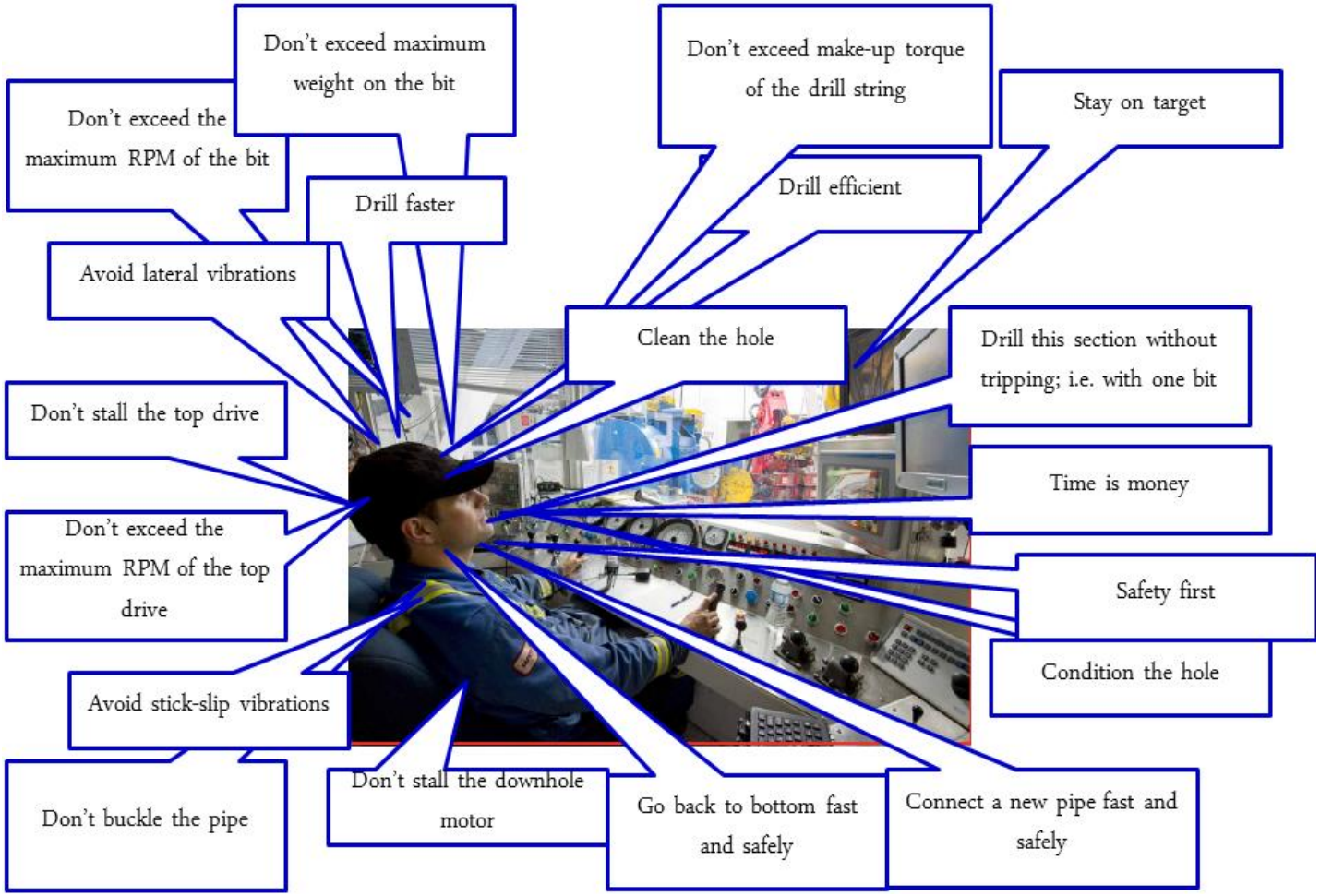
Drilled for Major in Texas as R&D project

RIP

Industry challenges
automation can solve them

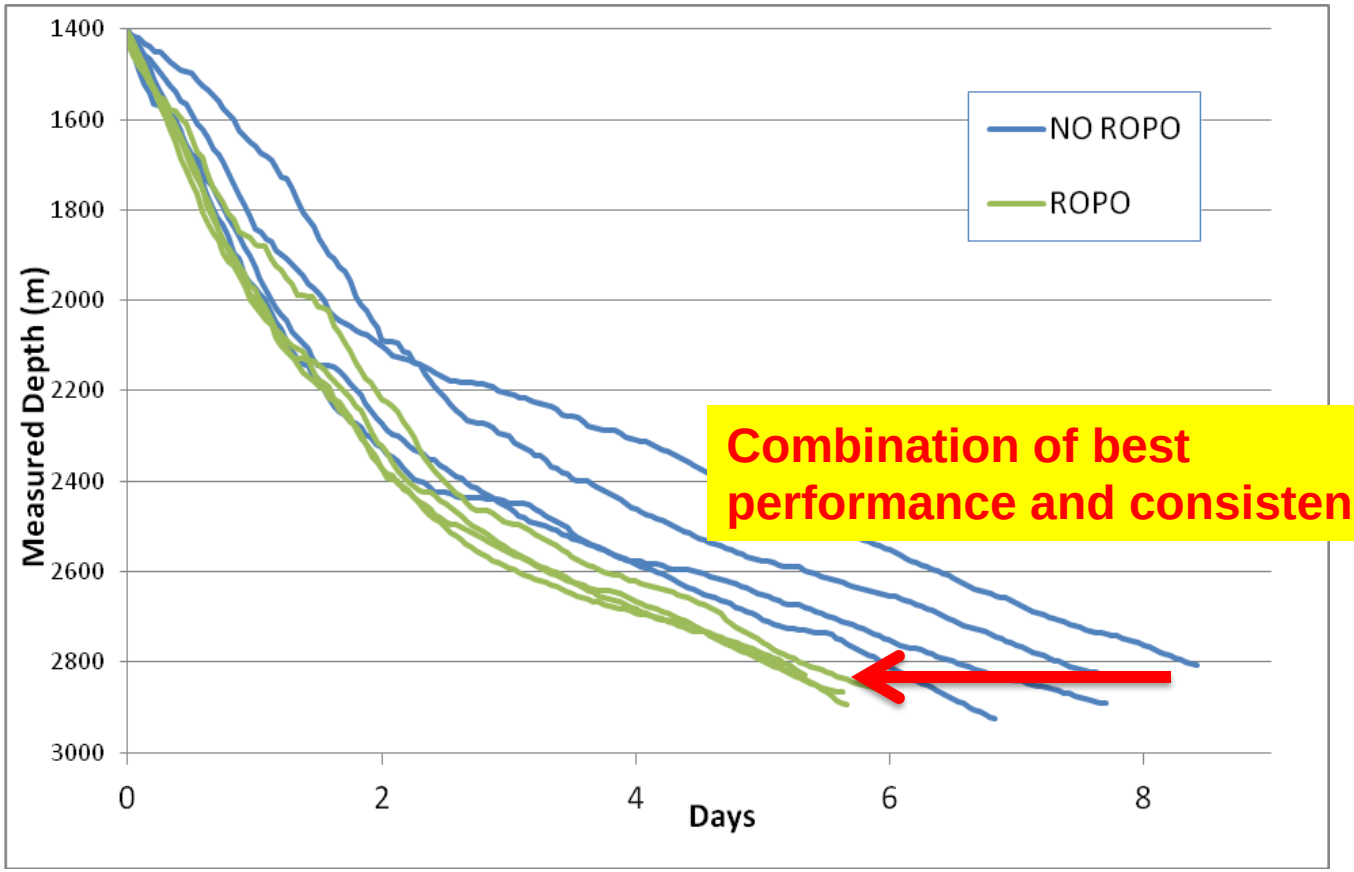
- Reducing HSE exposure for those working at the rig site.
- Offsetting the limited capacity of the workforce.
- Improving levels of performance
  - reduce overall well times and safely impact well costs.
- Reducing costs of large numbers of similar wells.
- Enabling the exploitation of shales, coal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

Why Automate?



Courtesy Shell

Proof – out perform the human driller

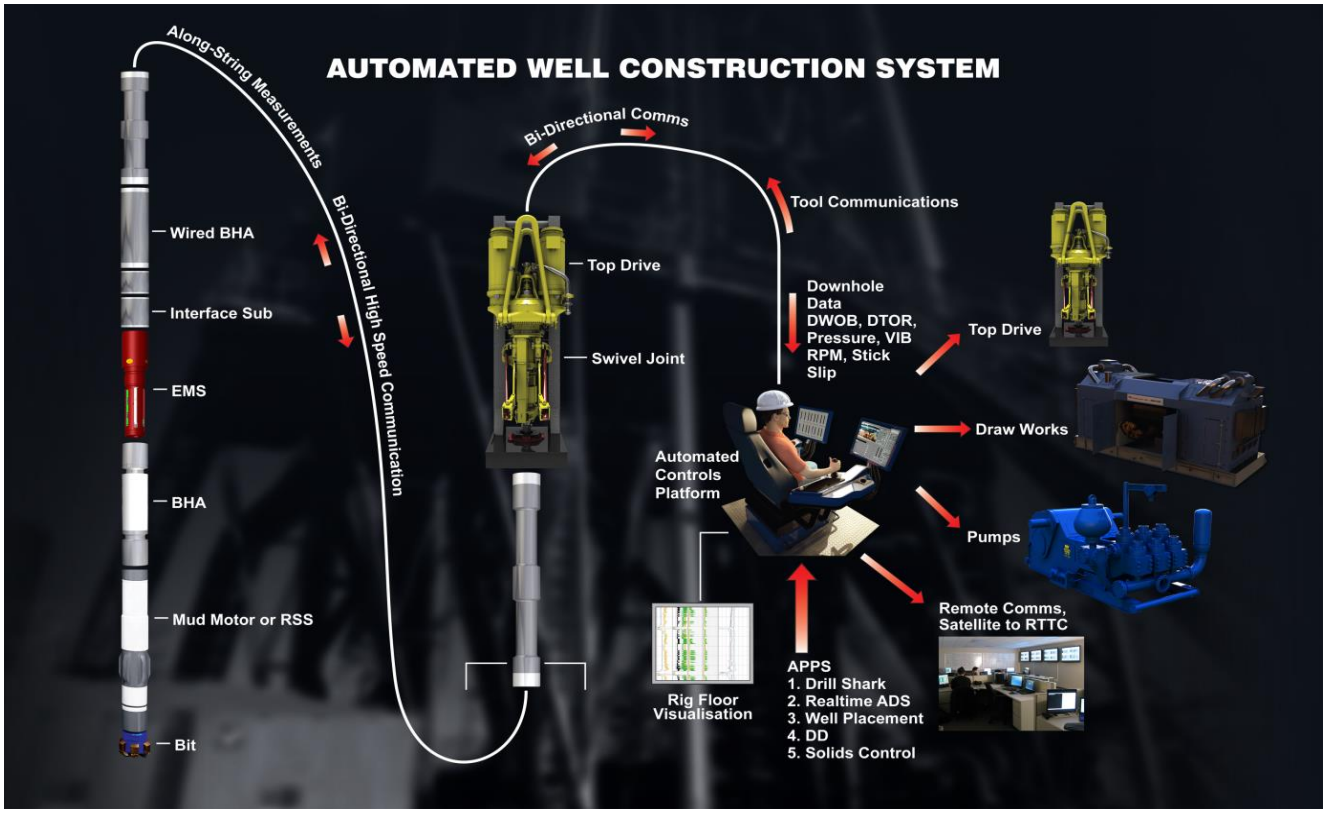


Courtesy Schlumberger

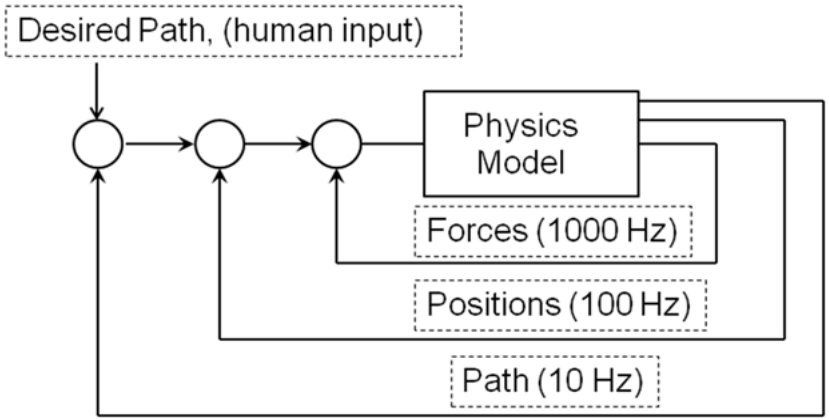
It is in the pipeline

- 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

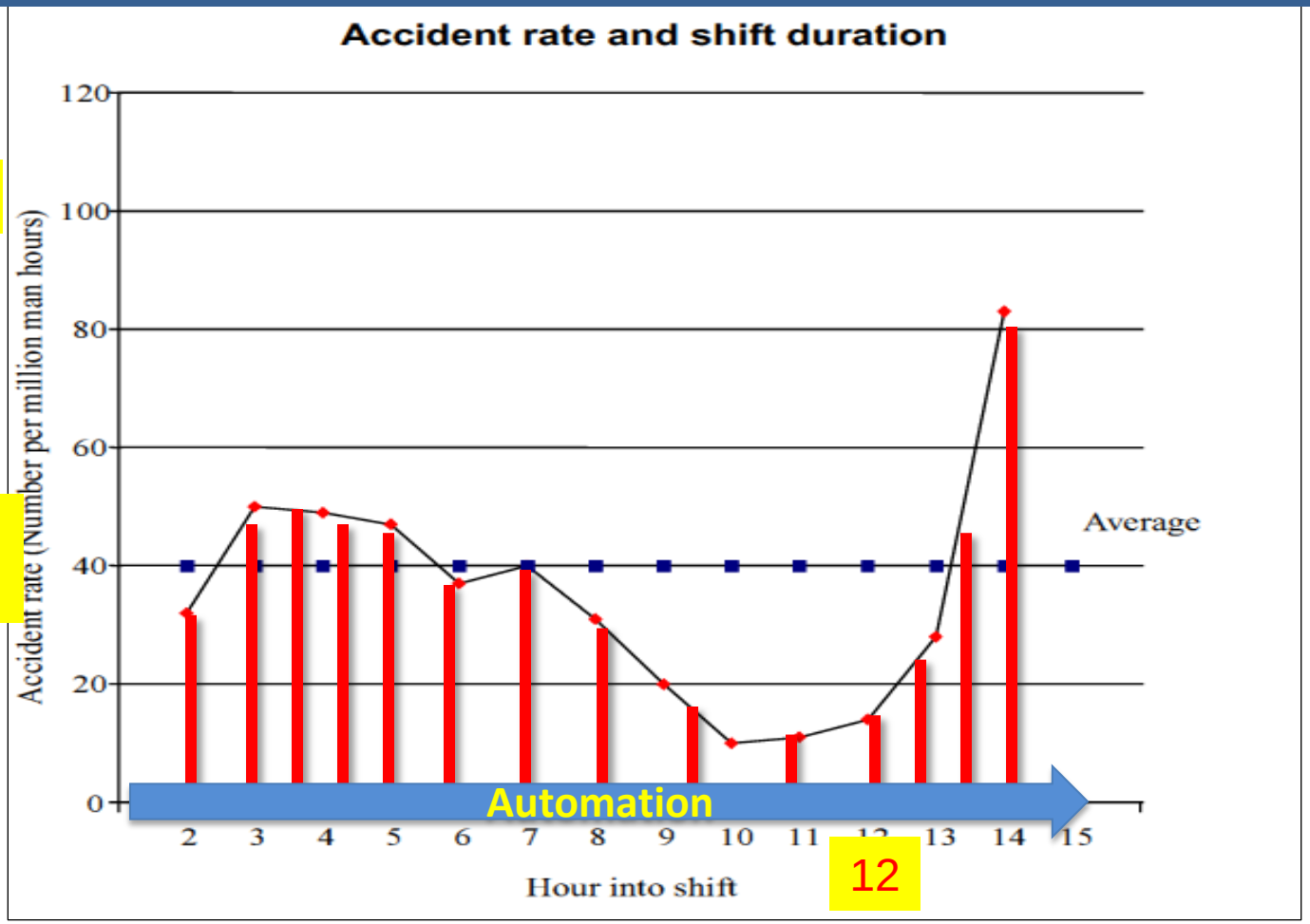
Courtesy Boston Dynamics

Automation can reduce human fatigue issues

100

40 / million man hours

0

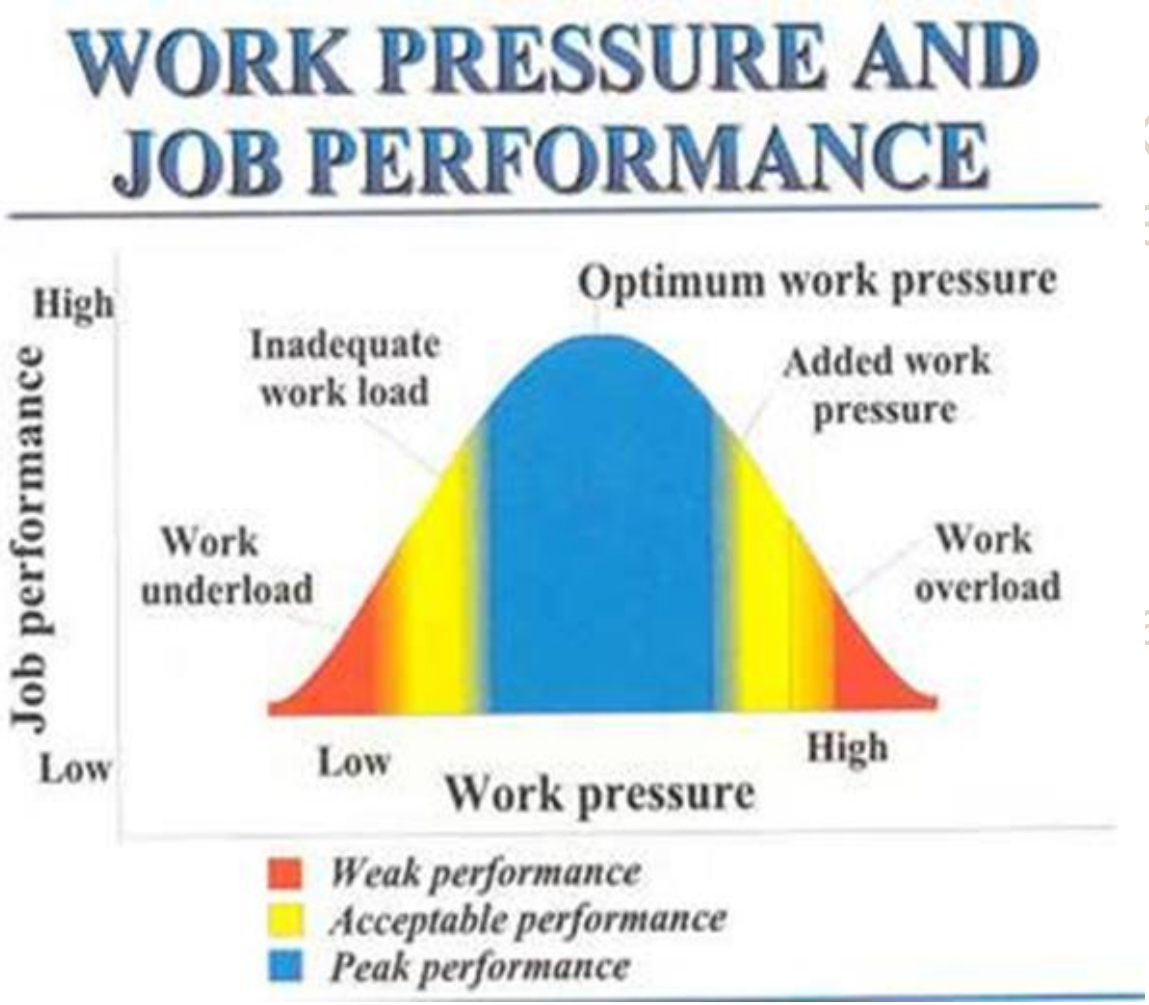


Human Systems Integration

- 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

Human Systems Integration

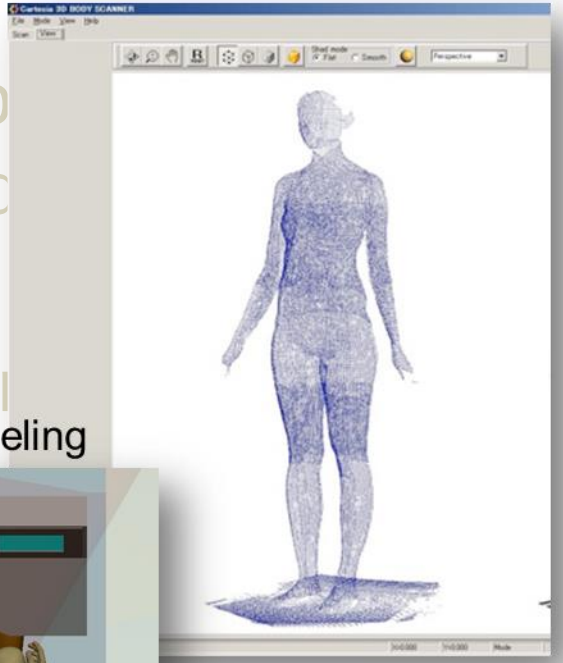
- Opti … load (auto … evel auto
- Trair … n skills
- Lowe
  - Pe … ack up
- High
  - Si
- Inclu



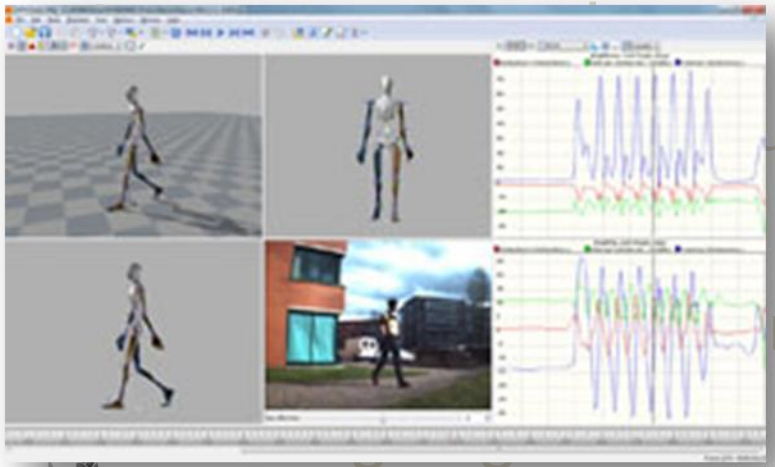
Human Systems Integration

- Optimal performance between lo
  (autonomous) and high workloac
  automation) levels
- Train for new technology and to

3-D Body Scanning



3-D Kinematic Motion Analysis



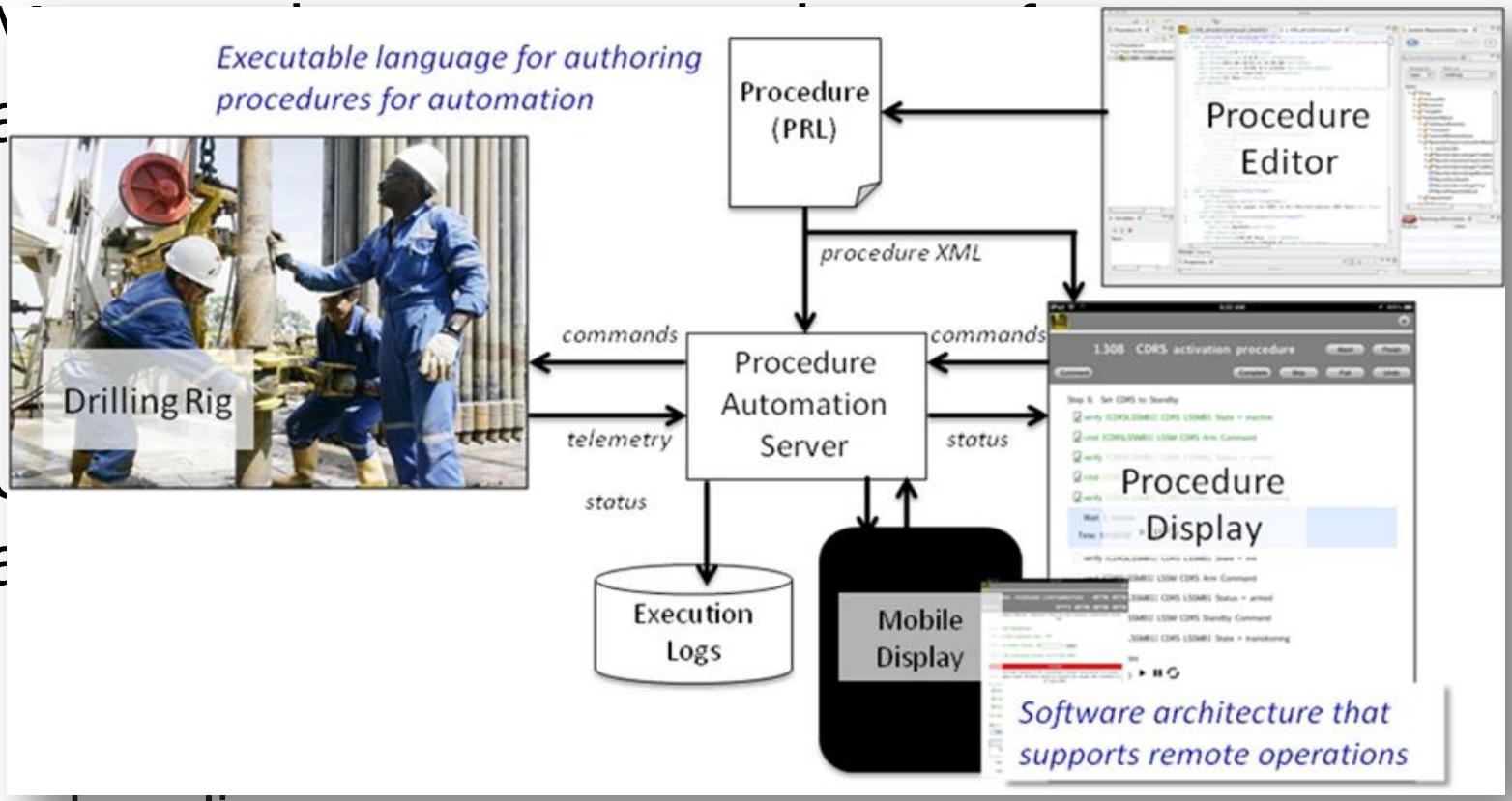
Workspace Modeling

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

Human Automation Performance - methodology

- M
  a
- U
  a
  baseline



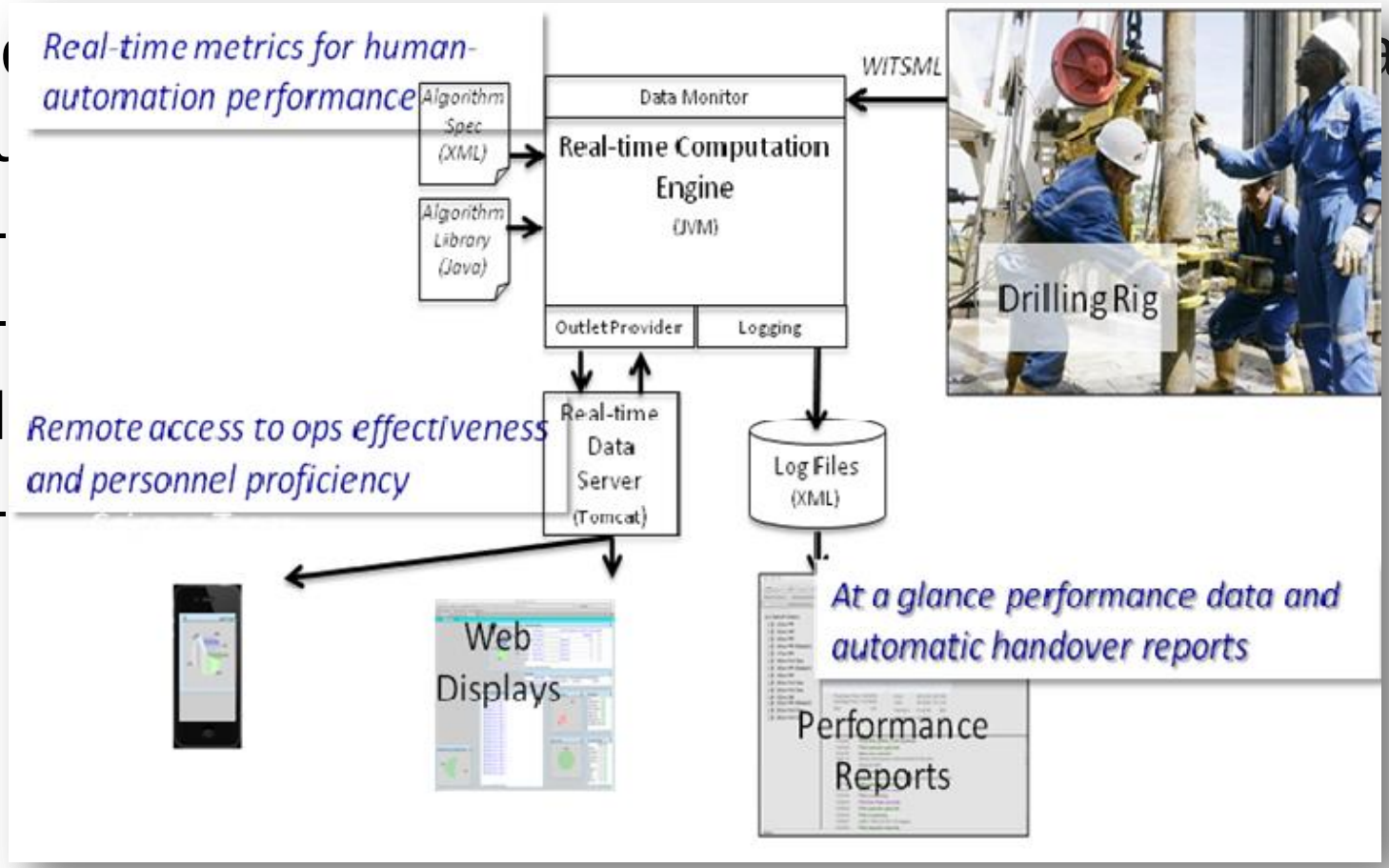
Human Factors in Automation

- 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

Courtesy Trac Labs

Human Factors in Automation

- R
  - a
  - a
- M
  - a



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

SPE/IADC Conference and Exhibition drilling
5–7 MARCH 2013
AMSTERDAM, THE NETHERLANDS
RAI CONGRESS CENTRE

Acknowledgements

The authors acknowledge the support of their respective companies and the hard work by the workshop committee and SPE events coordinators to create a valuable event.

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

Visit DSATS at http://connect.spe.org/dsats/home/

SPE International
Drilling Systems Automation Technical Section