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City Centre, Houston, Texas
ShaleTechConference.com

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Accelerating Completion Optimization in the Unconventional Reservoirs Through Machine Learning Coupled to Reservoir Characterization

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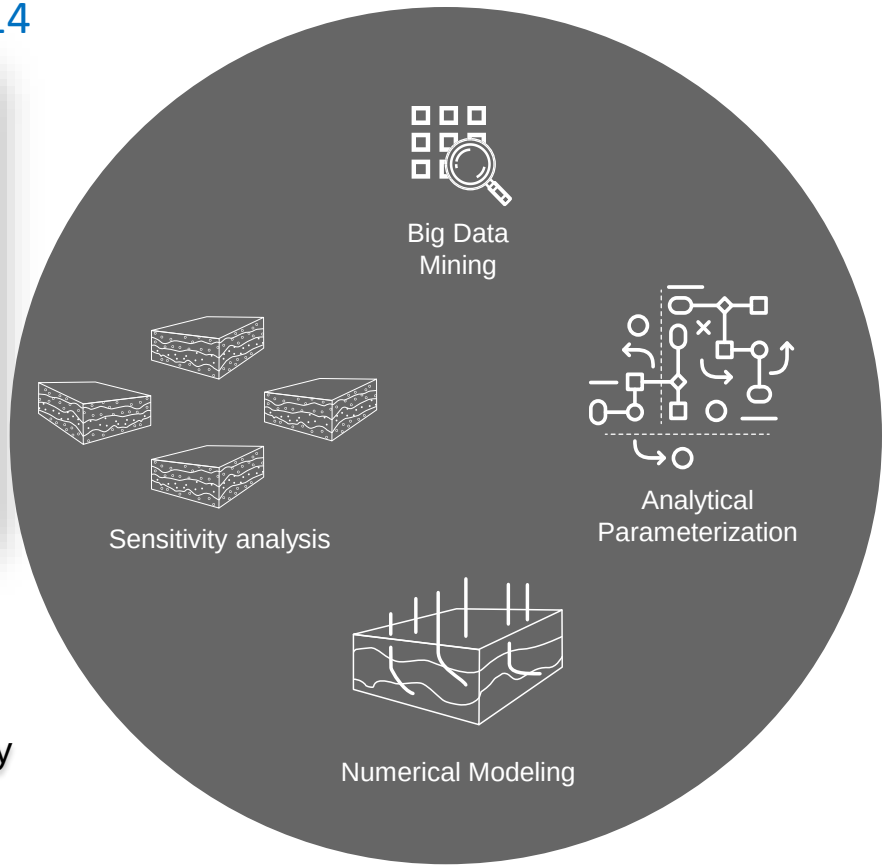
Exploiting the Reservoirs in a Factory Mode

CAPEX has dropped by approximately 25% since 2014

When you fly over Midland



“Get more out of little”

Improved Efficiency
Improved bbl/$

1-2TB of data daily

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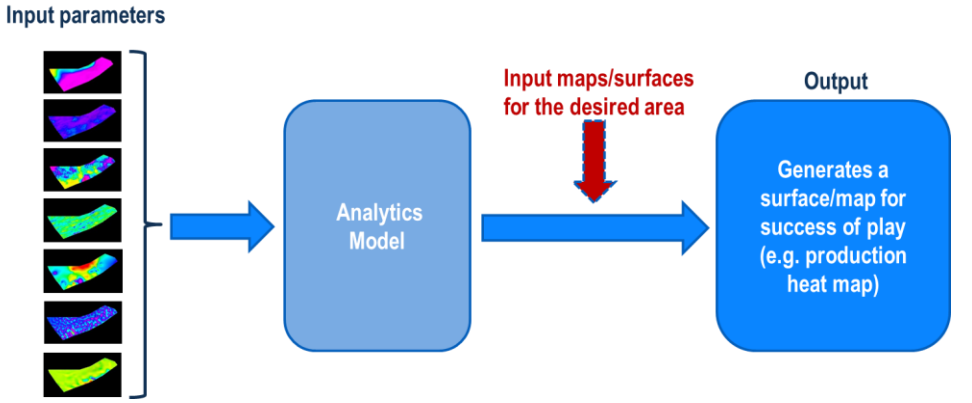
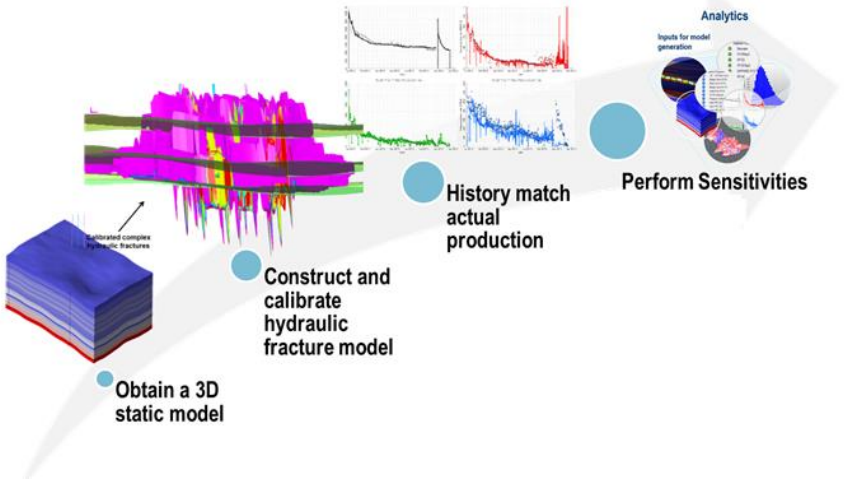
Machine Learning Approach



Sweet spot prediction technique using machine learning



Machine learning has enabled forward modeling in a faster scalable media

Completion Sensitivity Approach Coupled to Analytics

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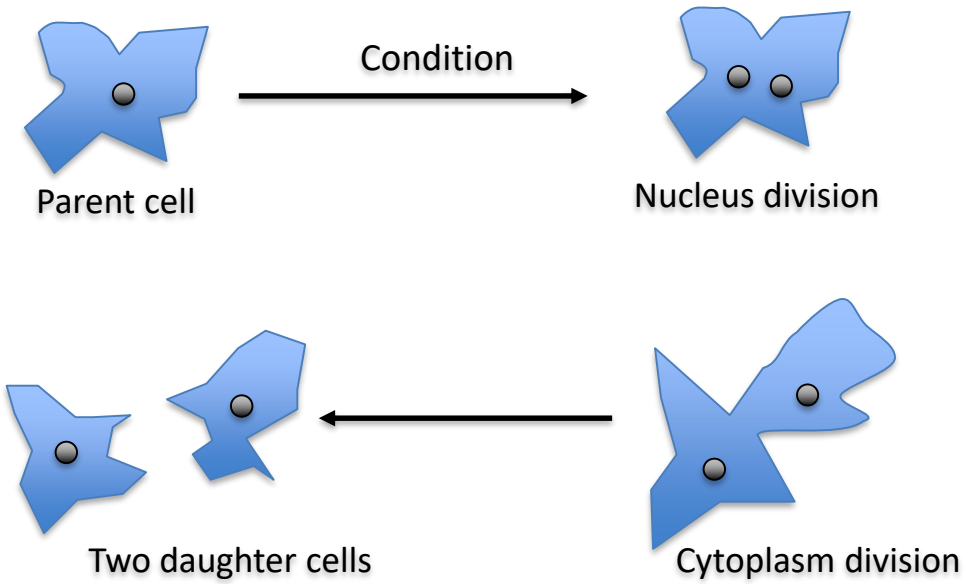
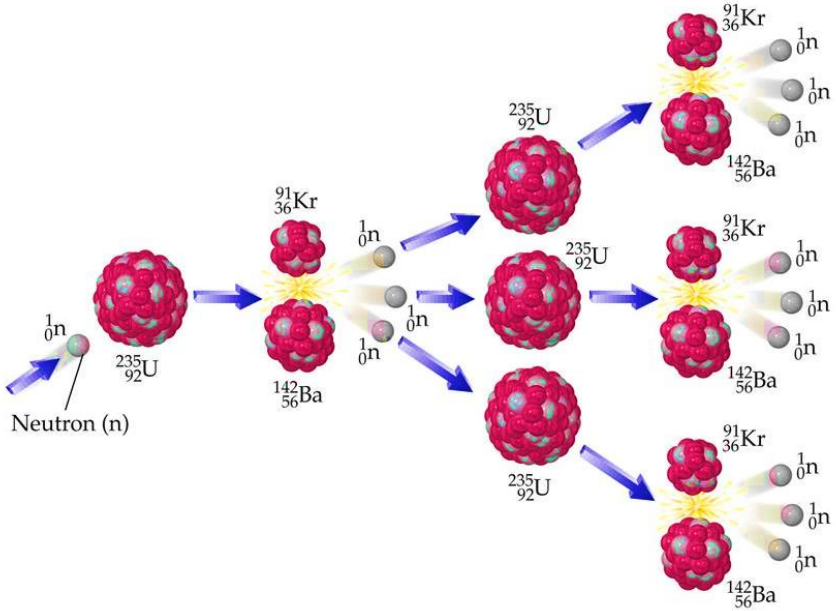
Methodology for completion “proxy” modeling

Binary Fission in Amoeba

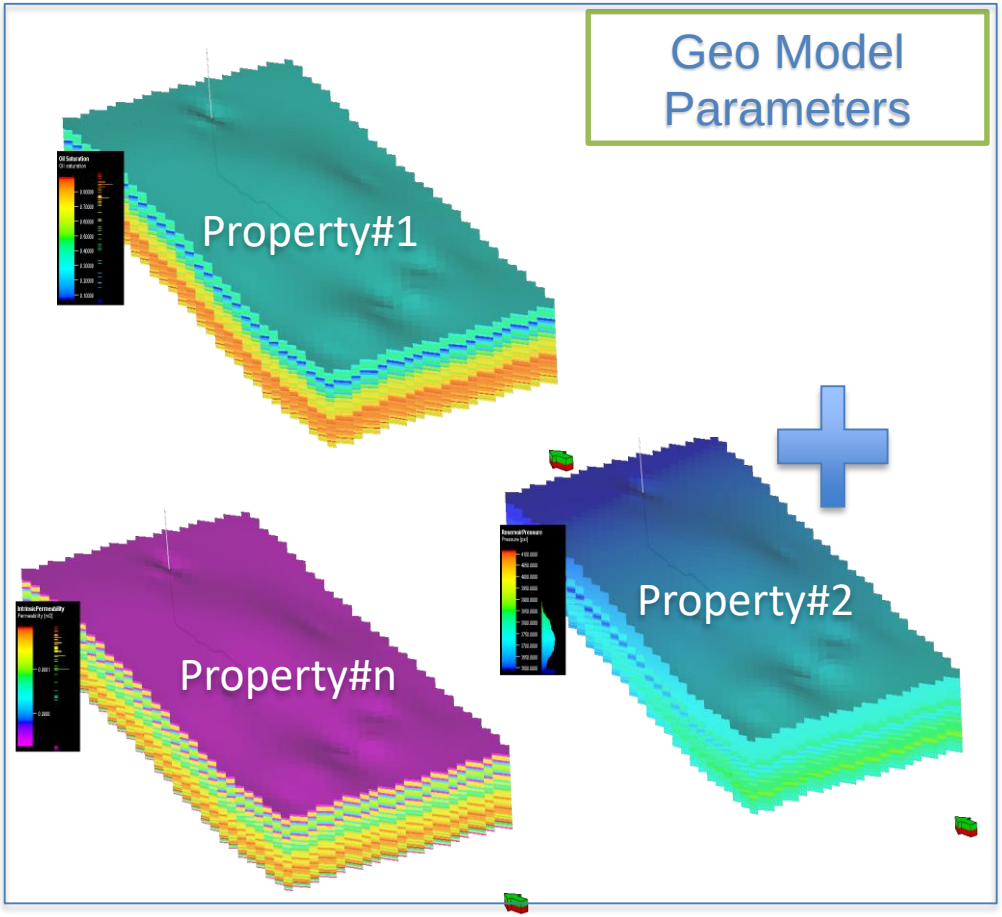


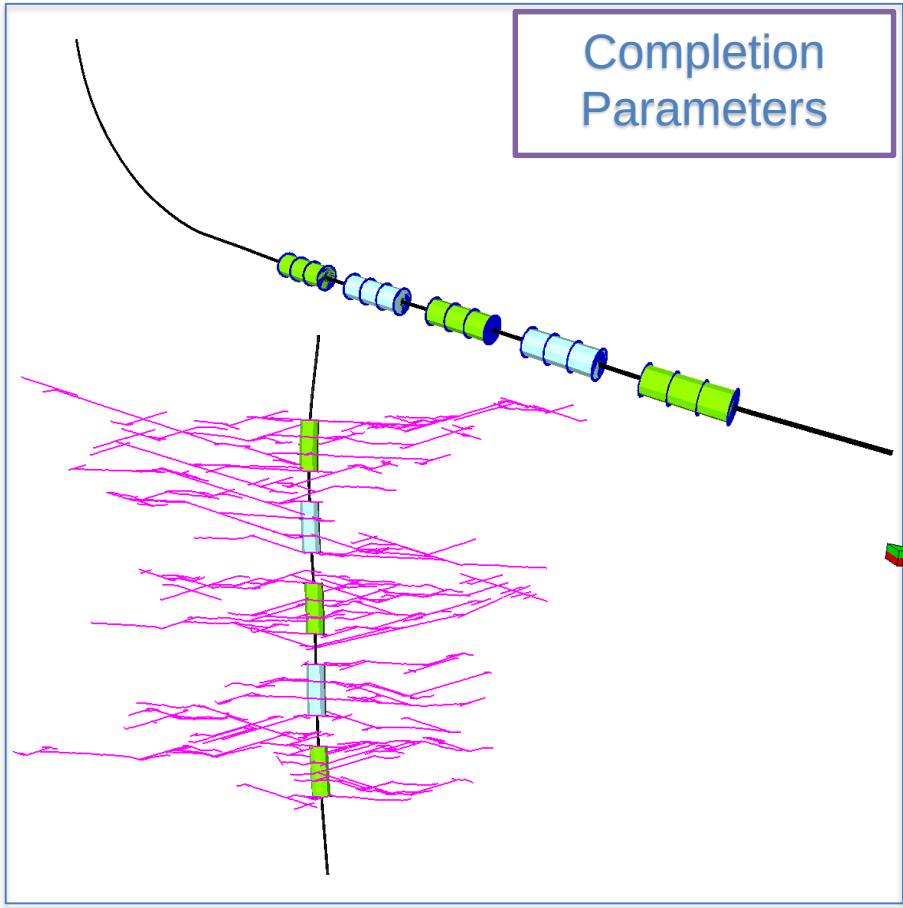
Multiple Fission in Uranium



With the right trigger, multiple realizations are created in the nature

Earth model serves as the uranium





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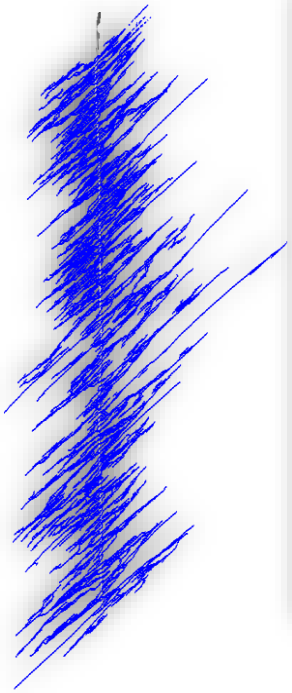
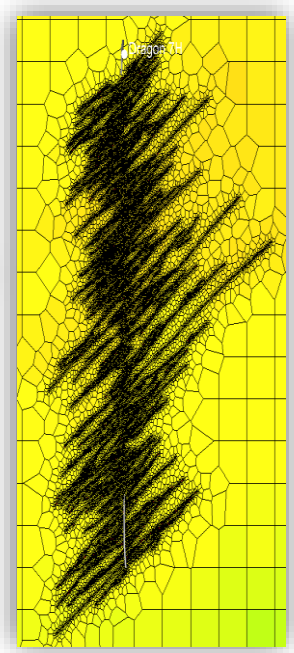
Methodology

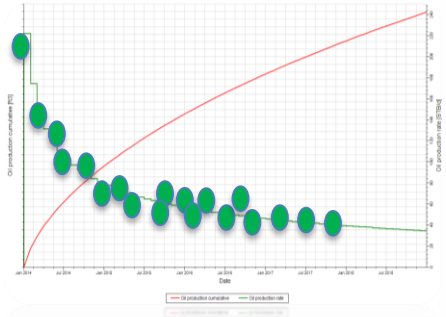
Calibration of model and perturbating in the space of possible variation



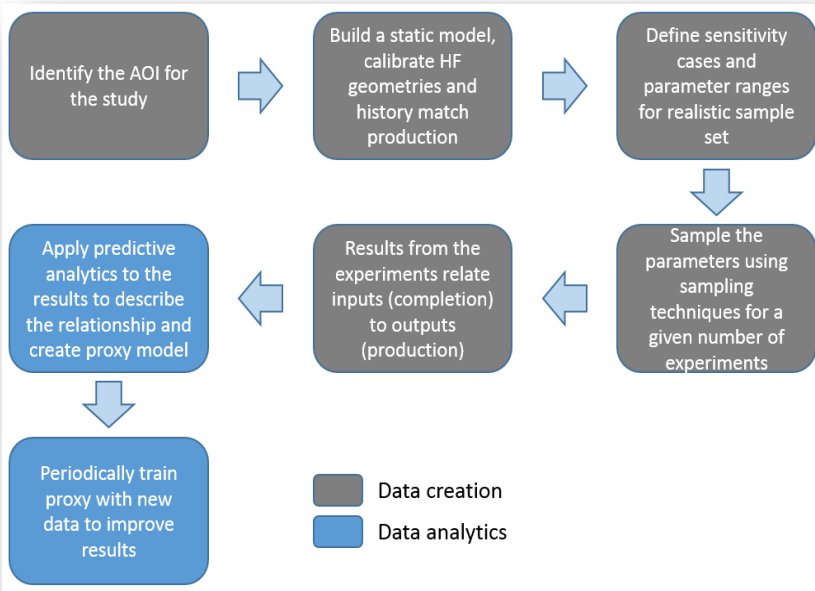
Hydraulic Fracture Calibration



Stimulated Rock Volume Calibration



System Calibration



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Space of the sensitivity variable

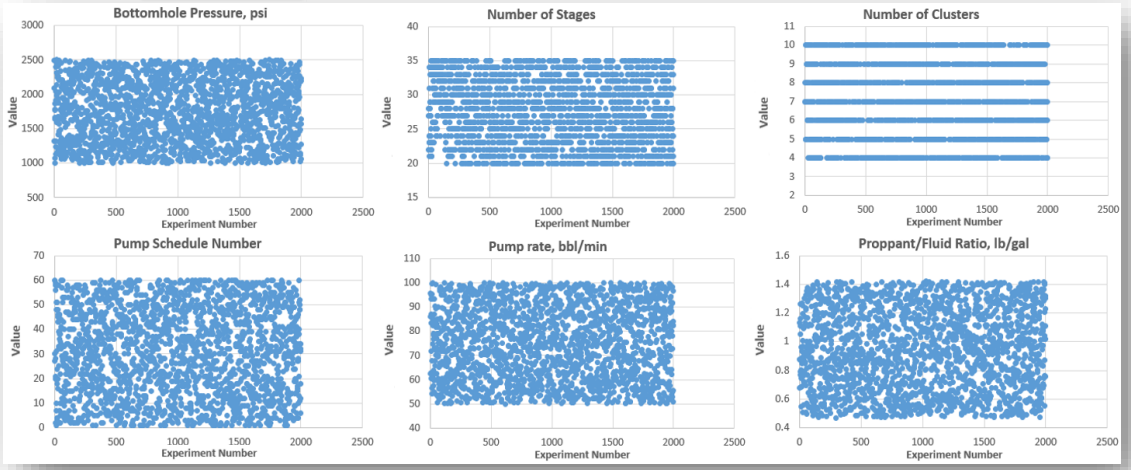
Completion Parameters as Sensitivity Variables

- Stage count (10-30)
- Number of clusters (4-10)
- Fluid type (9 fluids)
- Proppant amount (200-600 Klb)
- Proppant size (6 sizes)
- Proppant type (9 types)
- Pump rate (20-100 bpm)
- BHP (1,000-3,000 psi)

Analytics Prediction Model

- B1
- B3
- B12
- CUM 5

More than 2000 data points were generated



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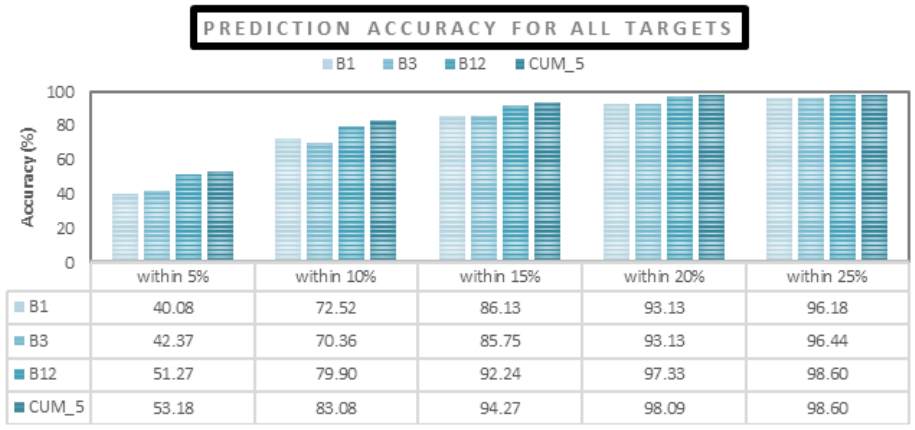
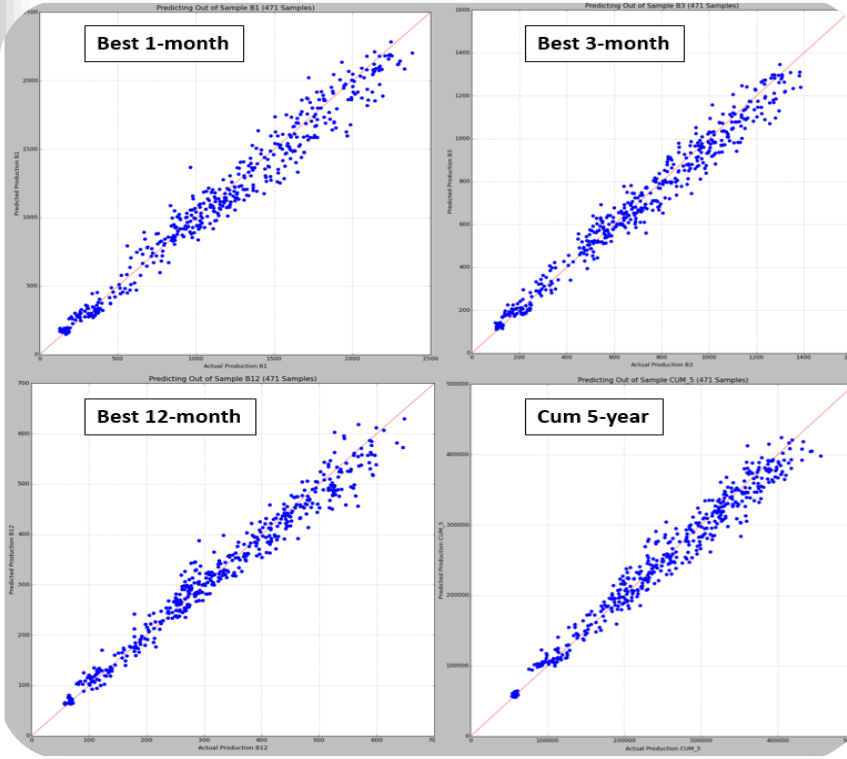
Best Suited Machine Learning Algorithm

Approach	Collinearity of Prediction	within 5%	within 10 %	within 15%	within 20%	within 25%	Predicted Sample Length
RandomForest	77.20%	34.84	62.07	80.09	90.37	95.84	1572
GradBoost	91.00%	52.73	82.1	93.44	97.04	98.77	1572
LinearRegression	84.90%	35.78	69.55	87.7	93.97	97.17	1572
DecisionTree	77.00%	33.91	61.94	79.43	90.77	95.71	1572
AdaBoost	82.00%	35.38	65.55	84.91	92.65	96.38	1572
MF OLS	84.10%	41.35	69.72	87.15	94.98	97.27	1572
MF NN	87.20%	45.4	76.07	90.53	96.61	98.23	1572



	within 5%	within 10%	within 15%	within 20%	within 25%
B1	40.08	72.52	86.13	93.13	96.18
B3	42.37	70.36	85.75	93.13	96.44
B12	51.27	79.90	92.24	97.33	98.60
CUM_5	53.18	83.08	94.27	98.09	98.60



Good fit with GradBoost Algorithm

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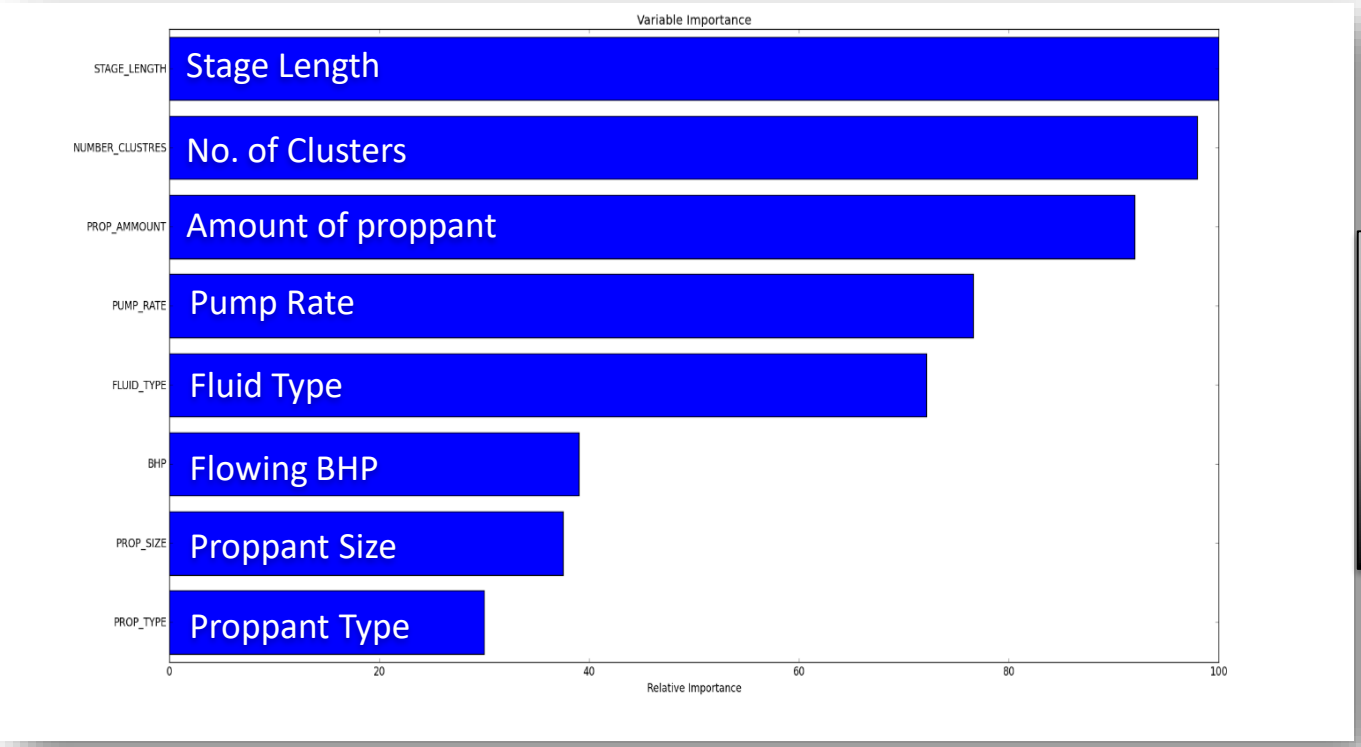
What impacted the result the most : Drivers for well performance



Predictive Proxy model allows faster economic decisions without rigorous modeling on future wells

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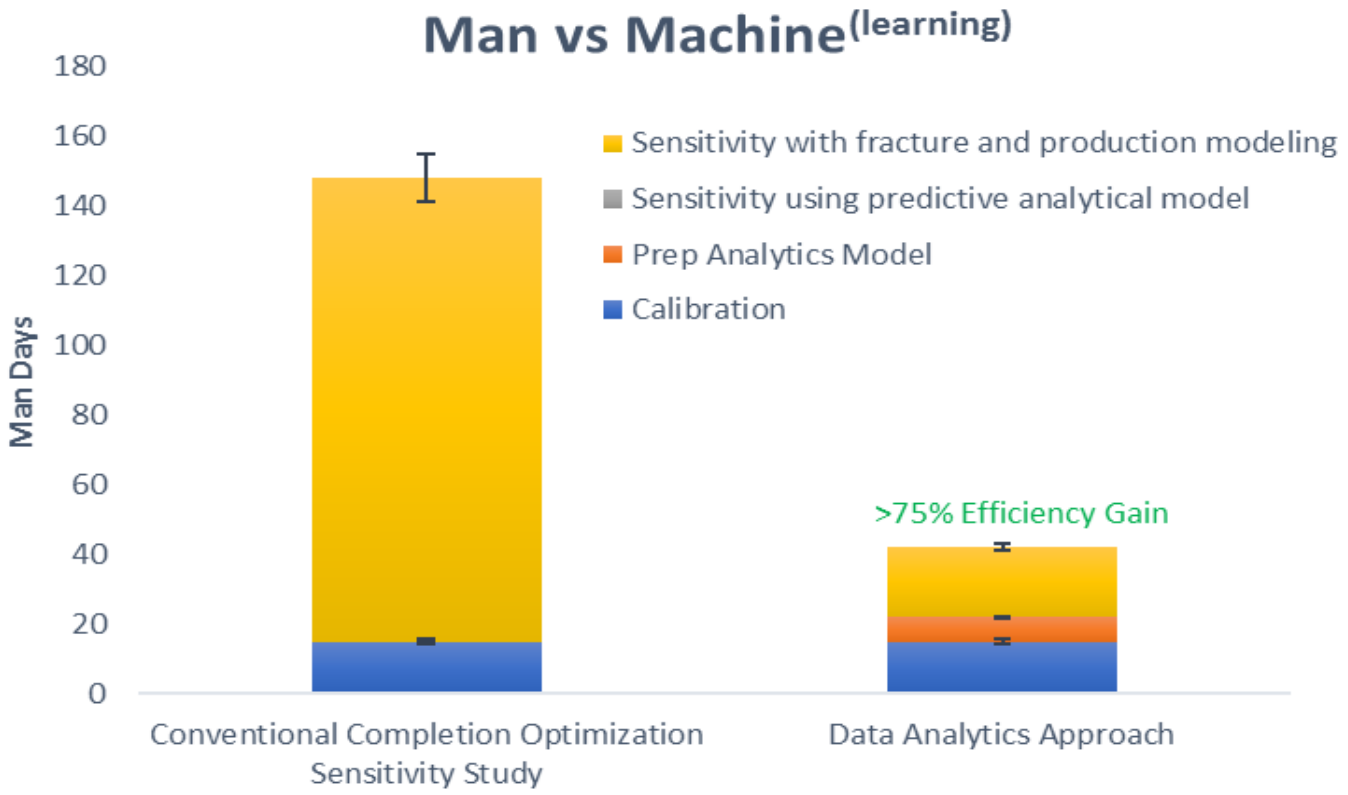
Time saving



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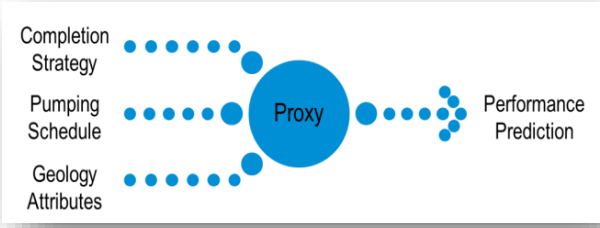
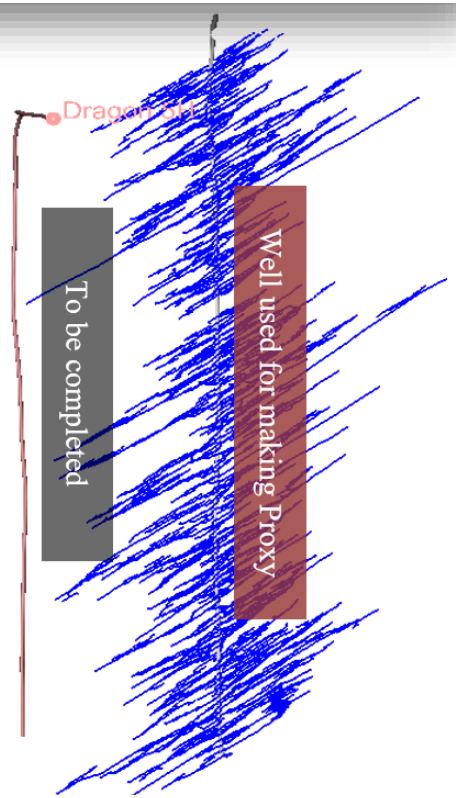
Conclusions



- Predictive proxy model allows engineers to design the completions and predict the response to production and NPV almost real-time.
- As long as the geology does not significantly vary, the directional response for optimum well completion can be derived from the proxy modeling.
- High level decision making does not have to wait on rigorous modeling and simulations to fast-track the “engineered” completion approach.
- Drivers for production performance can be identified quickly for different pads

The specific learnings from Predictive proxy model developed for Eagle Ford in this study are:
1. A calibrated model is a fundamental step to create a reliable predictive proxy.
2. The Predictive proxy models had an excellent predictability on all four targets of B1, B3, B12 and Cum_5
3. Higher accuracy is achieved for long term predictions (Cum 5 > B1)



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Acknowledgements

Schlumberger

World Oil

Reference

OTC-28632• Need for Speed: Data Analytics Coupled to Reservoir Characterization Fast Tracks Well Completion Optimization

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