Digital Transformation of the Oil & Gas Industry: 
the Hope, the Hype, the current Reality and the Challenges Ahead

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Understanding a revolution

• “A revolution cannot be mastered until it is understood. The temptation is always to seek to integrate it into the familiar doctrine to deny a revolution is taking place. It is time to attempt an assessment of the technological revolution which we are witnessing and to understand how it affects everything we once thought we understood.” (Nuclear Policy and Foreign Policy, 1957)
Data Rich...

Data in Process Historians, Manufacturing & IT Systems

...but Information Poor

Manual Analysis in Spreadsheets

Long Time to Insight

Inflexible, Static Reports
The Hope: Productivity

Growth in Production without proportional increase in costs (opex & capes), manpower.
How far can we push productivity?
Typical Life of a Field

Rate (STB/D or MCF/D) vs. Cum Prod (MSTB or MMSCF)
Average oil production per well in the Niobrara region

Source: U.S. Energy Information Administration, Drilling Productivity Report
Myths and Truths

Digital Oil Field of the Future Realities

Five Myths
1. Digital oil field is mostly about technology
2. Digital oil field is an IT thing
3. Digital oil field is mostly about automation
4. Operators trust the models asset team builds
5. Major Capital Projects are greenfield opportunities

Five Truths
1. Data management is worse than you think
2. Technology Capabilities >> Deployed Technology
3. Organizational Capabilities for digital oil field are more than just a strategic staffing numbers game
4. Most folks out there are too busy to listen
5. Lessons learned from refining and process industries are hard to transfer
Emerging new Digital Technology: Everyone’s is doing it. Why isn’t Oil & Gas?

THE HYPE
DATA REVOLUTION IN OIL & GAS

UPSTREAM EXPLORATION & DRILLING (SUBSURFACE)
- Scalable System Framework
- HPC in the Cloud
- Xeon, Xeon Phi, OmniPath, Ethernet, Lustre, HPC Orchestrator

UPSTREAM PRODUCTION (REAL TIME OPERATIONS)
- Wellhead Monitoring & Control
- Sensors, Wearables, Edge Compute, Machine Learning, Video Analytics, Networks, Wireless, SDN, SDIS, IOT, NFV, TCC, TSN, RTOS

MIDSTREAM (PIPELINES, TRUCK, RAIL)
- Pipeline Integrity
- Sensors, SDIS, IOT, Drones, Machine Learning, Video Analytics, CLP

DOWNSTREAM (REFINING)
- Software Defined Industrial Systems
- SDIS, NFV, TCC, TSN, RTOS, Wearables, Analytics, Machine Learning

MARKETING (RETAIL)
- Petrol Station of the Future
- Smart Terminals, Inventory Optimization, Digital Signage, POS Connected Logistic Platform, Big Data Analytics, AIM Suite

OPERATIONS STRUCTURE
- Advanced Analytics & AI
- Asset Optimization
- Self Aware/ Self Organizing Systems

BUSINESS STRUCTURE
- Advanced Analytics & AI
- Enterprise Cloud
- Data as Digital Capital

INFRASTRUCTURE, SECURITY & MANAGEMENT
- Distributed & Virtualized Compute Edge/Fog/Cloud
- Embedded E2E Security & Management

Ref: Intel USC lecture on Petroleum Informatics 8 Feb 2018
O&G technology hype cycle
Learning How to Learn

- **“Supervised Learning”** – a technique used to train a system with the aid of a known (labelled) set of examples with a set of rules predefined by programmer
- **“Unsupervised Learning”** – training a network by exposing it to a large number of unlabeled examples
- **“Reinforced Learning”** – training a network to interact with environment with only occasional feedback in terms of rewards
- **“Transfer Learning”** – would allow a reinforced learning system to build upon previously acquired knowledge

**ANN (Artificial Neural Networks)**
IoT in the Oil Field

- actionable information
- pump performance
- tank levels
- injection pressures
- chemical usage

Cloud storage & computing
Example of representation of data from the object

- Datasheets
- Equipment List
- P&ID
- Single Line Diagrams
- Detail Electrical Drawing
- Control Cabinets
- Connected via cables
- Part of Control Loops
- Control has HW & Channel Assignments
- CFC Implementation
- Control System Interface
- Test Documents – IO-Test
- Training Simulator/3D
- Commissioning Data e.g.
  - Set-point and Parameter List
This industry is making progress. Digital Oilfield 2.0 Use Case Examples

THE CURRENT REALITY
Digital Intensity
- Increase in number and variety of sensors
- Field automation
- Smart equipment
- Increase in documents
- Increase in size of seismic surveys and reservoir models

Interconnected
- Remote Decision Support Centers
- Remote Control of Processes
- Decrease in proprietary networks and growth of internet
- Connected Supply Chains
Analytics is Inherently Multidisciplinary
A mix of technology/science, business and management will ready future innovators for the big challenges presented by a knowledge-driven economy.

"IT professionals will need to possess expertise in multiple domains. Technical aptitude alone will no longer be enough. IT professionals must prove they can understand business realities – industry, core processes, customer bases, regulatory environment, culture and constraints. Versatility will be crucial.‘‘ – Gartner Group IT Professional Outlook
How to think like a programmer

• “Everyone in this country should learn to program a computer, because it teaches you to think.”
  - - - Steve Jobs
Are Algorithms Taking over the World?
DMDWD (Directional Drilling Measurement While Drilling)

• The first known multi-lateral well was drilled in Bashkiria, Russia in 1953. It was a nine-branch well with barefoot laterals drilled by Alexander Grigoryan, drilling engineer.

• The well reportedly produced 17 times more oil than offset wells in the field at 1.5 times the cost.

• But it was not until 1993 that the modern era of multi-lateral technology began.
ConocoPhillips Data Analytics Approach

Integrated Data Warehouse

Proprietary Algorithms

Data Visualization

Advanced Analytics

NEW INSIGHTS

DATA-DRIVEN

ConocoPhillips Eagle Ford Results

50% REDUCTION IN DRILLING DAYS

ADVANCED ANALYTICS IMPLEMENTATION

Unconventional Advantages

- Rapid, Low Cost Experimentation
- Numerous Operators
- Abundant Data to Analyze
- Small per Well Gains = Big Wins
- Considerable Play-to-Play Synergy
Predictive Analytics – Pattern Recognition

Build as an automated step
- Early detection for corrective and preventative measures
Al-powered artificial lift optimization

- **Ambyint**, the emerging player in AI-powered artificial lift and production optimization, and international energy major **Equinor** today announced that Equinor will deploy Ambyint’s technology on all rod pump wells in Equinor’s **Bakken asset in North Dakota**. The partnership comes at the end of a successful pilot and will expand to full field implementation in this asset.

- During the pilot, Equinor was able to **automate rod pump well optimization** through use of Ambyint’s **autonomous setpoint management functionality**. By identifying wells that were over-pumping or under-pumping, controller set points were adjusted with minimal human interaction. This kind of proactive machine-driven optimization resulted in increased production rates and pump efficiency while reducing well volatility.
Norway’s first platform to be remote-operated from land

- Valemon will be the first platform in Statoil’s portfolio to be remote-controlled from land.
- “This is a vital milestone for Statoil. We have had land-based surveillance and control of offshore operations for a long time, however, the remote control of Valemon marks one important step forward on our digitalisation journey,” says Gunnar Nakken, head of the operations west cluster in Statoil.
- Valemon is designed and constructed for such remote control. Statoil has currently no other platforms of this kind, but this solution will undoubtedly be considered for other small and medium-sized platforms in the future, and remote control will be a central building block.
- “Most of our production will still be carried out on large, manned platforms, such as Aasta Hansteen and the Johan Sverdrup platform, but for somewhat smaller platforms and fields it will absolutely be considered. First, we must gain experience from Valemon,” says Nakken.
- “Thanks to new technology and knowledge we can utilise the advantages of our smaller, standardised building blocks that are combined differently from field to field for optimal resource exploitation. We want to combine the best technology, below and above water, to find optimal solutions for every project, thereby ensuring safer operation,” says Nakken.
The ‘Perfect’ Well

• Shell’s iShale program
  • Shell announces first AI Well in the Permian Basin (2018). To drill the well, Shell used data on over 1300 wells that they have drilled in the basin, including data on geology, drilling and production to build algorithms that drill the perfect well.

• Challenges:
  • Road Safety Coalition: MVA fatality every 29 hours
  • GHG emissions
Remember People, Process & Technology (and don’t forget the data and the organizational culture issues).

THE CHALLENGES AHEAD
Our biggest challenges
Change Management Challenges

• “People are generally better persuaded by the reasons which they have themselves discovered than by those which have come into the mind of others.”

• Blaise Pascal, mathematician, physicist and theologian (1623-1662)
TRANSFORMATION IS MORE THAN TECHNOLOGY

The Impact of Technology and Enterprise Change on the Likelihood of Success in Digitalization

Impact of Technology Change

Cloud
Big Data and Analytics
AI
Internet of Things

Omnichannel
Competition, Culture and Mindsets
Ways of Working
Leadership and Change Management
Customer Experience
Compliance and Risk Management
Business Model and Strategy
Corporate Clock Speed and Governance
IT’s Operating Model
Incentives, Prioritization and Funding Model

Impact of Enterprise Change 15x

Source: CEB analysis.
THE CONNECTED WORKER: SMART RISK MANAGEMENT

CLOUD EHS PLATFORM
- Data, workflow, reporting

BUSINESS AND PLANNING SYSTEMS
- ERP, Supply Chain, HR, Maintenance, Quality
- Strategy governance and planning

MANUFACTURING & PROCESS CONTROL SYSTEMS
- Smart Connected Assets
- Manufacturing Operations

EQUIPMENT, INSTRUMENTATION, SENSORS
- Sensor equipped devices
- Proximity beacons
- Area monitors

SMART MANUFACTURING WORK ENVIRONMENT

RISK CONTROL DECISION SUPPORT
- EHS, Ops, Executive

ENTERPRISE
- Information technology
- IT/OT convergence
- Operational technology

PLANT FLOOR

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Change Management Challenges

• "It is difficult to get a man to understand something when his job depends on not understanding it."

• Upton Sinclair, American Novelist, author of Oil!
Search for the Digital Core

IloT Digital Core

- Oil Field Services
- ERP
- Operations Technology
- Information Technology
- Engineering Technology

IloT & Big Data
New Sources of Data
In Summary: Keep Your Eyes on the Prize

• Incremental vs Acceleration for Technology Adoptions
• Business Plan Objective
  • Operational Excellence (Efficiency)
    • Safety & Health (legacy wells & pipelines)
    • Lower Opex
    • Environment footprint, Community ‘license to operate’
    • Reduce drilling & completions costs
• Unconventional Reservoirs (Effectiveness)
  • 4x production increase in 4 years without adding staff
  • Ultimate Reservoir Recovery and maximum Reserves
  • Midstream Infrastructure
  • Natural Gas supply chain
What does the Future Hold??????

• “The future is already here — it's just not very evenly distributed.”

• William Gibson, sci-fi author, interview on Fresh Air, NPR (31 August 1993)

• Author of Necromancer, Mona Lisa Overdrive, Burning Chrome, All Tomorrow’s parties, Johnny Mnemonic, Count Zero and many others
Are you ready to meet about “digital transformation?”
We can’t see your slides.

Do you need to download the video plug-in?
We’re restricted to I.E. 7.

Ok, I tried to email the slide deck but it bounced back.
Our file limit is 1 MB.

Dropbox? Or WeTransfer?
Blocked by our firewall.

Google Docs?
Yeah, right.

I’m not sure how to present to you.
Can you fax it to us?
YOU KNOW, IF YOU GO IN THERE, THERE'S NO COMING BACK.

I... I HAVE TO DO IT. I HAVE TO KNOW WHAT HAPPENED TO MY FRIENDS.

THE FOOL...