Analytics and Big Data in the Oil Field
Occidental Petroleum Corporation
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Use of non-GAAP Financial Information

This presentation includes non-GAAP financial measures. You can find the reconciliations to comparable GAAP financial measures on the “Investors” section of our website.
Agenda

• Introduction

• Oxy’s Journey to Digital Transformation

• Re-Imagined Oilfield (RIO) – What’s Next

• Driving Value Through Data Analytics
Differentiated Value-Based Approach

• More Oil
• Less Cost
• Better Inventory

Creating shareholder value over the long-term

• Culture of innovative technology and process
  – Subsurface characterization
  – Integrated development planning
  – Oxy Drilling Dynamics
  – Innovative facility designs
  – Long-term base management
  – Enhanced reservoir recovery

• Early adoption of external trends
  – Big data, analytics, and mobile workforce
  – Multi-lateral wells (SL2)
  – Crude export facility

• Innovative cost efficiency strategies
  – Logistic and Maintenance hubs
  – OBO portfolio and investments
**Oxy Permian**

- Largest operated position in the Permian
- Exceptional subsurface characterization
- Proven value based development approach
- Improving through unique technology advancements
- 68% 4Q16 oil production

**Oxy Permian Business Overview**

| Resources – Unconventional Areas | 1.4 | 5,150 | 124 |
| Enhanced Oil Recovery Areas     | 1.1 | 19,310 | 145 |
| **Oxy Permian Total**            | 2.5MM | 24,460 | 269 |

**Permian Basin Industry Production**

- **10,000 mi² 3D seismic**
- **130,000 mi² 2D seismic**
- **~10,000 gross OBO wells**
- **250 OBO wells since 2015**

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*Gross Oxy operated wells including producers and injectors, and idle wells.
**Source: Wood Mackenzie 2016 production, 3/2/17, company NWI% production rates, operators shown represent ~85% of Permian Basin daily production.
Our Journey to Digital Transformation

Production Optimization
- Institutionalized Processes and Tools
- Single reporting repository
- Focus on analysis and decision making

Consolidated ERP Systems
- Integration of operational, technical and financial data
- Global Supply Chain
- Single Chart of Accounts

Technical Data Management
- Technical Data Consolidation
- Global Well Naming Convention

Field Automation
- Standardized End Devices
- Segregation of Automation Network
- Secured Remote Access to Real time Data
- Process Historian

Next Generation Production Optimization
- Real time Data Historian
- Predictive Analytics
- Advanced Surveillance

- Smart Oilfield
- Edge Computing
- Internet of Things
- Cloud and Mobility
- Big Data and Analytics
- Cognitive Service and Machine Learning
- UAV
- Virtual Reality
A flexible system that flows, changes form in real time, and seeks the most natural path to its destination.

**Oxy's Innovation Process**

**Current Innovation Pipeline Statistics and Results**

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(As of: 05.03.2017)
Data Science – Going Beyond Interesting

Data Collection & Profiling
- Data Preparation & Tagging
- Data Quality & Cleaning
- Data Forensics & Profiling

Insight & Recommendations
- Visualization
- Benchmarking
- Exploitation & Exploration

Computational Methods
- Numerical and stochastic Simulation
- Signal Processing
- Network Analysis

Optimization
- Computational Intelligence
- Natural Language Processing
- Image/Voice Processing
- Data Structure & Classical Algorithms

Artificial Intelligence
- Bayesian Analysis
- Survival Analysis
- Uncertainty Analysis
- Design of Experiment
- Statistical Learning (Machine Learning)
- Spatial/Temporal Analysis

Statistical Methods

Key Levers
- University Partnerships
- O&G Industry Research
- Outside Industry Research
- Commercially Viable Algorithms
- Vendors
- IT

Data Management
Driving Value @ the Bit

@Bit + @Target

• $325K avg. per rig savings

• Vendor performance metrics
• Increase in Rate of Penetration
• “Problem Well” avoidance
• Optimal path determination (staying in producing zone)

@ Bit Algorithm

• Predicts bit location using physics + machine learning
• Calculates dogleg severity, build/turn rate, motor yield

@ Target Algorithm

• Determines optimum build & turn rate, sliding and rotating lengths to reach target point
• Minimizes loss of weight on bit, tortuosity, drilling time, dogleg severity
High Speed, Low Fidelity Reservoir Models

Historical/field data to calibrate and quantify uncertainty

Optimizer

Maximize NPV honoring economic, operating, and well constraints by generating thousands of what-if scenarios

Reservoir & Operational Facilities

Target=$100MM

Field decisions that optimize daily total field production

Steam/Water/CO2

• Leverage field data and new data sources
• Optimize over larger areas
• Integrates with existing workflow
• Significantly lower computational costs

Driving Value @ the Reservoir

Temp, Press
Injection
Production
Injection Well Data
Production Well Data
Driving Value @ the Well

- Increase run life
- Earlier detection of failures
- Improve staff efficiency, quality
- Industry leading capabilities into Oxy’s proprietary lift platform (Oxylift)

Lift System Diagnostic/Optimization

- Leverages artificial intelligence and pattern recognition
- Proprietary deviated well algorithms based on mechanical engineering+applied mathematics

Upcoming Opportunities

- Text and image analytics of unstructured data to drive efficiencies with chemical treatments, safety, failure detection, etc.
- Survival and risk analysis to identify odds of failure in advance.
- Combine maintenance cost factors and risk of failures to optimize preventative maintenance.
Driving Value
@ Field Development

Multivariate Modelling

• Predictive, interactive multivariate statistical model that predicts geologic sweet spot areas and compares completion practices and cost factors

• Driven by strong collaboration with geologists, petrophysicists, geophysicists, operations, etc.

• Introducing seismic, additional well control and fluid properties
The Possibilities Are Endless...

Exploitation & Appraisal
- Exploration & Appraisal
- Field Development
- Drilling & Completion
- Production
- Refining & Distribution
- Workforce Management
- Risk Management
- Reservoir Characterization
- Lease Management Analytics
- Production Forecasting
- Production HES
- Production Allocation & Monitoring
- Job Performance Monitoring
- Asset Maintenance
- Contract Optimization
- Supply Chain Optimization
- Pipeline Inspection
- Route & Fleet Optimization
- Inventory Optimization
- Identifying Organization Issues
- Identifying Key Players & Future Leaders
- Equipment Loss & Failure
- Subsurface Dysfunction Detection & Prevention
- Resource Risk Management
- Drilling Trajectory Optimization
- Minimize Environmental Risk
- Optimization Cost vs Productivity
- Optimization of required Workforce
- Well Profiling
- Production Profiling
- Drilling & Completion
- Capital Optimization
- Reservoir Characterization
- Prediction of Supply Requirements
- Where to Drill
- Risk Management

Digital Foundational Capabilities
- Predictive Analysis
- Internet of Things
- Cloud Computing & Mobility
- Cognitive Services & Machine Learning
- Big Data and Analytics
- Drones
- Robotics
- Virtual & Augmented Reality
- Edge Computing