



PPSDM Jakarta, Oct. 31st, 2017

## Company decision-making for geothermal projects

(GEOCAP course 1.07)

### Topic: Decision Tree Analysis (DTA)

Lecturer - Ir. Christian Bos

Public document (GEOCAP-2016-REP-TNO-1.07-xx)

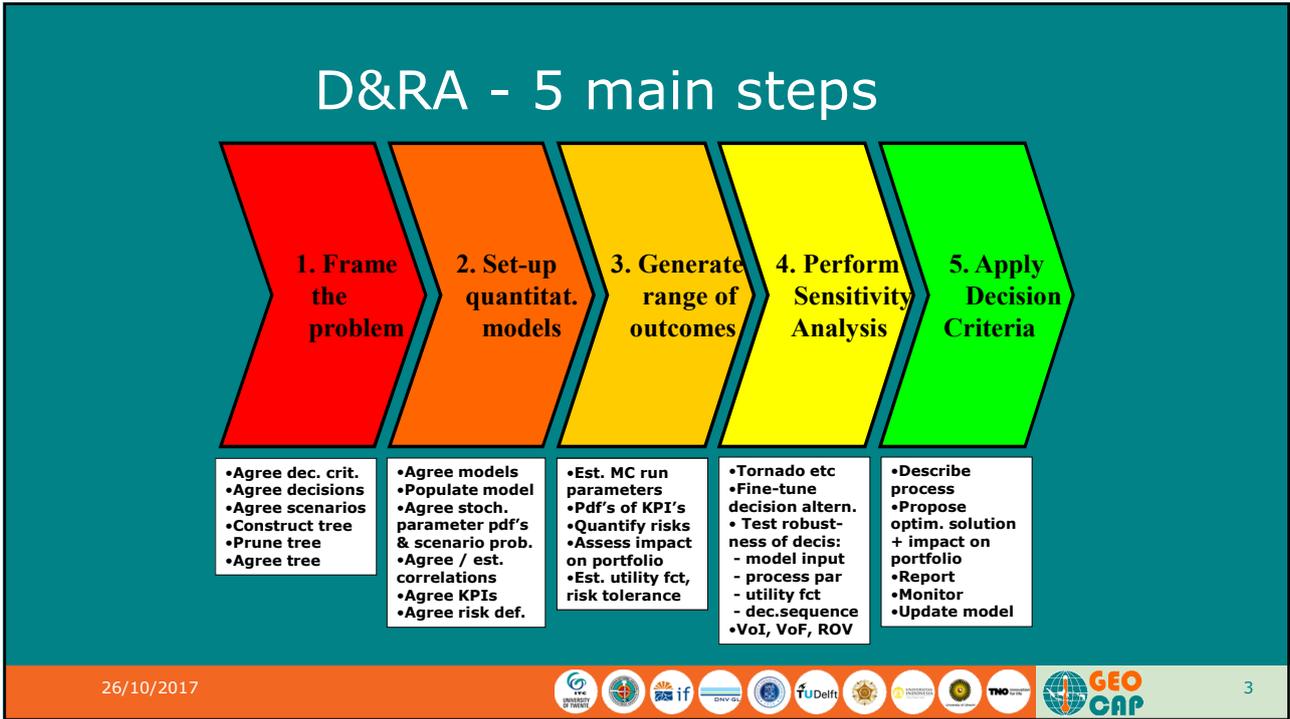
## Decisions, decisions, .....

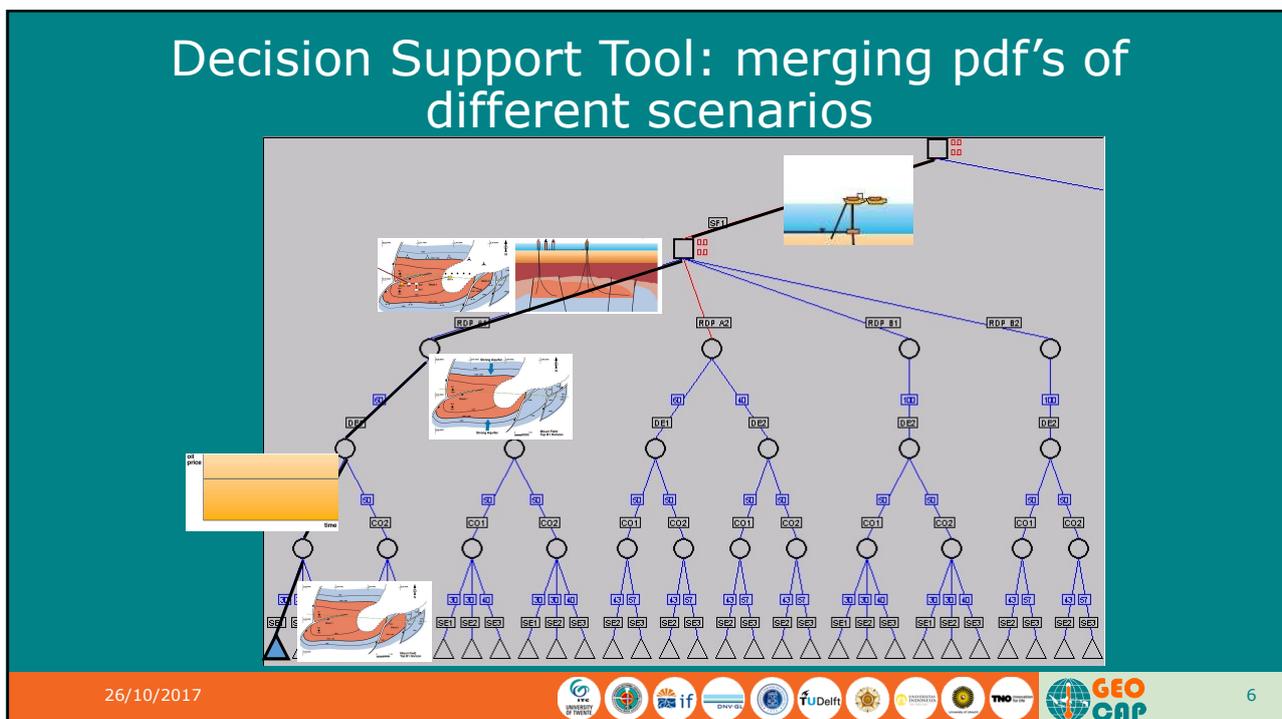
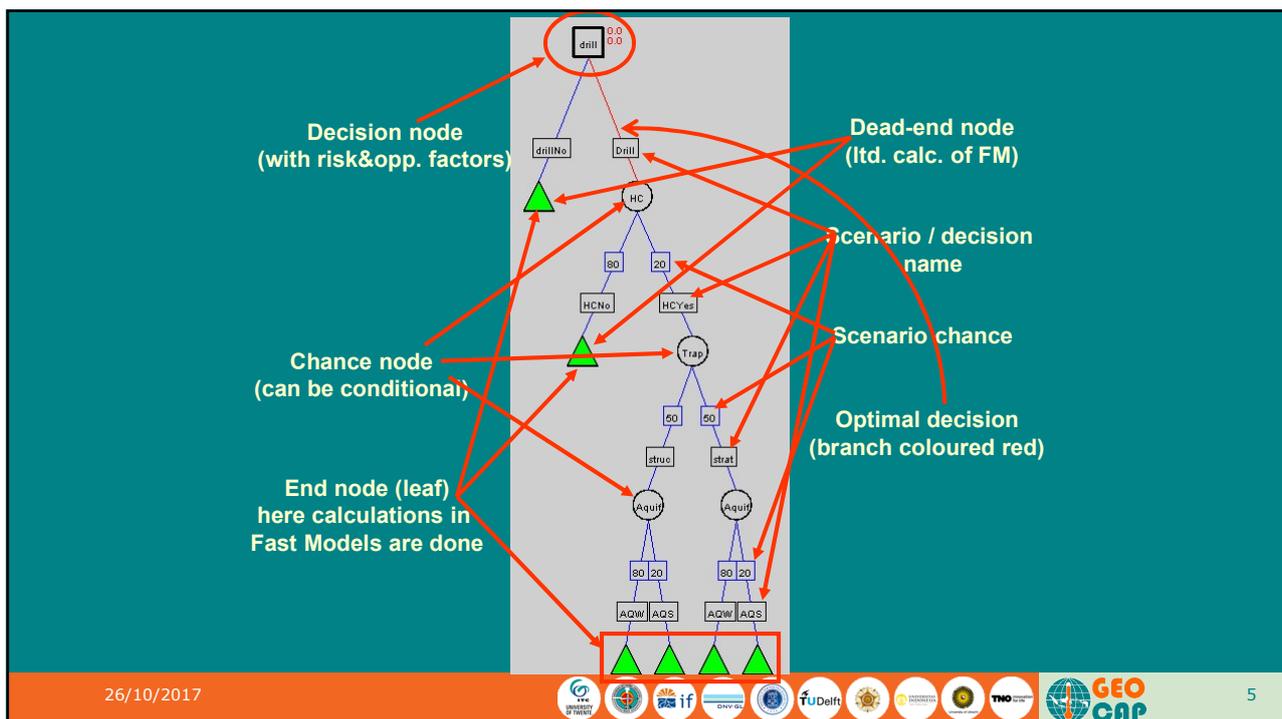
- Decision are our value optimization controls
- A decision-maker should investigate the framed decision alternatives, to select the optimal course of action
- Since decisions have to be made based on uncertain project outcomes, all decision paths have to be modelled together with the pertinent uncertainties
- Decisions can
  - be Static: now, vs. Dynamic or Contingent (depending on the value of future "state variables" = time-dependent output variables)
  - apply to investing in hardware, or investing in information (VoI)

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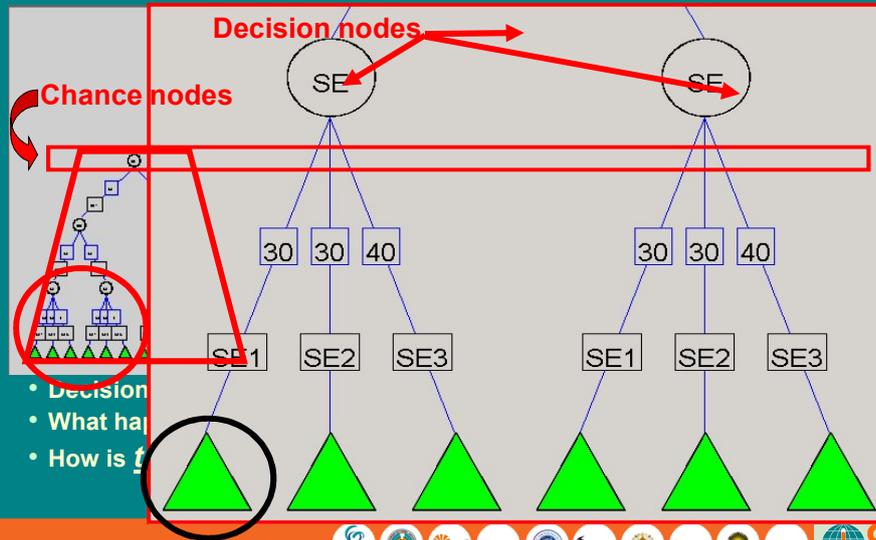


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# A typical decision tree

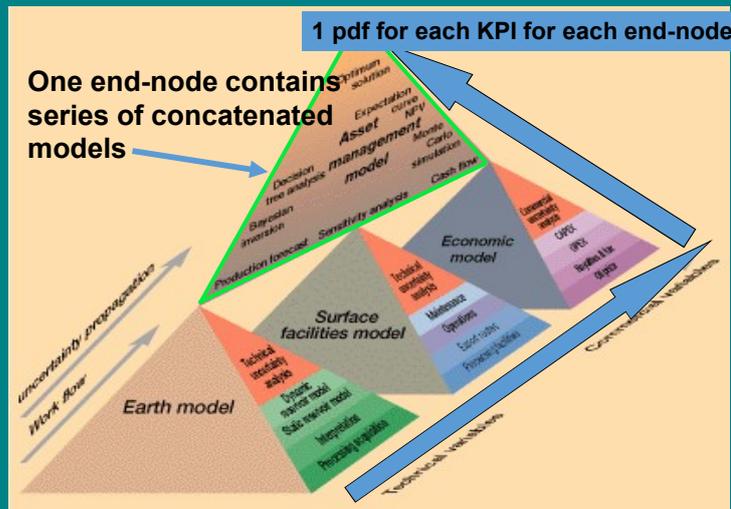


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# Concatenated, nested models in each end-node

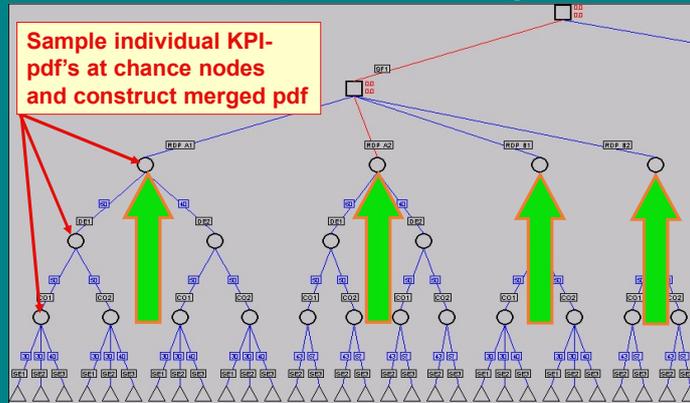


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# Integrating discontinuous uncertainties by defining scenarios



NPV  
P/I  
IRR

Correctly model scenario dependencies !

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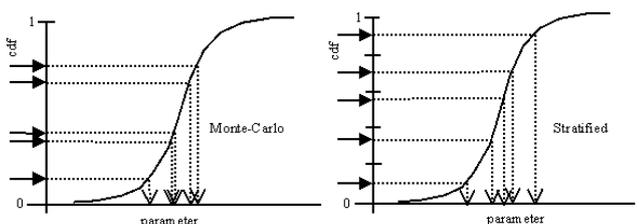
# Constructing merged pdf's in scenario trees

• Example: Two

Objective: U

Oil Production Fo

min \$



(MC)

(stratified)

new

statistical

population from

both data sets:

merged set of 100

samples

100 samples

100 samples

1

2

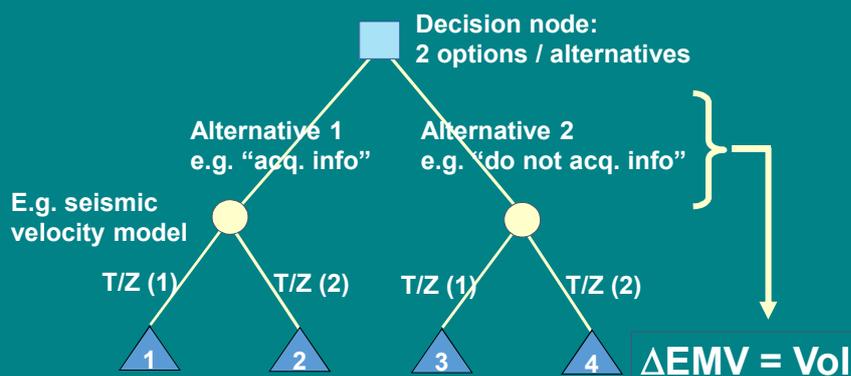
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## Use full statistical information of each alternative branch for decision-making

- Combine continuous uncertainties from end-node input parameter pdf's (processed into KPI-pdf's) with discrete uncertainties from scenarios



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## Type of decisions in tree and in IAM

1. Static decisions
  - To be taken "now", i.e. with information currently available
  - I.e. not based on information still to be acquired
2. Contingent decisions (or conditional decisions)
  - Decisions to be taken with information not yet available
  - In decision tree, these decisions normally follow some data acquisition activity + a scenario node
3. Dynamic options
  - Option that is exercised as a function of the IAM's state variables (time-series model output)
  - Decision algorithm evaluated at each time-step.
  - Example: if  $q_{oil} < target$ , drill new well.
  - Other example: if  $NCF < 0$  over last  $n$  years, close-in field

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# Exercise - Decision on whether to explore a geothermal Prospect

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