PPSDM Jakarta, Oct. 31st, 2017

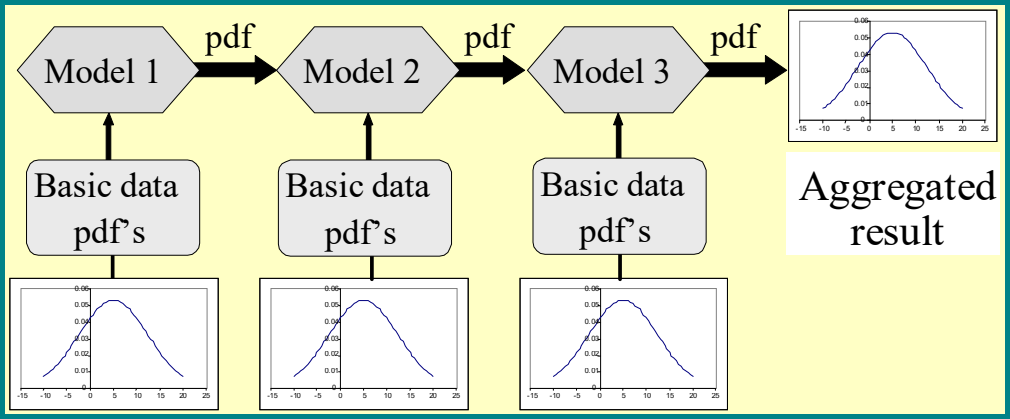
Company decision-making for geothermal projects

(GEOCAP course 1.07)

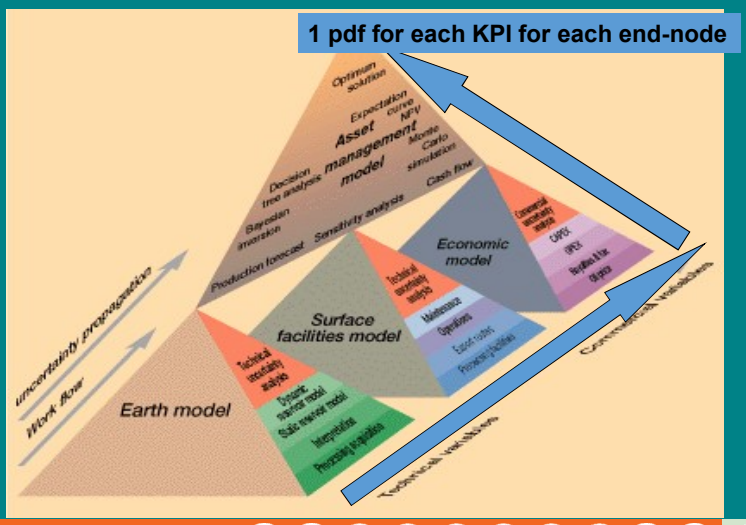
Topic: Integrated Asset Modelling (IAM)

Lecturer - Ir. Christian Bos

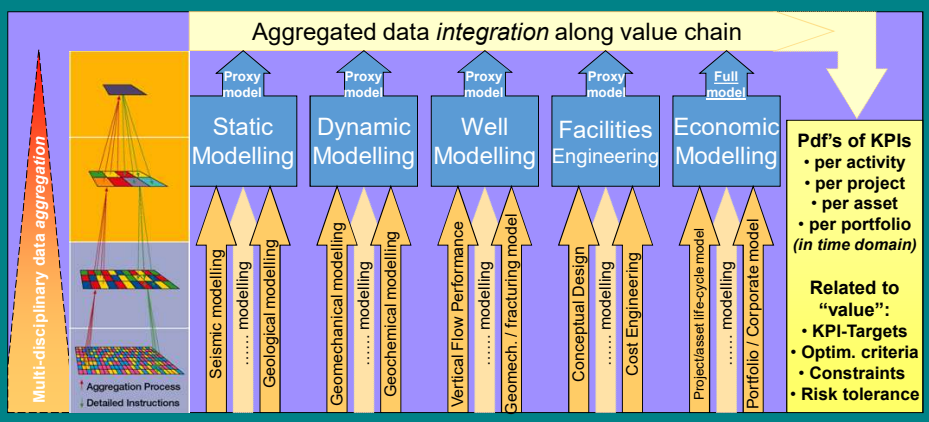
Information flow through the various concatenated models



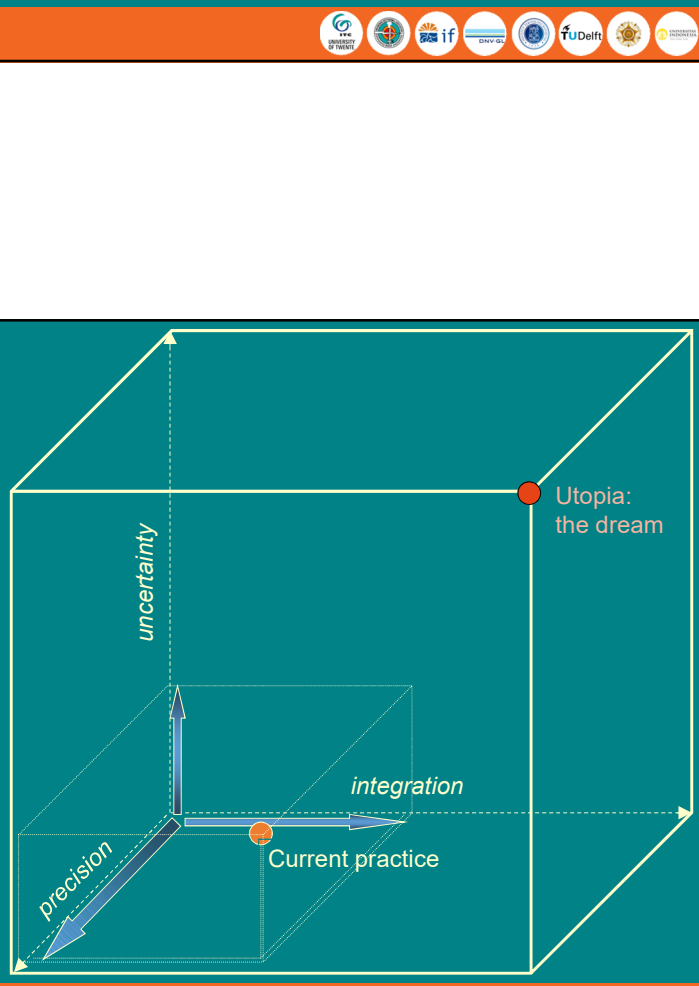
Integrated Asset Management

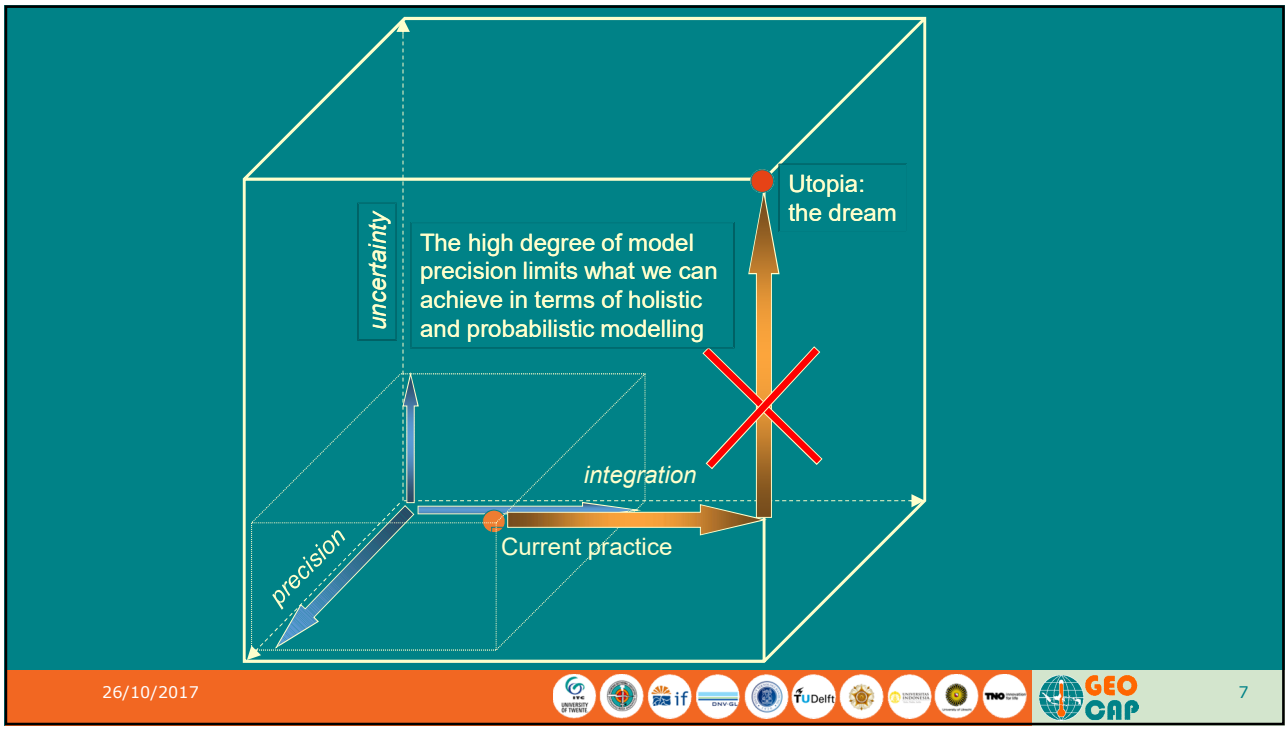


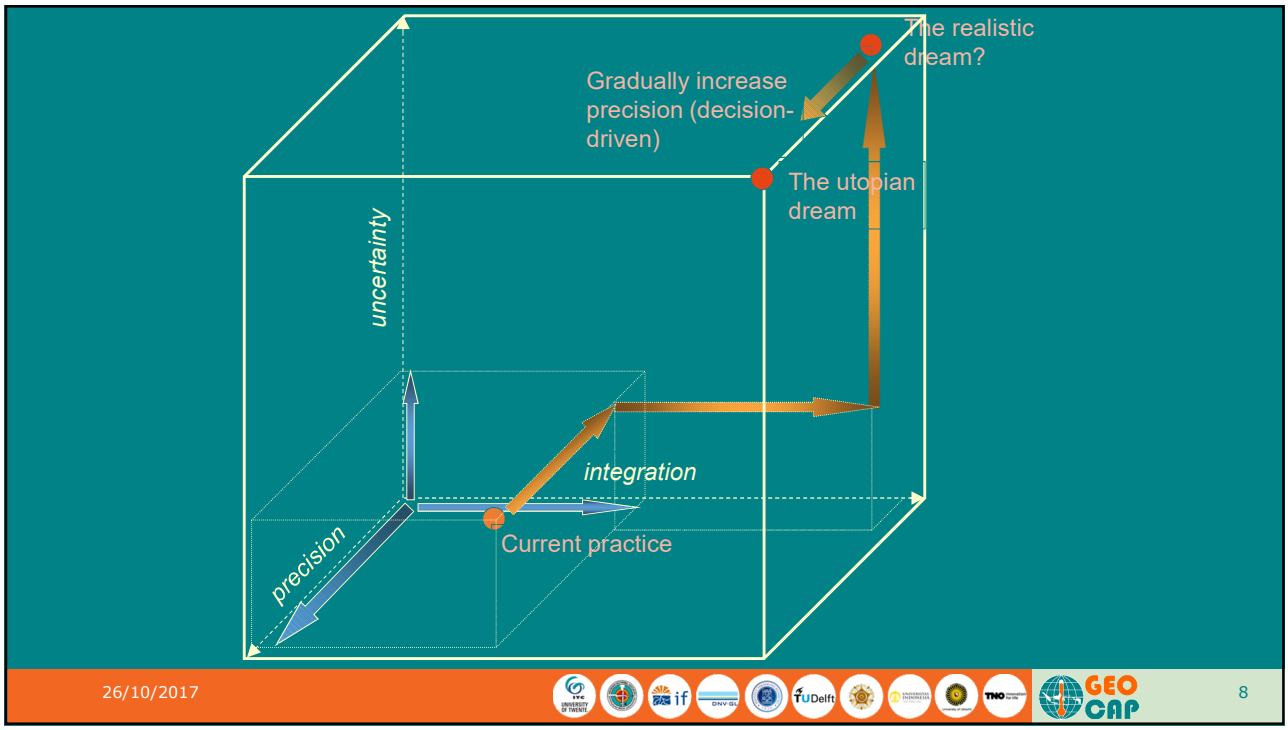
Multi-disciplinary data aggregation & model integration along value chain



The "modelling cube"




Utopia:
the dream
uncertainty
The high degree of model precision limits what we can achieve in terms of holistic and probabilistic modelling
integration
Current practice
precision
26/10/2017
7


The realistic dream?
Gradually increase precision (decision-driven)
The utopian dream
uncertainty
integration
Current practice
precision
26/10/2017
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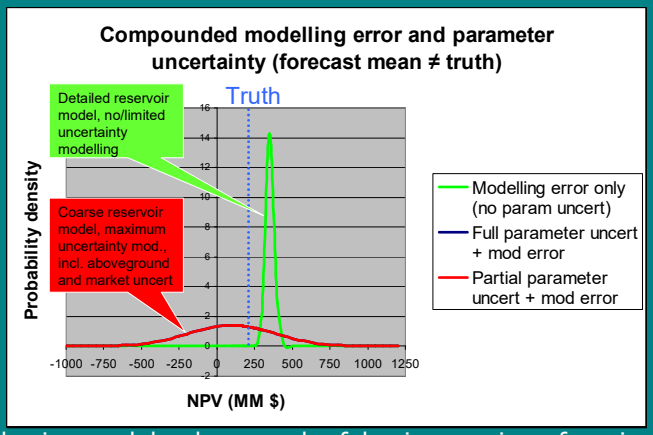
Uncertainty modelling, forward models, continuous mathematical space

- Analytical methods
  - uses error functions that are directly integrated in the forward model
  - only practical in case of simple functions
- Monte Carlo
  - uses statistical sampling of input parameter distribution functions
  - easy to understand basics
  - in E&P more generally applicable, because of the generally complex mathematical equations and solution techniques used, rendering analytical techniques impractical.
  - **but can be too computer-intensive**

Limited vs. full uncertainty modelling



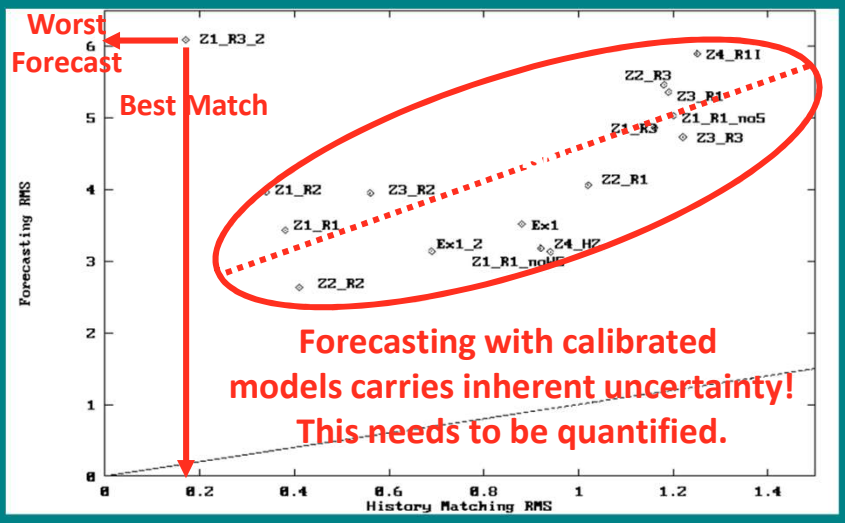
- Precise full-physics model only caused a false impression of engineering accuracy, illustrating the E&P industry's quite typical problem of "inflated expectations" and "under-estimated risk"

3D reservoir simulators are not that accurate

I.e. in terms of production forecasting.

Calibrating / history matching reservoir models is a statistical problem.

The best history match does not necessarily yield the best forecast.



IAM conclusion

- It may be more meaningful to evaluate systems with complex, non-linear cause-effect relationships, such as a GTE-asset value chain, using simplified, analytical "fast models" rather than maximum precision detailed models (Finite Difference, Finite Element, CFD flow models, full thermodynamics, etc.). Reason: it allows a more comprehensive uncertainty analysis, by applying the Monte Carlo process to the series of concatenated analytical models.

➢ Trade-off, depending on type of decision and information required to support that decision.

- Challenge: link behaviours obtained from detailed (maximum precision) models to IAM.