D427: Reservoir Model Design *(Distance Learning)*

Tutor(s): Mark Bentley

4 Days	Competence Level: Skilled Application
Virtual Course	

Summary

This Distance Learning course will be scheduled as a series of two- to three-hour long webinars over a two-week period (equivalent to a four-day classroom course), comprising a mixture of lectures, discussions, case studies, and worked examples to be completed by participants during and between webinar sessions.

The course offers a software-independent view on the process of reservoir model design and simulation model-building. It tackles the underlying reasons why some models disappoint and offers solutions that support the more efficient construction of fit-for-purpose models.

Learning Outcomes

Participants will learn to:

1. Form a fluid-sensitive conceptual model for a heterogenous reservoir, built from a selection of elements and placed in a realistic architectural framework: the "sketch".
2. Intuitively-guide the use of geostatistical tools, balancing deterministic and probabilistic components with awareness of the limits of the tools.
3. Select appropriate methods for modelling of matrix properties, including the handling of net (cut-off's vs total property modelling).
4. Evaluate fracture properties, covering both faults and fault seal and also flow through open fracture systems; understand how to model these practically.
5. Understand issues surrounding permeability modelling and why this differs from the handling of other properties.
6. Learn a rule of thumb ('Flora') to help assess what level of static model detail matters to flow modelling and forecasting.
7. Review how to use well test analysis to constrain models.
8. Review options for model based uncertainty handling (base case led, multi-deterministic, multi-stochastic 'ensembles'), how to post-process the results and how to select an appropriate workflow which minimises impact of behavioural bias.

Duration and Training Method

A virtual classroom course divided into 8 webinar sessions, comprising lectures, discussion, case studies, and practical exercises to be completed by participants during and between sessions.

Who Should Attend

Geoscientists with some knowledge of reservoir modelling; Petrophysicists who provide input to static reservoir models; Reservoir engineers involved in simulation work who deal with the static-dynamic interface and upscaling on a regular basis.

The ideal delegate group is a blend of geoscientists, petrophysicists, and engineers. It is highly valuable if geoscientists, petrophysicists and reservoir engineers working together in asset teams are able to join the class together.

The course is also of benefit to team leaders who wish to have a deeper understanding of the principles behind modelling. Any subsurface staff involved in the QC of models made by others are also welcome.

Prerequisites and Linking Courses

Some practical experience of reservoir modeling and simulation software is assumed.

For those looking to apply and build upon the learnings of this course, attendance on N012 (Reservoir Modelling Field Class, Utah, USA) and/or N033 (Characterisation, Modelling, Simulation and Development Planning in Deepwater Clastic Reservoirs, Tabernas, Spain) is recommended.

Course Content

Considerable time is dedicated to reservoir modelling and simulation exercises in many companies but the results often disappoint: the time taken to build models is often too long, the models too detailed and cumbersome and the final model ultimately not fit-for-purpose. This course tackles the reasons why and offers remedies to fix these problems. The advice is based on the experience of the course originators, who have been involved in excess of 100 reservoir modelling and simulation projects over the last thirty years.

The central theme of the course is Reservoir Model Design, on the premise that it is design rather than software knowledge that typically distinguishes ‘good models’ from ‘bad models’. This is organised around the following five themes, issues within which are often the cause of a poor model outcome:

1. **Model purpose** – why are we logged on in the first place and what is the question we are specifically trying to address? What do we really mean when we say 'fit for purpose?'

2. **Elements and architecture** – how much detail should be incorporated in the models? From the rich spectrum of potential lithofacies, electrofacies, biostratigraphic and analogue data inputs, how do we select the ‘right’ number of components (elements) to take forward into the modelling process? Once selected, how do these elements combine into a realistic description of length scales and reservoir architecture? How to capture this in an interpretative sketch which can be used as a cross-discipline communiction tool.

3. **Probability and determinism** – is the balance of probabilistic and deterministic components appropriate given the model purpose? Should heterogeneities be handled implicitly or explicitly in the static and dynamic models and if implicitly, then how should we average properties? What are our expectations of geostatistics and how do we control the algorithms intuitively to replicate a sketched reservoir concept? This applies both to modelling of the matrix and also fractures, and we explore how we can use well test data to place deterministic constraints on our models.

4. **Multi-scale modelling** – what scale should we be modelling and simulating at given the fluid type and model purpose? Can everything be modelled at one scale, or are static/dynamic multi-scale models required? We address the full spectrum of heterogeneity using the concept of Representative Elementary Volumes and conclude that traditional static-dynamic upscaling is only part of the story, and not always the main part. Illustrations of fine-scale 'Ultimate Truth' models will be used to illustrate where we sometimes go wrong with over-simplifying a design.

5. **Model-based uncertainty-handling** – how to really go wrong. What are the tools we can use to identify natural bias in the modelling process and select workflows which capture useful ranges in a practical way, minimising bias in the process. We summarise the current range of stochastically- and deterministically-led options, including the current trend to 'ensemble' modelling, and discuss which techniques are appropriate to use, and when, and how to post-process the results and communicate them usefully to colleagues.