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Evaluating The Impact of 3D Seismic in Unconventional Resources

James Gouveia P. Eng.
Rose & Associates

Summary

This presentation provides a methodology for evaluating the value of 3D Seismic surveys in the realm of Unconventional resource development. The focus is on North American plays where a resource play has been de-risked from the perspective of Geological chance of success.

A simple Decision Tree approach is used to initially evaluate the value where we know with high confidence how the 3D seismic will impact value, a rarity. A far more common scenario is where we have somewhat analogous data set to guide us.

The approach is based upon a reverse engineered decision tree solution for a “break-even” confidence in the 3D seismic data to support a go ahead recommendation for our 3D seismic program based upon a chance weighted decision.

The talk addresses the need to make a large 3D seismic program prior to implementing a large follow-up drilling program with enhanced geosteering based upon the 3D seismic program. The program is implemented with a staged approach to support an early exit decision if the initial analysis of the benefit of enhanced geosteering is proven to be invalid.

A key insight is that building decision trees with Management “optionality” is critical to support moving forward with a recommendation to shoot large area 3D seismic program. Making early decisions based on the early data mitigates the downside risk whilst still providing full exposure to the upside.

As an industry we have "Squandered Billions" in investor dollars. Investor confidence has evaporated based on our poor returns over the past 5 years. Rather than seeking growth at all costs the market’s message today is clear; prove that we can deliver value on a sustained basis. This new reality is supported by our staged approach.

Method

The following simplifying assumptions are made:

- That landing more of a horizontal well’s lateral within the target zone will increases rates and EUR. This is analogous to increasing horizontal well lateral length.

- Drilling with a greater percentage of the lateral within the target landing zone will reduce uncertainty by mitigation of downside outcomes. This is modeled as an increased P99. The P1 or highest observed outcome, is kept static as a well drilled, without 3D seismic support while geosteering, may serendipitously be drilled to a large extent in-zone.
- The observation is that P10:P90 ratios will decrease as a result of the increased P99 whilst keeping the P1 constant.

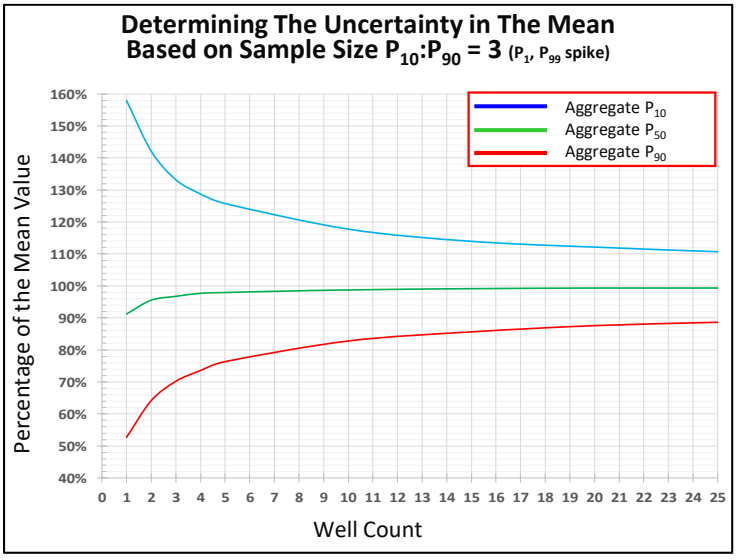
In 1,000 to 1,500 m laterals in resource plays, the P10:P90 ratios have been observed to drop from 4 without 3D seismic geosteering to 3 with 3D seismic driven geosteeering.

The observed daily Peak oil production rates for an analogous set of wells are normalized for lateral length, and pressure drawdown. These values are plotted on a log cumulative probability chart and fit to a straight line. This forces the data fit to a lognormal distribution. The resulting P10:P90 ratio is determined. Normalizing the data to a 1,500 m effective lateral should result in a P10:P90 ratios of 3 to 5 in most tight and shale reservoirs. Further normalization, for example normalization to in place volumes and proppant load and the drilling to 3,000 m furthers the observed P10:P90 ratios to 2 or less in oil reservoirs and under 3 in gas reservoirs.

Economics are run based on the mean of the observed data and set as the base case with a P10:P90 ratio of 4. The impact of 3D Seismic on enhanced geosteering will be to land more of the zone within the target and as a result decreased the observed P10:P90 ratio. In this paper we assumed that the P10:P90 ratio will decrease from 4 to 3. The P1 is kept constant. A lognormal distribution with a P10:P90 ratio of 3 is then drawn and the mean value derived.

Economics for the case with 3D seismic is burdened with the costs of the 3D seismic and the additional costs to control with geosteering based on seismic attributes.
If the value of the asset with enhanced 3D seismic driven geosteeering exceeds the base case then the project should be recommended for funding.

Over the past five years we have observed in our Rose & Associates training courses that 90% of the attendees do not build in management optionality into their decision trees. Additional value can be derived by putting into the development plan an Option for management to exit a new technology, such as 3D seimic driven geosteering, based on early results.



This ability for Management to make informed decisions provides downside mitigation whilst keeping exposure to the upside potential. In the presentation's example, a stop or continue decision is made after the first 10 wells in a 100 well program. Based on principles detailed by Miller and Gouveia in SPE195811 and McLane and Gouveia in SPE175527, 10 wells is adequate and supports making an 85% confidence decision.

When analog data is not directly comparable a reverse engineered confidence level, required to support a proceed recommendation from the Asset team can be derived. When combined with sensitivity analysis a decision maker will be well informed in the face of uncertainty.

Conclusions

3D Seismic in Unconventional resource plays, where there is no element of geologic chance in long reach horizontal wells, adds value by reducing the uncertainty in the range of possible outcomes. The reduction is best modeled by increasing the low side outcomes and assuming there is no increase in the most optimist case. Reducing the volatility in our resource plays increases their economic robustness and hence attraction to investors and decision makers.

Modeling an early decision point to exit or proceed significantly enhances the economics of a geologically derisked play. By modeling the ability of our staff to make sound recommendations and for our business leaders to decisively act on this and make sound decisions dramatically increases the chance weighted value of an Unconventional opportunity. Modeling the "Optionality" provides us with downside mitigation, with our ability to exit after a partial program is drilled, and capture the success case where we realize the full upside.

References

Miller, Patrick, Gouveia, James 2019, SPE195811, Applying Decision Trees to Improve Decision Quality in Unconventional Resource Development presented at the 2019 SPE Annual Technical Conference & Exhibition, Calgary, Alberta, September 30th to October 02nd, 2019.

McLane, Mark, Gouveia, James 2015, Sept 02, SPE175527, Validating Analog Production Type Curves for Resource Plays, presented at the 2015 SPE Annual Technical Conference & Exhibition, USA September, 2015.