N683: Prospect Evaluation, Risks and Volumes

Instructor(s): Jan de Jager

Format and Duration
Classroom - 4 Days

Summary

Business Impact: **Risk and volume assessments** form the basis for **decision making** to drill a well or not, and as such it is the **link between subsurface evaluation and the business aspects of the petroleum industry**.

A decision to drill an exploration well with the objective of finding a new oil or gas field must be based on a sound assessment of the prospect's risks and of the volumes: what is the chance that a well will find hydrocarbons, and how much could it yield? This course explains how risks and volumes can be assessed in a realistic manner, based on a sound understanding of the geological details of the prospect, its regional geological setting, and our understanding of the play.

Learning Outcomes

Participants will learn to:

1. Translate geological understanding of prospects and hydrocarbon plays into realistic numbers and ranges for calculating the Probability of Success (POS) and volume ranges of undrilled prospects.
2. Know how Chance Factors for risk elements can be determined as objectively as possible.
3. Understand what the Play POS is and know how to apply it.
4. Confidently select uncertainty distributions that are consistent with the understanding of uncertainties in prospects.
5. Explain how the input parameters for volume assessments impact probabilistically calculated volumes.
6. Appreciate the volume promise and related uncertainties of undrilled prospects from expectation curves and frequency plots (probability density functions).
7. Understand how to communicate prospect volumes, and when zero- or commercial cut-off volumes should be used .
8. Describe the impact of dependencies between prospects and know how to add prospect volumes statistically correct for a realistic volume promise of a portfolio of prospects.
9. Determine a realistic final POS for prospects with direct hydrocarbon indicators (DHIs) and/or controlled source electromagnetics (CSEM) anomalies.

Training Method

This is a classroom or virtual classroom course comprising a mixture of lectures, discussion, case studies, and practical exercises.

Who Should Attend

This course is intended for geoscientists working in exploration and their direct supervisors. The course is also very instructive for staff from other disciplines working closely with exploration staff, such as reservoir engineers, petrophysicists and prospect portfolio analysts.

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Course Content

This is a comprehensive course on Risk and Volume assessment in exploration. Emphasis is on a sound and pragmatic understanding of the play, the main risk elements (trap/structure, reservoir, seal and charge), the prospect geology and geometry. The course provides pragmatic guidance for translating geological knowledge and understanding in sound and realistic numbers and ranges for consistent risk and volume assessment of exploration prospects.

Session 1:

The main concepts of risk and uncertainty, and how these terms are used in probabilistic Risk & Volume assessments, will be discussed. It will be made clear how Expectation Curves and Probability Density plots display the results of probabilistic volume calculations, and what the terms MSV, P10, P50, P90 and Expectation (or Risked) Volume mean. These issues are discussed at the start of the course as they will clarify some of the recommendations for input parameters that will be discussed on day2. It will be strongly emphasised that a meaningful Risk & Volume assessment is only possible if the prospect is understood in the context of the basin development and of the play to which it belongs. While relevant statistical issues are discussed, it will be made clear that Risk & Volume assessment is in the first place about geology: about translating geological understanding in a meaningful way in numbers and ranges of numbers as inputs for the R&V assessment.

Welcome and Introduction

- An outline of the programme, the objective of the course and participants' goals.

Introduction and the basics

- Introduction to Risk & Volume assessment: the main concepts and discussion of how the results of risk & volume assessments are used in the business.

Risks, Volumes and Uncertainty

- The difference between risk and uncertainty, basics of essential statistical concepts, the play elements and workflow to assess prospect risks, biases in estimating uncertainties, the results of probabilistic volume assessments and their representation in expectation curves and frequency plots, exercises to enhance understanding of introduced concepts.

Uncertainty Distributions

- The difference between variability and uncertainty. Understand how uncertainty distributions should be defined.

Session 2:

Discussion of the Play concept and the use of the Play POS. Next two of the main play/risk elements will be discussed: Trap and Reservoir. The essential aspects of these play elements are presented and it will be explained how to assess their chance factors, and how to best translate geological understanding into reasonable and meaningful uncertainty distributions for a volume assessment. Pitfalls and work arounds that may sometimes be required are illustrated with examples and exercises.

Reflections on Session 1

- Re-cap of insights gained.

Prospects and Plays

- Play maps and demonstration of how understanding of the regional geology, petroleum systems and hydrocarbon plays is an essential element in the assessment of risks & volumes for individual prospects, risk profiles and ranking of prospects, risk mitigation, scenarios in prospect assessment: when to use them and when not, exercises on the use of play maps for risk assessment.

Play POS

- Explanation of what the Play POS is, and when to use it in addition to a Prospect-specific POS. Exercise on the application of Play POS with specific emphasis on reducing the risk of 'double-dipping'.

Traps

- Risks and uncertainties associated with hydrocarbon traps, the difference between spill and leak points, how to deal with sealing faults and overpressures, what are the risks of stratigraphic traps, how to estimate realistic uncertainty ranges for hydrocarbon column length, exercises.

Reservoirs

- Risks and uncertainties associated with reservoir rocks, how to deal with layered reservoirs, waste zones and irregularly shaped reservoirs, facies and depth trends in reservoir characteristics, exercises.

Session 3:

The next two main play/risk elements will be discussed: Seal and Charge. Probably the most important element of the final day is doing a risk and volume assessment of a prospect that is already introduced during the first 2 days. This is done in the form of group exercises and discussions.

Reflections on Session 2

- Re-cap of insights gained

Seals

- Mechanisms of seal failure, how to deal with leaky seals and differential leakage of gas, overpressures and impact on seal risk and column length prediction, exercises to enhance understanding. Pressures and overpressures are presented and it is explained with examples and exercises how high pressures may lead to leakage and/or underfilled traps.

Charge

- Impact of source rock types and timing issues for charge assessment, how to deal with mixed columns (oil and gas), formation volume factors (gas expansion and oil shrinkage), hydrocarbon saturations and recovery factors, the impact of long transition zones in tight reservoir rocks.

Risk assessment

- Practical exercise in small groups on prospect risk assessment, group discussion on the impact of positive and/or negative geological indications for the presence or absence of play elements.

Volume assessment

- Practical back-of-the-envelope volume calculation exercise, how to quickly calculate low, medium and high volumes for a prospect, recapitulation of how to select appropriate distributions.

Session 4:

Advanced topic related to Risk & Volume assessment will be discussed. First the important and often misunderstood topics like adding prospect volumes correctly with appropriate dependencies and how to incorporate the presence of observed potential Direct Hydrocarbon Indicators in the assessment are discussed. This will again be done in the form of exercises and discussions. The essential of exploration economics are also discussed, and there will be time to discuss any prospects the participants may want to bring in. The course will be concluded with stressing the importance of doing look-back studies. One can only improve prospect assessments when it is clear if and where consistent errors are made.

Reflections on Session 3

- Re-cap of insights gained

Volumes and portfolios

- The impact of dependencies between prospects in a portfolio, risking and volume assessment of

prospects with stacked reservoir-seal pairs, adding probabilistic prospect volumes statistically correct.

Geophysical evidence

- The impact on prospect POS (probability of success) of direct hydrocarbon indicators (DHIs) and/or positive (or negative) evidence form controlled source electromagnetics (CSEM) – consistent with Bayes' theorem, exercises.

Exploration economics

- An introductory module on exploration economics with an explanation of the main factors that control the economic viability of prospects, and of the terms Net Present Value (NPV) and Expected Monetary Value (EMV). The module includes an exercise on calculating the EMV of a prospect.

Look-back studies

- How can we best evaluate how good our predictions have been. How can we best compare pre-drill predictions with actual well results.