UT Energy Week 2018
Panel 2: Innovation in Oil & Gas: Impacts of Digitalization on Operations

Technology & Big Data in Unconventional Oil & Gas Development

James Courtier
Vice President Exploration
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Technology & Big Data Outline

- Massive quantities of data being generated
- Physics-based technical assessments remain essential
- Why “Big Data Analytics” is rapidly gaining momentum
- Macro industry insights
- Future for new industry entrants
What and where is the data?

**Initial Subsurface Data Sets**
- Cores
- Logs
- Seismic

**Subsurface Characterization & Modeling**
- High resolution 3D models
- Reservoir, mechanical and fracturing properties
- Hydraulic fractures, reservoir simulation & studies

**Operations**
- Drilling & Completions
- Real-time instrumentation data
- Pressure pumping data

**Production**
- Metered production data
- Downhole pressure data

Massive quantities of data being generated across entire value-chain
Steady, Strategic Plan Yields Repeatable Results

A disciplined focus on key value drivers since inception has driven shareholder returns
Today’s talk focuses on how data & analytics assist an unconventional oil company during development.
Reprocessed 3D seismic dataset exhibits substantial imaging improvements
MegaMerge Processing Improvements

Improvements in image clarity, continuity & depth accuracy

Improving existing data sets adds tremendous value at low cost
High-Resolution 3D Geomodel Reservoir Characterization

High quality inputs improve 3D reservoir characterization

Improved Petrophysical Model

Improved Inversion Products

Improved High-Resolution Facies & Rock Property Volumes

High quality inputs improve 3D reservoir characterization
Integrating data within geomodels greatly improves development planning toolkit.

Consistent geological framework
high-resolution
multiple data type inputs
quantitative
multi-attribute outputs

High-Resolution 3D Geomodel Overview
Proprietary workflows are shortening time from concept to field implementation, enabling continual optimization of completions designs.
Why “Big Data Analytics”?

Bivariate Example: Impact of 1 parameter

Multivariate Example: Impact of 9 parameters

Patterns may not emerge in bivariate studies - necessitating a multivariate approach
Fundamental Insights from Multivariate Analytics

Algorithms detect individual parameters that impact value drivers (e.g. oil production) and their significance.
Key engineering & geoscience production drivers are detected amongst multiple input parameters.

Multivariate Analytics: 3D BO/ft Predictions

- 45 Input Variables Examined
  - Engineering Variables (7)
  - Acoustic Properties (6)
  - Petrophysical Parameters (13)
  - Lithology Indicators (9)
  - Oil Storage Attributes (6)
  - Structural Attributes (3)
  - Pore Pressure

- Multivariate 3D Bo/ft. Solution
  - Completed Lateral Length
  - Parent-Child Tangent Distance
  - Completion Parameter #1
  - Completion Parameter #2
  - Production Parameter
  - Geological Parameter #1
  - Geological Parameter #2
  - Geological Parameter #3
  - Geological Parameter #4
  - Geological Parameter #5

6-Month Oil Production MODEL PREDICTION

\[ R^2 = 0.8012 \]
Sugg-Graham Nine-Well Package Performing vs. Type Curve

Wells drilled with tighter spacing are exceeding type curve expectations

~36% Outperformance of all 96 wells to 1.3 MMBOE type curve

Note: Production has been scaled to 10,000' EUR type curves and non-producing days (for shut-ins) have been removed. Average cumulative production data through 10/25/2017. This includes 96 Hz UWC/MWC & Cline wells that have utilized optimized completions with avg. ~1,900 pounds of sand per lateral foot. Type curve utilizes a weighted-average of 89 Hz UWC/MWC 1.3 MMBOE wells & 7 Hz Cline 1.0 MMBOE wells.
Summary of “Big Data” Utilized in Machine Learning Project

**LPI Proprietary Data**
- 320+ LPI Hz Wells
- 120 Subsurface attributes
- Multi-year drill schedule
- Detailed well economics
- Direction surveys
- Detailed completions
- Daily production
- Well-spacing distances

**Subscription Data**
- 15,000 OBO Permian Hz Wells
- Public well economics
- Directional surveys
- Daily production
- Public completions details
- Public well spacing details

**Organized Database**

Over 15 million unique attributes accessed via machine-learning to quantify dominant economic drivers
Machine Learning Example: Solving For Production

Constituent Model Parameters

Predictive Accuracy

Geology

Completions

Spacing

Optimizing multi-well development for NPV via machine-learning analytics reduces risk & enhances total asset value
Multivariate, multidisciplinary, multidimensional

Integrating traditional workflows with rapid analytics accelerates technical insights & understanding
Technology & Big Data Summary

- Physics-based technical assessments remain essential
- High-resolution geomodels heavily influence workflows
- “Big Data Analytics” taking off
- Macro industry insights
- Future for new industry entrants
Thank You