Analytics Explorer

S&P Global
Commodity Insights

Demystifying Data Science

A predictive modeling workflow for E&P engineers

Overview:

Data science made accessible

Today's oil and gas industry is different.

With constant oil and gas market disruptions, exploration and production (E&P) companies must do more with less. In this market, engineers face the continuous challenge of maintaining and increasing well production and developing new ways of optimizing production strategies.

In this guide, we will show you how to use a data-driven workflow that uses advanced data science and Machine Learning (ML) techniques to identify key well performance drivers and develop a production strategy that best fits your production system.

Data science in Analytics Explorer

Good data is the foundation of good data science

Analytics Explorer's ML algorithms were built from the unparalleled S&P Global Commodity Insights data library by a network of data scientists and domain experts. In one such case, our well property estimations and log imputation algorithms were calibrated using 10 million wells and 350 thousand digital logs from multiple basins.

The algorithms have been rigorously tested and fine-tuned to address known E&P challenges so we can bring our clients out-of-the-box workflows for reliable modeling:

- Ideal well spacing
- Optimal completions strategy
- Sand production and liquid loading issues

All tailored to your asset.

Analytics Explorer has built-in connections with the following IHS Markit solutions, services and databases:

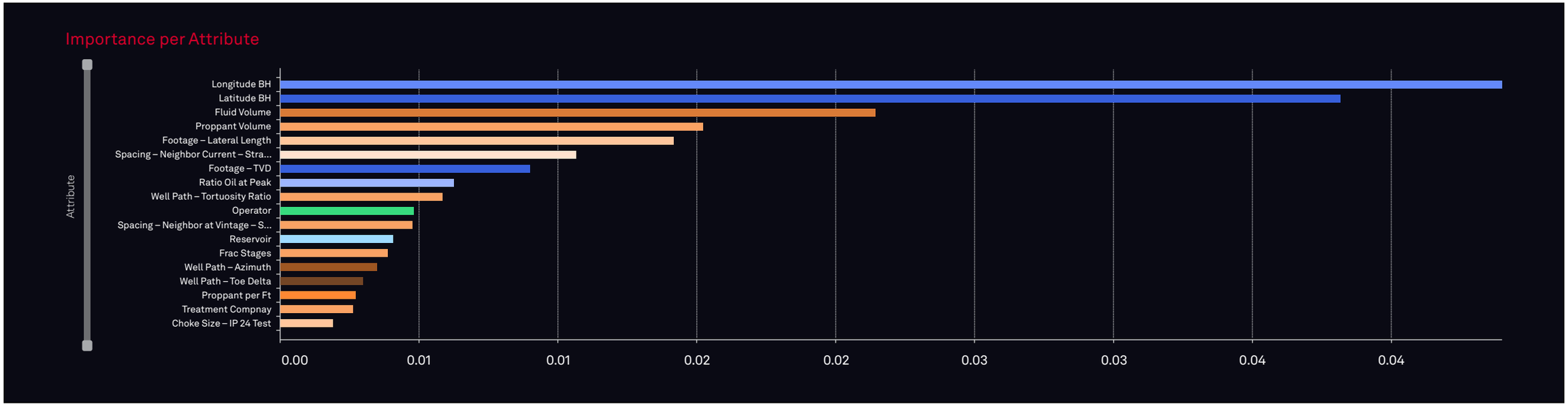
- Energy Studio: Impact
- Kingdom™ Geoscience Software
- Harmony Enterprise™ Reservoir & Production Software
- Enterprise Data Management (EDM)
- EDIN
- SQL/Postgre SQL databases

Building a predictive model that you can use

What is impacting production?

Analytics Explorer's feature importance ranking function helps you evaluate all of your well data at once–location, target formation, well path, proppant volume, spacing and how these attributes impacted the prediction model.

The feature importance ranking utility will list the attributes from most impactful on the prediction model to the least important. In other words, we can identify which input features are having the most impact on production by simply reviewing the order of this list. In this image example, the well's longitude and latitude location is the most important attribute to production performance, while number of frac stages and well path tortuosity are less important.



The ranking utility results in Analytics Explorer with production model attributes listed from most impactful (top) to least impactful (bottom).

Controllable and non-controllable factors

Geology vs. Engineering

In geologically heterogenous basins, like unconventionals, differentiating between physical and geologic controls on production can be difficult. Analytics Explorer categorizes each attribute as non-controllable (geological constraint) or controllable (engineering constraint).

Controllables (engineering)

- Lateral length
- TVD
- Fluid and proppant volume
- Well spacing

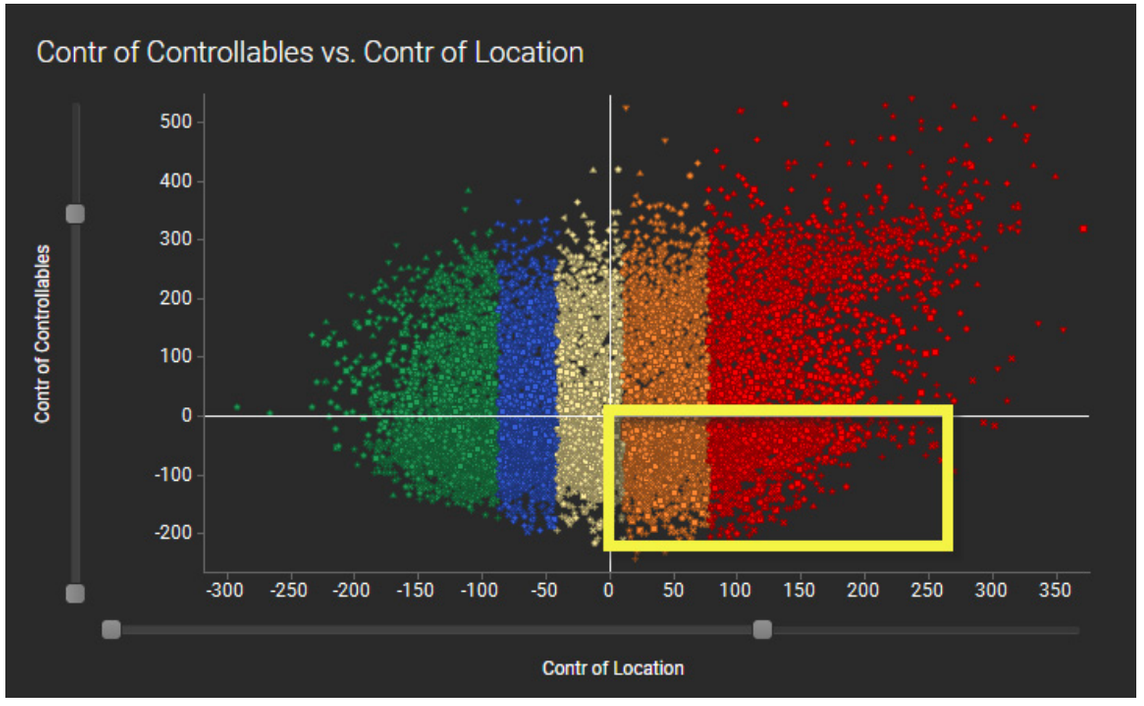
Non-Controllables (geology)

- Well location (latitude and longitude)
- Acreage quality
- Formation thickness
- Structural Depth
- Gas to oil ratio (GOR)

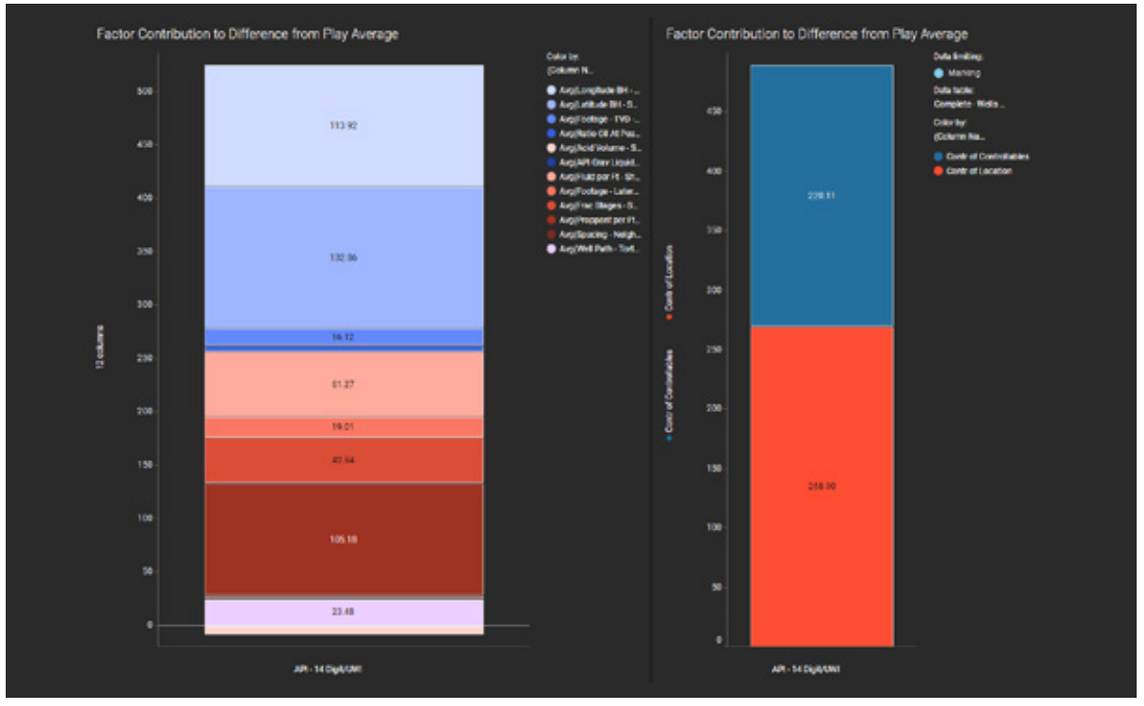
Understanding the difference between what you can and cannot control in your asset, and how each impacts production, is critical for optimizing completions and production strategies.

Controllable and non-controllable factors

Analytics Explorer enables you to develop and test engineering programs that will work for your asset. If geological factors, like acreage quality and formation thickness, are impacting production, analyze the completions programs of wells in similar acreage and adjust yours accordingly. Similarly, this data will help you build the optimal completions and production program for different well spacing and lateral length scenarios.



The impact of controllable attributes (completions and engineering) and non-controllable attributes (well location). The yellow box indicates wells that benefit positively from their location on production but have been negatively impacted by controllable variables.



Bar chart on the left shows the contribution of individual parameters to a certain well's production. Individual parameters include well location, TVD, fluid per foot, proppant volume, distance to nearest neighbor, etc. Bar chart on the right, shows the impact of controllable attributes (blue) compared to the impact of well location (red).

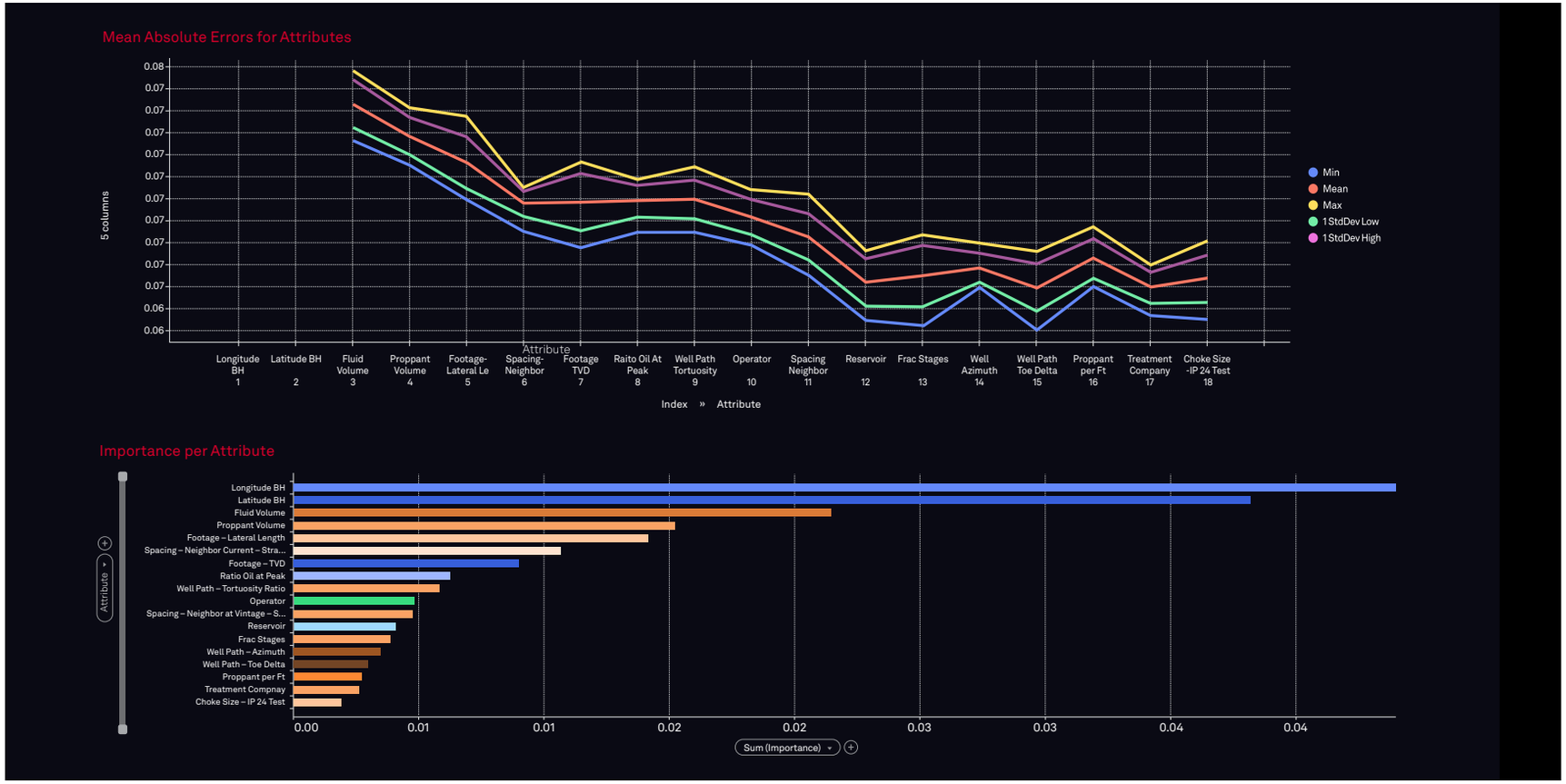
Optimize the predictive model

Attribute Analysis

The number of attributes Analytics Explorer can analyze is limitless; however, not all of these factors belong in predictive models. Unnecessary data can slow down model run time and decrease clarity about which factors truly influence production. Incorporate your proprietary knowledge with the error analysis function to decide which attributes to include in your predictive model.

The attribute analysis function performs a series of iterations with the three most important attributes, then repeats the process with the top four most important attributes, continuing until all attributes have been used.

Error is recorded at each step. The model determines the point where error flattens out–all attributes beyond this point simply clutter the model.

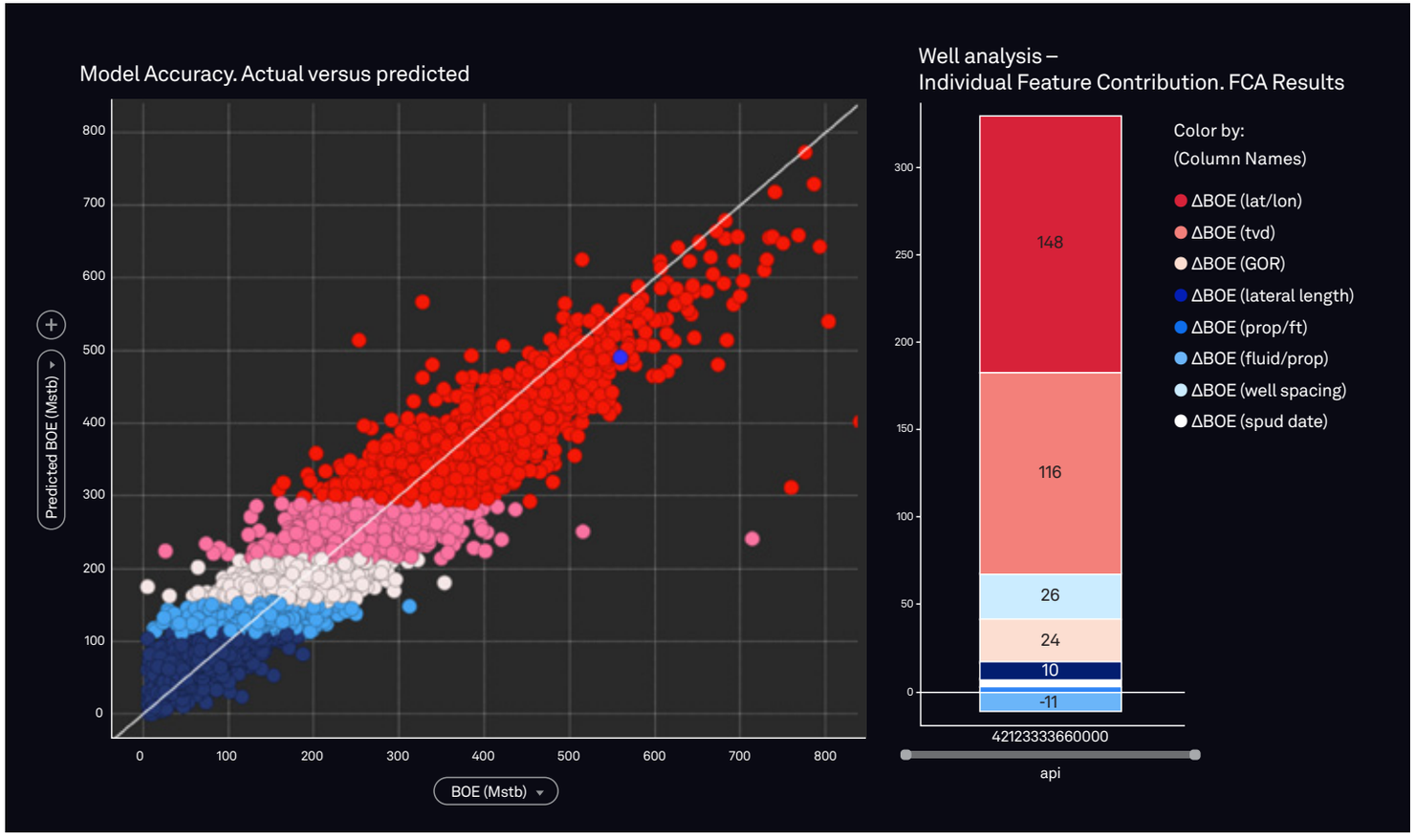


Analytics Explorer dashboard showing analyses of multiple data sources to be used in a predictive model. Results show the order of importance of variables and which ones should be used to create the predictive model.

Evaluating and validating the model

Validate your model before using it by comparing the predicted results to ground-truth data. If the model deviates from the truth, you can refine it with your proprietary data and adjust the input attributes.

Validate model results



Crossplot showing on the x-axis actual 12-month production data and on the y-axis, predicted machine learning model results. This model is highly accurate, with some deviation among the highest performing wells. The bar chart shows the contribution of the input variables to production for a selected well.

Using predictive models

Once you have created a robust predictive model in Analytics Explorer, you can:

Determine what is driving your asset's production

- Isolate the impact of geological and engineering constraints
- Integrate dynamic and static models
- Understand the impact of well spacing

Develop the best completions strategy

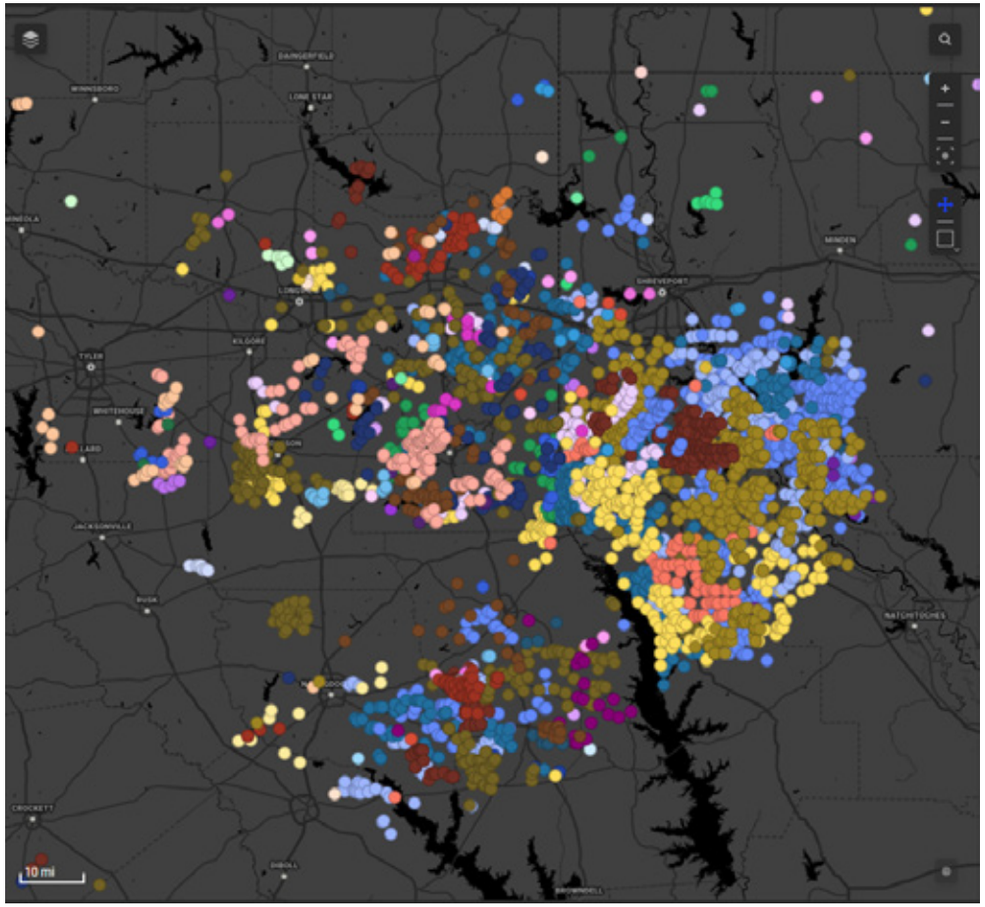
- Model different completions scenarios before drilling
- Determine the optimal proppant and fluid volume
- Understand the relationships between parent, child and sibling wells

Optimize your production system

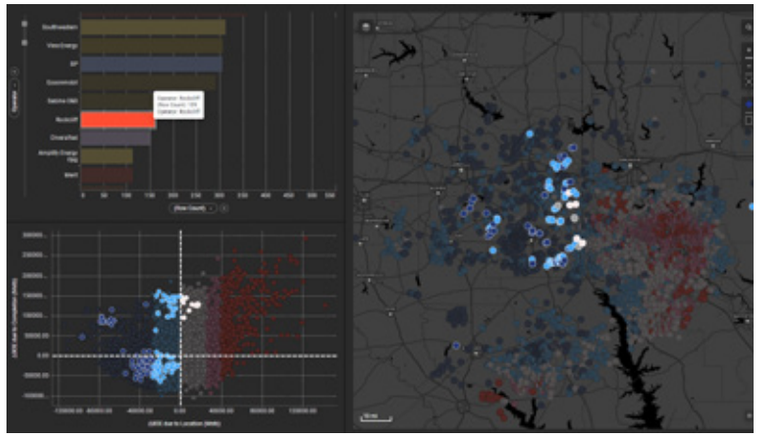
- Predict sand production and liquid loading issues
- Optimize choke management strategies
- Evaluate different scenarios to optimize recovery factor

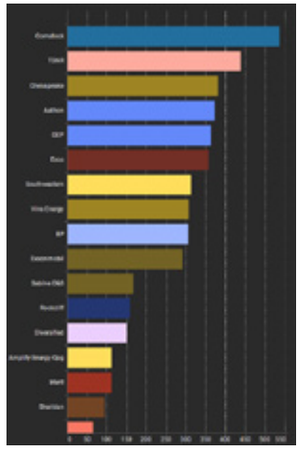
Case study: Offsetting poor acreage quality with engineering in the Haynesville

A Haynesville operator made the most of their low-quality acreage by drilling longer wells. The shallow TVD in this operator's acreage negatively impacted production and economic performance relative to their nearby peers. However, their long lateral lengths and associated completions practices positively impacted production and breakeven.



Haynesville case study area and data location.





Rockcliff's acreage position, relative to other Haynesville operators, color-coded by acreage quality (blue is lower-quality acreage).

Originally published in *Hidden Figures: Big data analytics shed light on Haynesville private operator performance*, from the Upstream Companies & Transactions report

Case study: Offsetting poor acreage quality with engineering in the Haynesville

Use Analytics Explorer to figure out what's driving your asset's performance. If it is something you can control, like lateral length or completions design, make adjustments and optimize your wells.

Rockcliff's three-year cumulative gas production and lateral length, with a comparison to other operators in the area.

Haynesville Analytics Explorer data set summary—average well performance and designs

Original operator	Well count	Analytics Explorer predicted three-year prod (MMcf)	TVD (R)	Lateral length (ft)	Proppant loading (lb/ft)	Fluid loading (gallft)	Initial well spacing (ft)
All	5,123	4,871	12,003	5,570	2,090	2,187	2,277
Aethon	185	7,570	12,001	6,736	4,346	4,127	1,820
GEP	114	8,025	12,363	6,461	3,281	3,061	2,169
Rockcliff	**113**	**8,290**	**10,961**	**9,026**	**3,556**	**3,853**	**3,028**

Source: Data taken from S&P Global Commodity Insights Upstream E&P Content

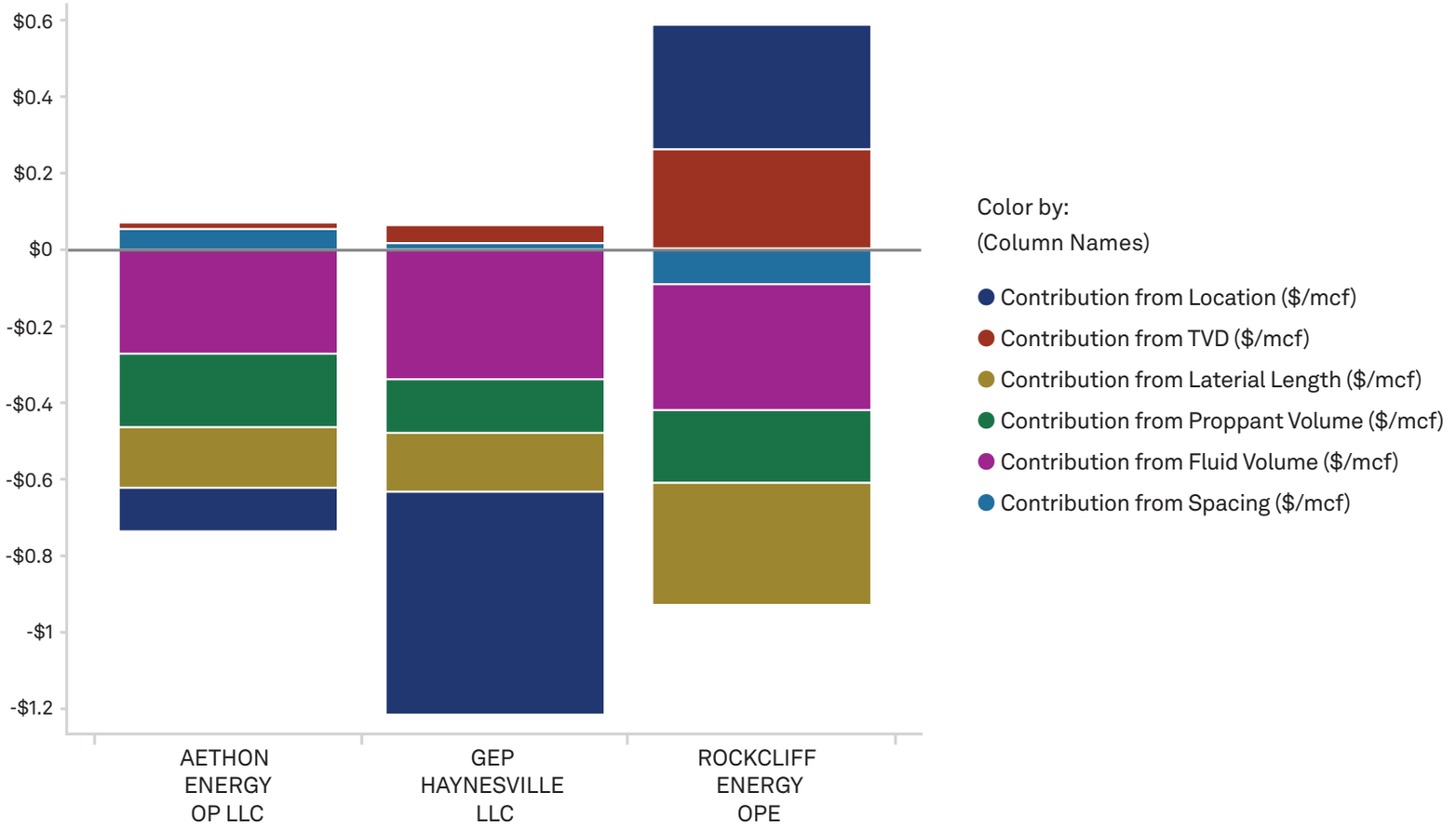
Originally published in *Hidden Figures: Big data analytics shed light on Haynesville private operator performance*, from the Upstream Companies & Transactions report

Case study: Understanding breakevens in the Haynesville

An operator drilling for gas in the Haynesville made the most of their low-quality acreage by drilling longer wells.

This data was benchmarked against other operators to provide context for breakevens and well performance contributors.

Well location and TVD negatively impacted breakeven, while lateral length, proppant volume, fluid volume and well spacing positively affected breakeven.



Originally published in *Hidden Figures: Big data analytics shed light on Haynesville private operator performance*, from the Upstream Companies & Transactions report

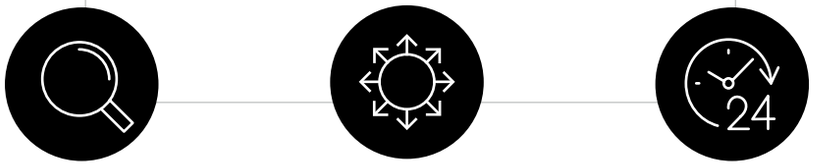
How will you use Analytics Explorer?

Optimize your completions and development strategy

Exploration and Production Companies:

- Streamline modeling for multi-disciplinary teams
- Improve production forecasting
- Optimize well spacing and recovery
- Develop effective choke management strategies
- Reduce risk and uncertainty

Oilfield Service Providers:



- Identify refrac and workover candidates
- Automate tedious data analytics for big data projects
- Help your clients optimize their completions and production programs

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For more information about Analytics Explorer visit us at spglobal.com/analytics-explorer

Want to read the full Haynesville case study? Contact sales to subscribe to our Upstream Companies & Transactions Research where you can access the full case study report.

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