



Collaborative Geological-Engineering Integration for Unconventional Reservoir Development

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Objective Selection of Representative Models for Robust Reservoir Optimization Using Ensemble-Based Methods

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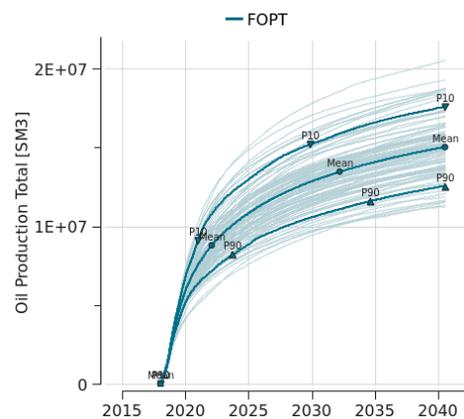
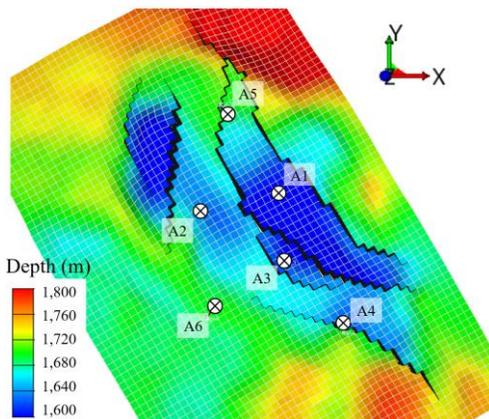
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Introduction & Challenges

Data Set & Tools

- Equinor's Synthetic Drogon field (100 geo-realizations)
- Optimization engine: EVEREST™ ([SPE-223850-MS](#))
- RMFinder algorithm ([SPE-185502-MS](#))

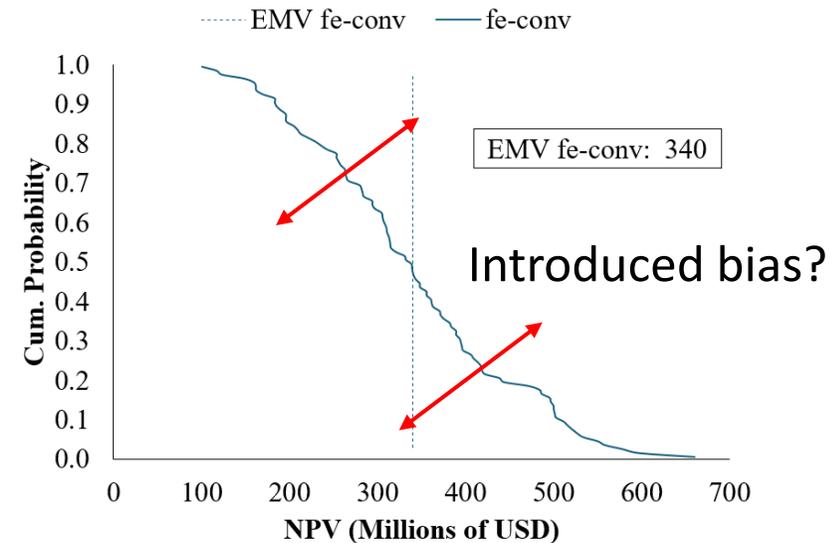
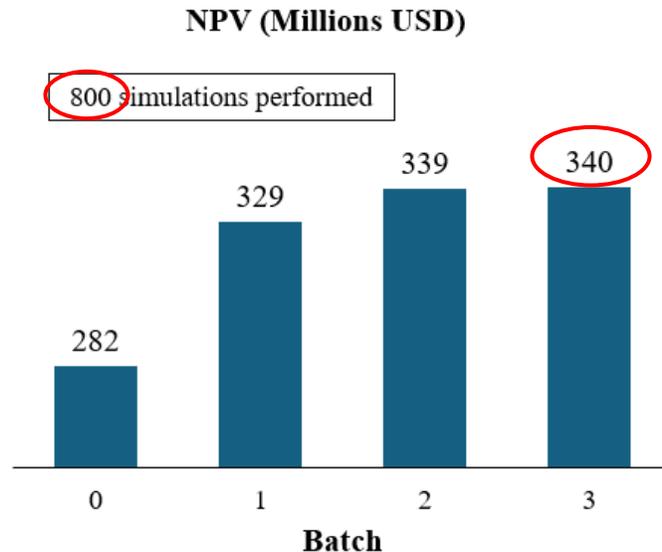


Challenges

- Maximize NPV by optimizing inj/prod rates
- Reduce computational time / # number of simulations
- Eliminate user bias in RMs selection
- Enable decision-making under uncertainty

Conventional Robust Optimization

- 60 rate control points over a 20-year simulation timeframe
- 100 simulations per optimization batch
- **All results will be benchmarked against this reference case**



RMFinder Setup

- Minimize the objective function

$$F(\tau') = 2 F_{cross}(\tau') + 6 F_{risk}(\tau') + 1 F_{atr}(\tau') + 1 F_{penalty}(\tau')$$

τ' = subset of scenarios

4 output variables were considered in $F_{cross}(\tau')$:
NPV, Np, OOIP and Wp

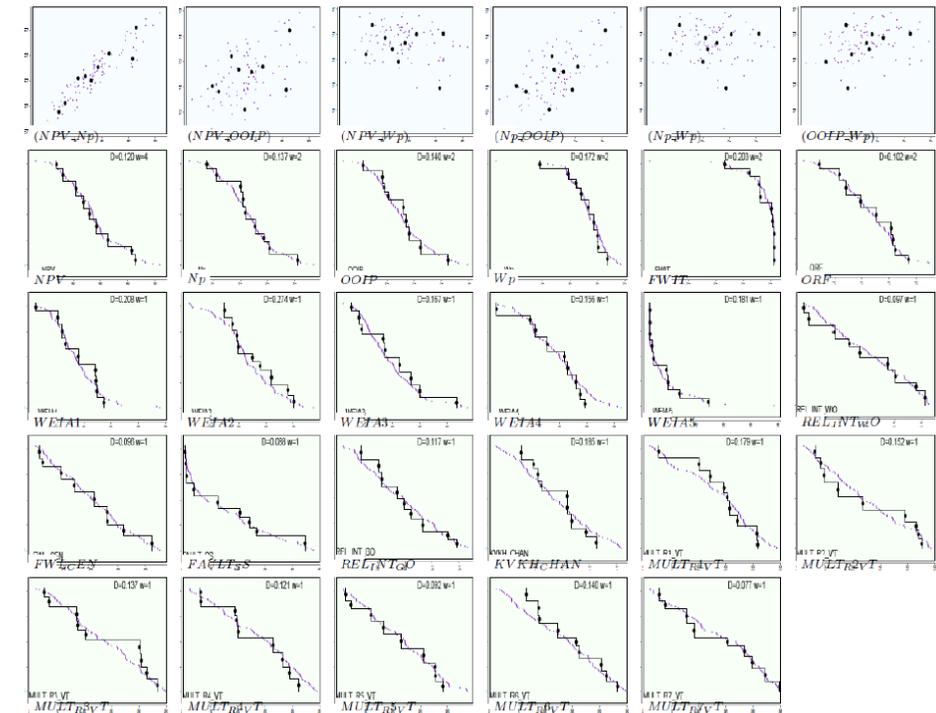
23 continuous variables were considered in $F_{risk}(\tau')$:

6 field variables: NPV, Np, OOIP, Wp, FWIT and ORF

5 well economic indicators (WEIA1,...,WEIA5)

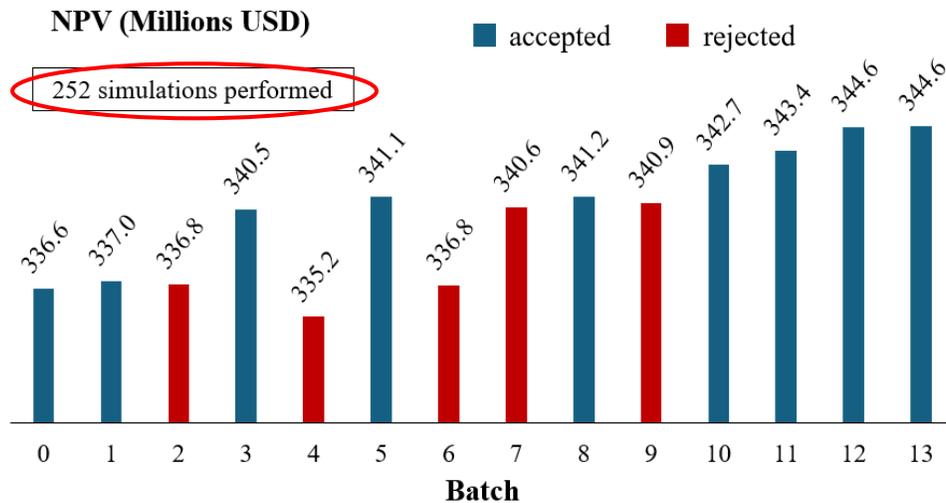
12 geological uncertainties

$\mathcal{R}_1 = 14.9726$ (1.0004) $F_{risk} = 0.144 \pm 0.043$ $lb = 0.0624$ $\#RM = 9$

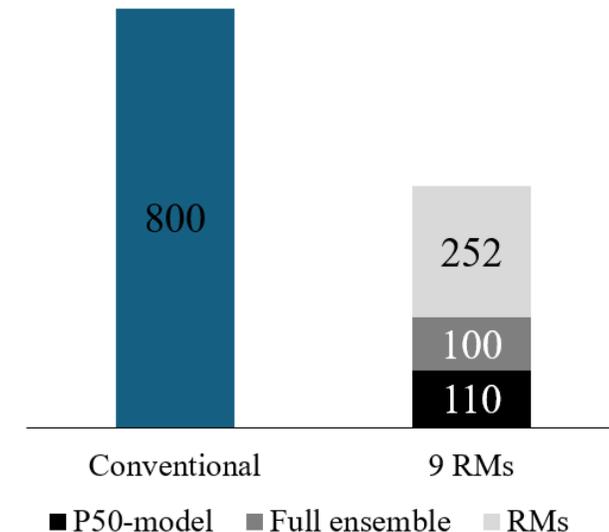


Comparison Using 9 RMs vs Full Ensemble

- First, a P50-model is optimized using EVEREST
- Next, the full ensemble is run using the optimal rates obtained from the P50-model
- Finally, 9 RMs are optimized (10, 16, 22, 27, 37, 47, 55, 62, 65)

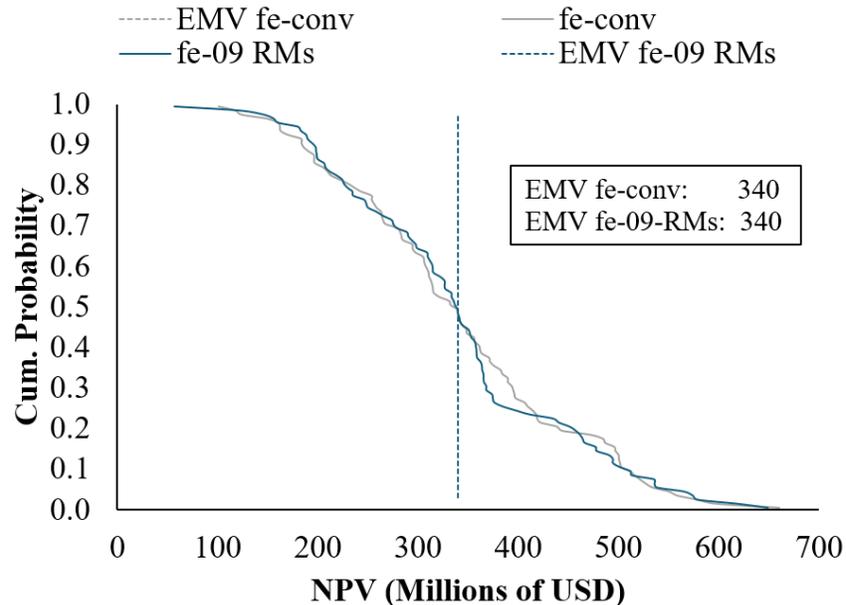


Number of simulations performed

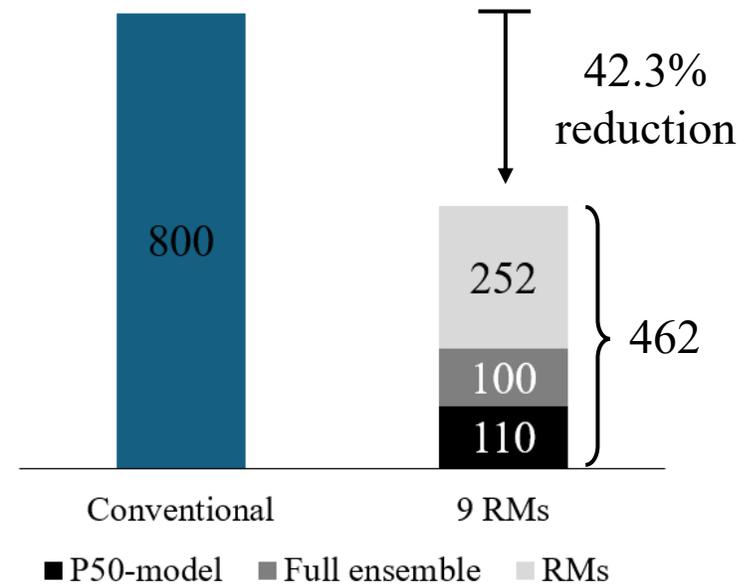


Comparison Using 9 RMs vs Full Ensemble

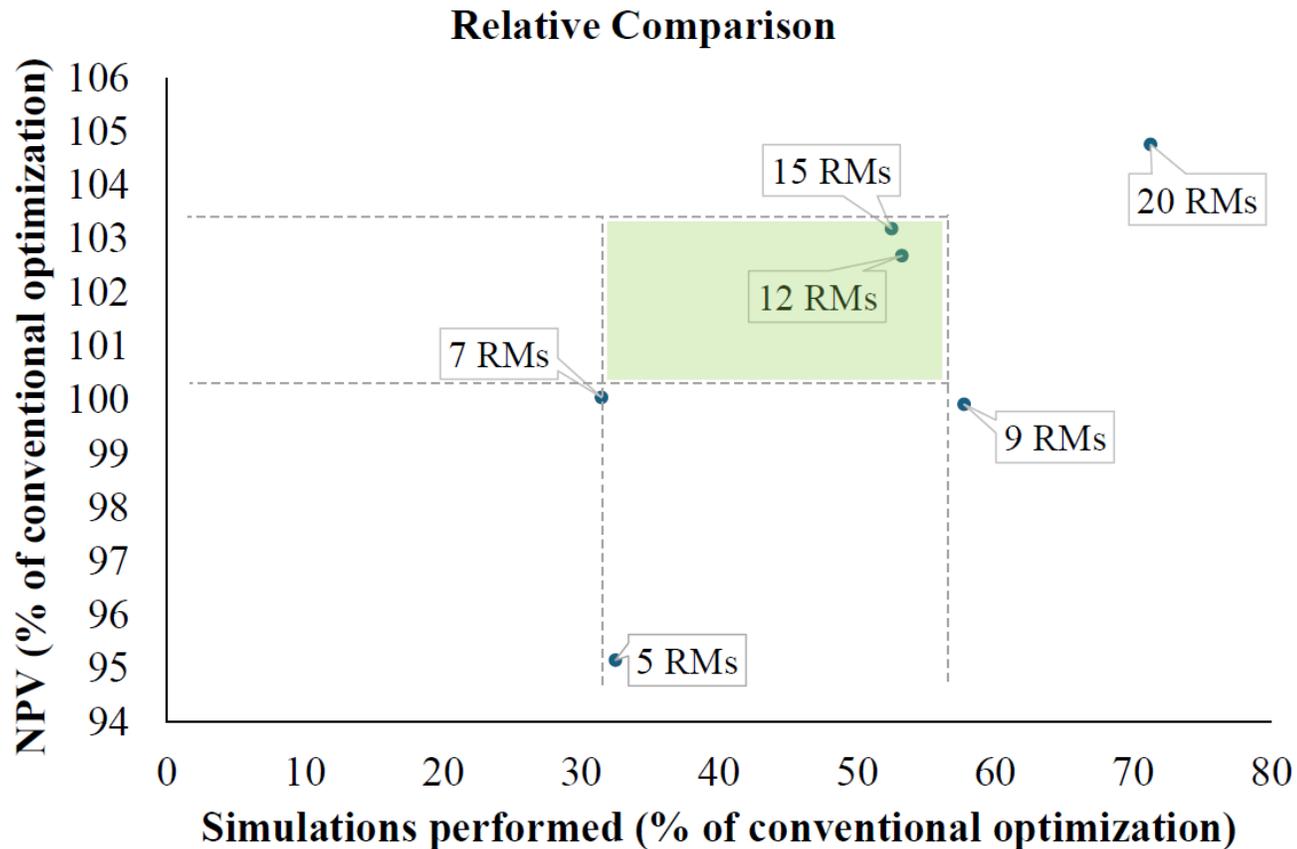
- **42.3%-time reduction** while achieving same EMV (VPN)



Number of simulations performed



Final Results



The exercise was repeated using different numbers of RMs:

5, 7, 9, 12, 15 and 20 RMs

A time reduction of 30–60% was observed, while maintaining economic performance ranging from 100% to 103%

Acknowledgments & Questions

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