Abstract

Uncertainty is the foundation of subsurface reservoir management and field development planning. From geological variability to fluid behavior and dynamic responses, these uncertainties propagate through the modeling and forecasting chain into the process of operational decisions. A key question to address is: *Where do the subsurface uncertainties end up in the broader process of decision making?*

We contrast the world of ensemble-based Assisted History Matching (AHM) and Optimization—which focuses on generating probabilistic forecasts conditioned on data—with the domain of Decision Analysis (DA), Decision Quality (DQ), and Risk Management and Probabilistic Risk Assessment (PRA)—which provides a structured framework for evaluating decision alternatives under uncertainty. While AHM and optimization emphasize model calibration and scenario evaluation to inform potential outcomes, DA and DQ frameworks focus on ensuring clarity of objectives, framing, and value-of-information when selecting among competing strategies.

We argue that while ensemble methods are the right tools at representing uncertainty in forecasts, their integration into a full decision framework often lacks transparency regarding values, trade-offs, and stakeholder preferences. On the other hand, classical DA and PRA methods may rigorously treat decision structure and value metrics but are often disconnected from the physical modeling realities captured in ensemble-based workflows.

Do we need a more integrated approach—bridging the quantitative richness of ensemble-based methods with the structured rigor of decision analysis?