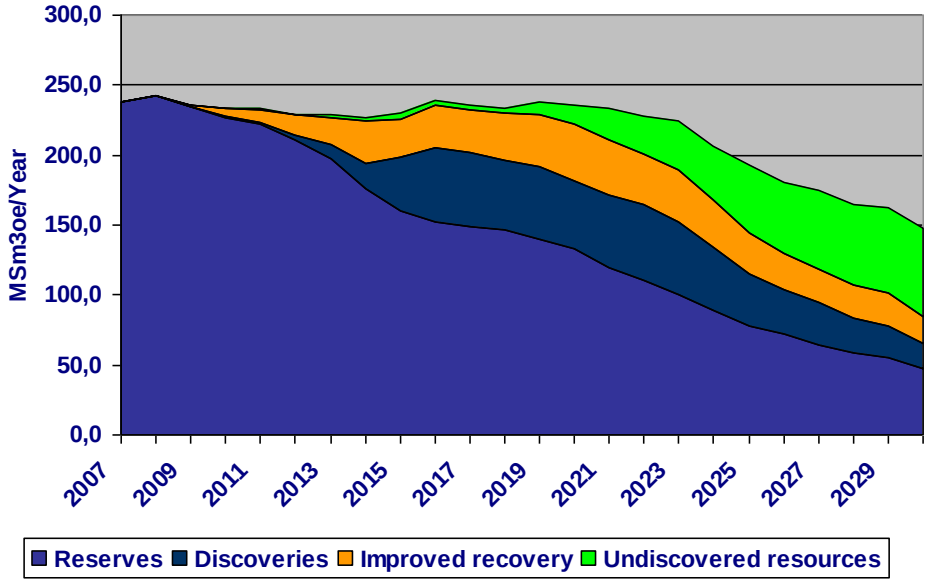
INTEGRATED DECISION SUPPORT SYSTEM

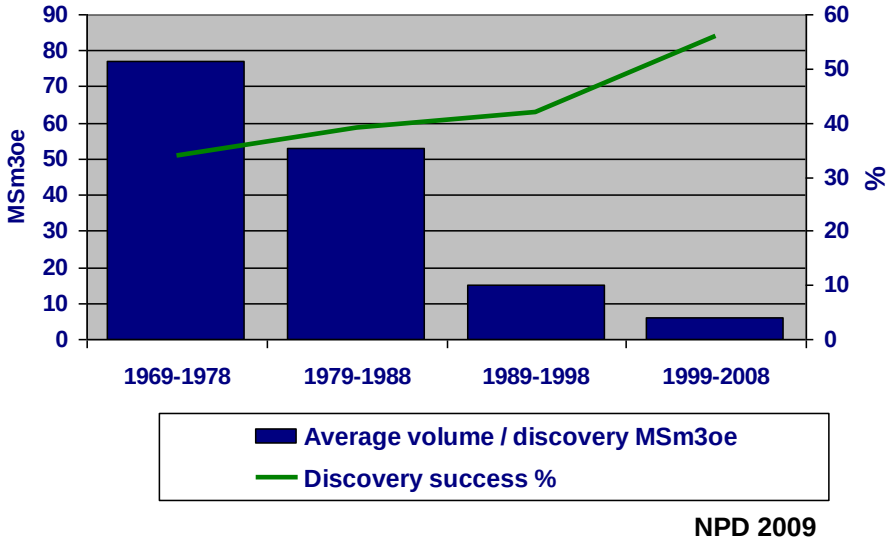
Integrated approach to upstream decision making

London 20 – 21 January 2010

IPRES

Setting the scene





NPD 2009

Production decline and smaller discoveries are seen in many mature areas.

Oil and gas companies are looking for new areas, risk and uncertainty may be high

- offshore ultra deep water
- challenging logistics onshore
- new technology required

Upstream – ”a complicated industry”

Risks and uncertainty everywhere

- exploration
- recovery
- new technology
- infrastructure
- market
- rules and regulations
- prices
- etc...

Risk and uncertainty influence on upstream decisions

Typical upstream decision situations

- drill exploration well
- start field development
- select drainage strategy
- concept selection
- drill production wells
- portfolio transactions (buy and sell)
- etc…

Exploration

- Discovery ?

$$P_{\text{probability of success}} = P_{\text{trap}} \times P_{\text{res}} \times P_{\text{source}}$$

- Discovery volume?

$$\text{STOOIP (stock tank oil originally in place)} = GrV \times NG \times \Phi \times (1 - S_w) / B_o$$

Seismic interpretation

Geoanalyses

Recoverable volume

How much of the STOOIP can be produced ?

$$\text{Reserves} = \text{STOOIP} \times R_{\text{rec.factor}}$$

Reservoir quality Analyses Decisions

Development and operation

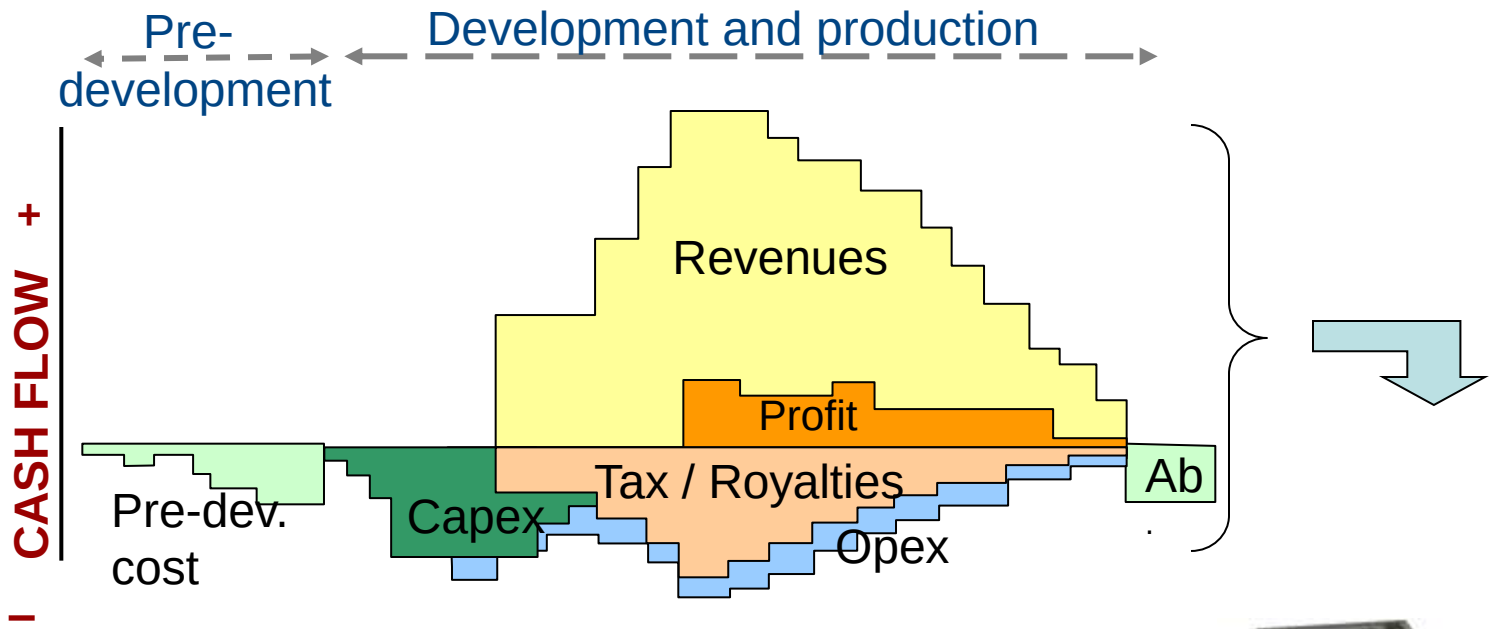
Drilling time and cost?

- Rig rate
- Cost of materials
- Rig availability
- Drilling time

Production start, cost and regularity?

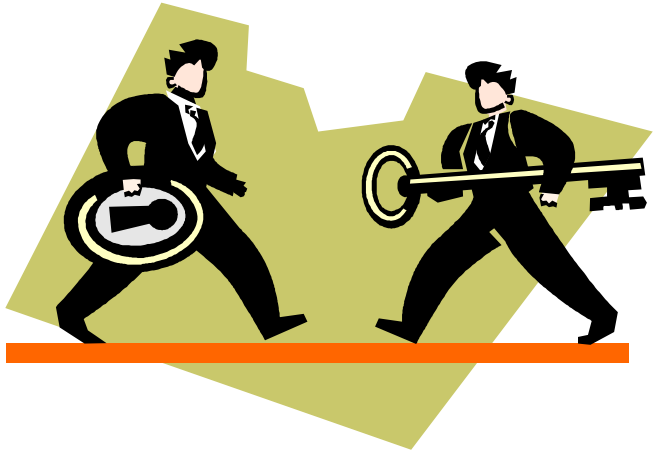
- Technology
- Capex
- Infrastructure
- UP time
- Opex
- Shut down

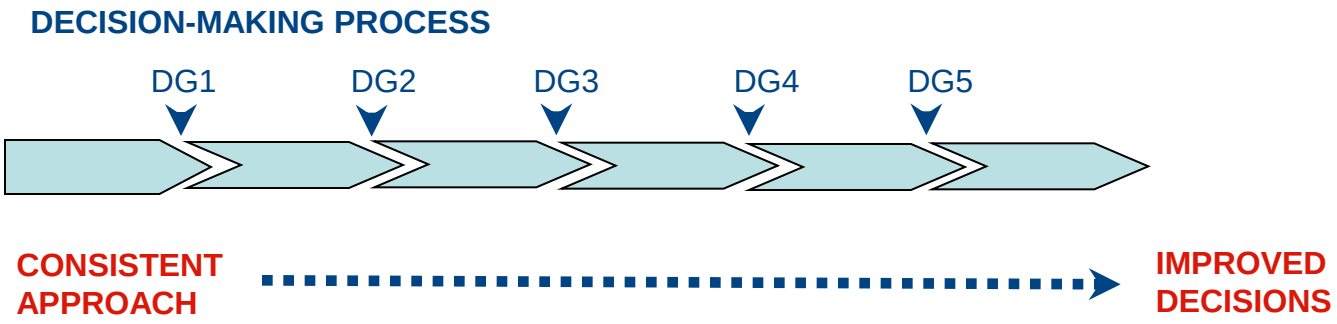
Economic modelling basis for decision making



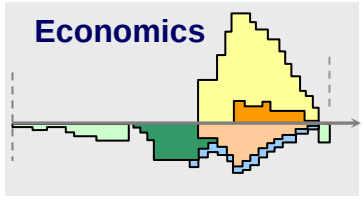
Essential in an upstream decision making process

- Integrated work approach
- Software tool to handle all data

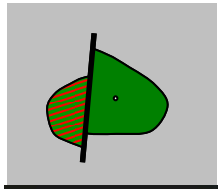




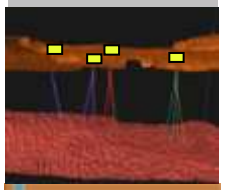
Integrated work approach



Geolgy
Geophysics



Reservoir
engineering



Drilling
engineering

Field
Development

Economic analysis

Production

Commercial premises

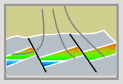
Rules
Regul-
ations

Tax

Market

Cost elements

DRILLEX



CAPEX

OPEX

TARIFF

ABANDM.

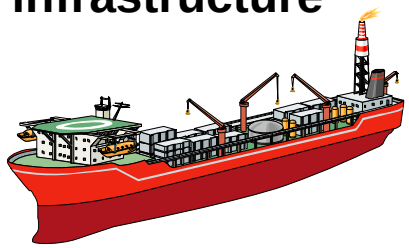
Integrated work approach - benefits

- Includes all disciplines from subsurface to portfolio management – common understanding
- Inspires and promotes cooperation within the project teams - better communication
- May trigger new and different perspectives
- Includes all relevant data
- Takes risks and uncertainties for all relevant disciplines into account
- Ensures that all sides of a decision situation are considered
- Easier to update project if needed

Example - Decision making process

Discovery and prospect located close to infrastructure offered for sale

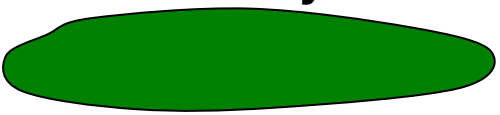
Existing infrastructure



Work to be done

- map discovery STOOIP
- map and risk the prospect
- decide drainage and production strategy
- make a development plan
- price prognosis
- evaluate the tax system and possible fees
- decide to include the prospect or not
- evaluate the discovery in relation to total portfolio

Discovery A



Calculate and decide bid for the discovery with or without prospect!

Prospect B

Some of the uncertainties

STOOIP?

Oil price?

New Platform?

CAPEX?

OPEX?

Regularity?

Drilling rigs?

Subsea?

Market?

Pipeline cost?

templates?

Pipeline capacity?

Logistics?

Tie in to Field A?

Production rate per well?

wells?

Exploration risk?

Tariff?

Pre-drilled wells?

Cost per well?

Available processing capacity?

Injection wells?

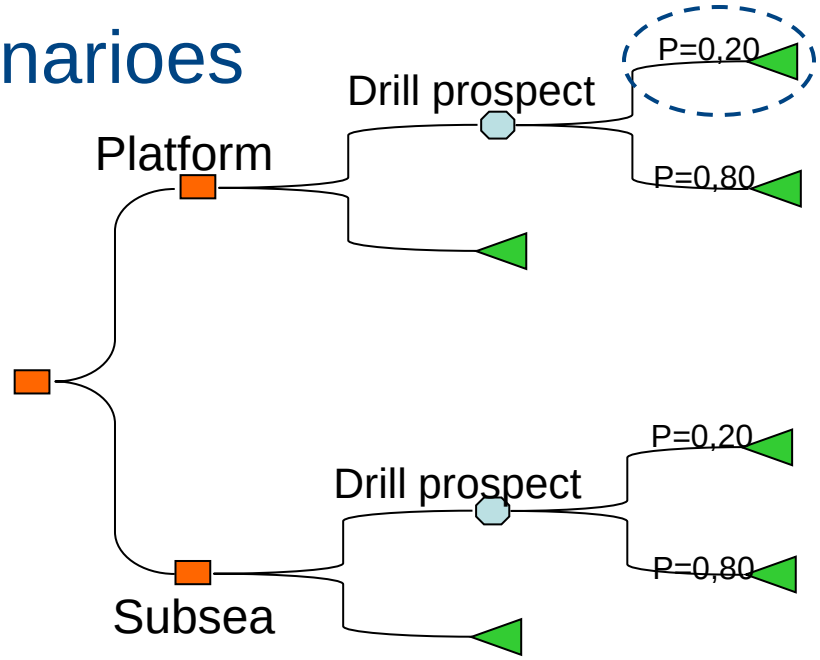
Discovery A

Prospect B

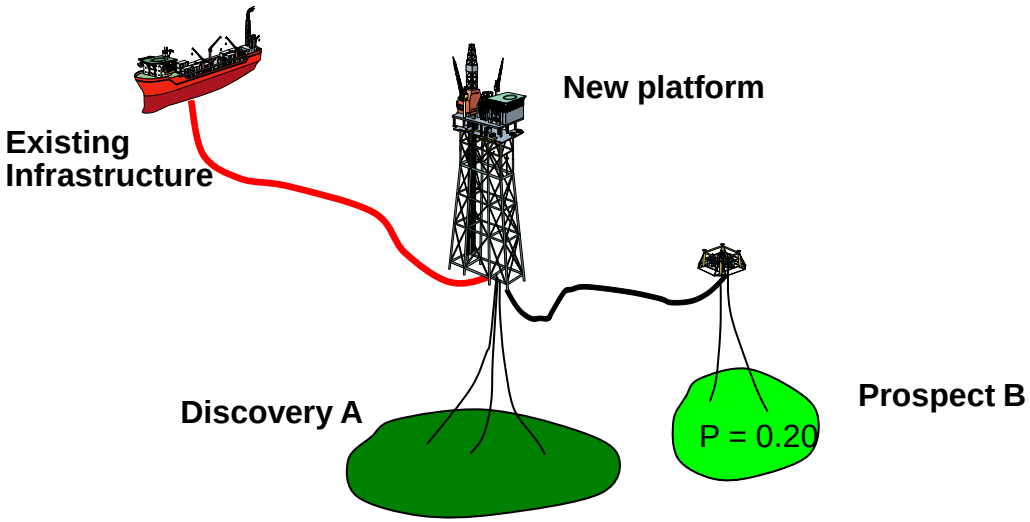
Define concept scenarioes

Base scenario

Concept scenario decision tree



Base Scenario



Deterministic vs. probabilistic approach

How can input risk and uncertainty be quantified?

DETERMINISTIC

PARAMETER 1	'high'	'base'	'low'
PARAMETER 2	'high'	'base'	'low'
PARAMETER 3	'high'	'base'	'low'
PARAMETER 4	'high'	'base'	'low'
PARAMETER 5	'high'	'base'	'low'

Low case

Base case

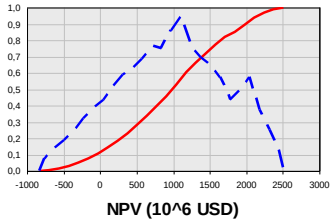
High case

- Three discrete outcomes
- Base Case ≠ Expected for the project
- High case and low case are extremely unlikely to occur

PROBABILISTIC

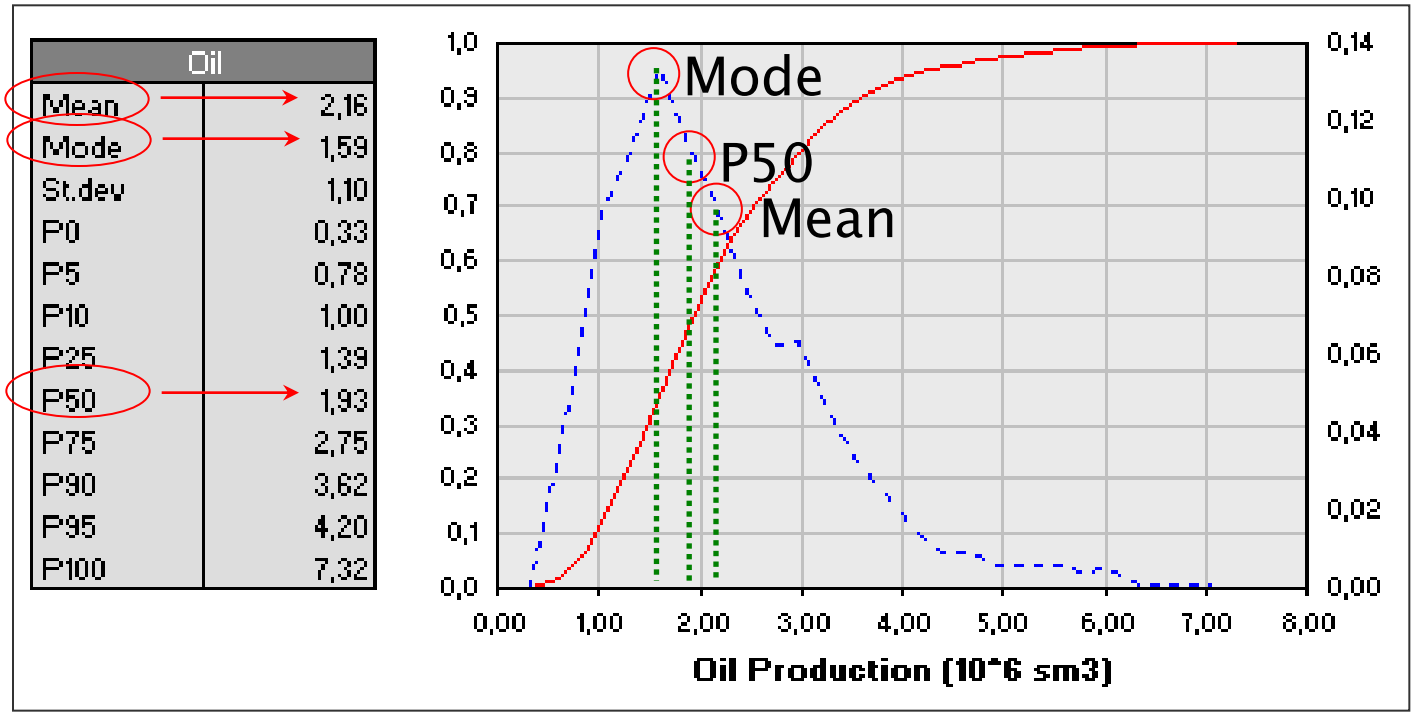
PARAMETER 1	Distribution
PARAMETER 2	Distribution
PARAMETER 3	Distribution
PARAMETER 4	Distribution
PARAMETER 5	Distribution

Simulation



- Full range of possible outcomes
- True expected NPV
- True P90
- True P10
- Correct comparison and ranking of options

Statistical Measures

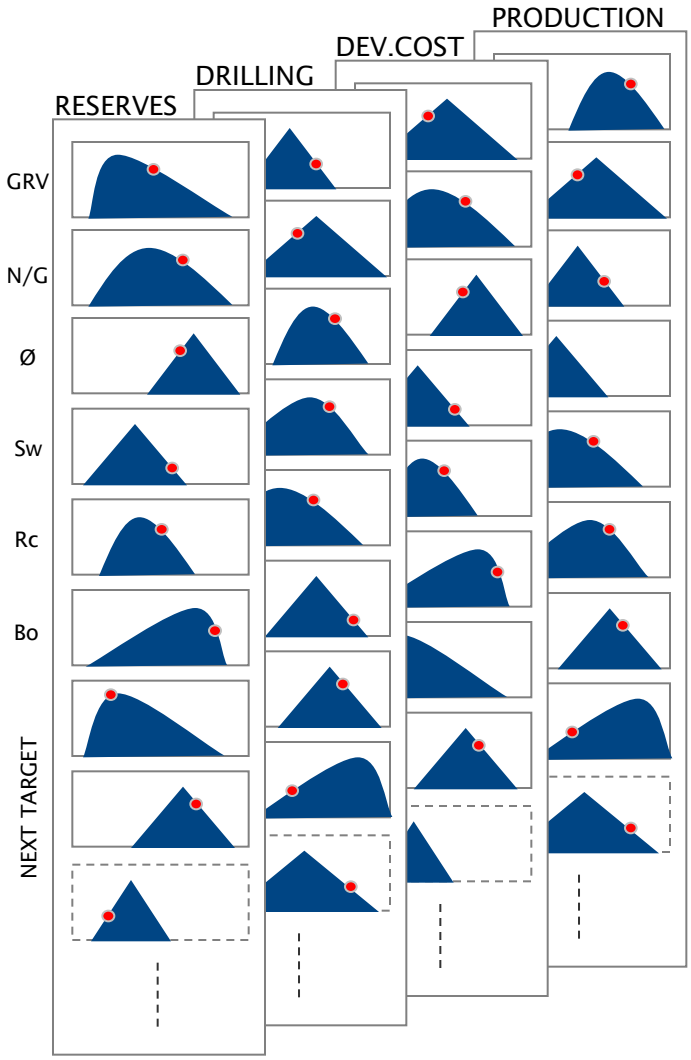


Mean The same as expected value. Arithmetic average of all the values in the distribution. The preferred decision parameter.

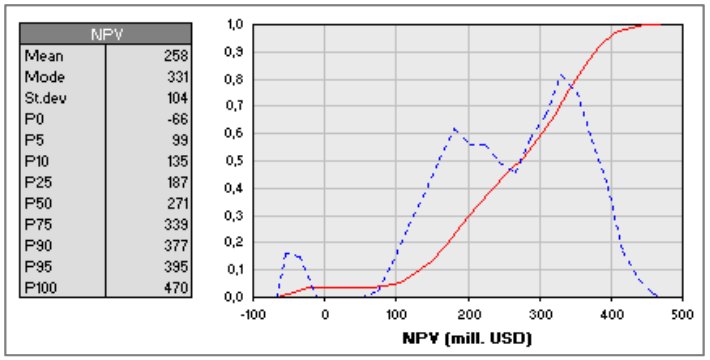
Mode Most likely value. The peak of the frequency distribution. Base case?

P50 Equal probability to have a higher or lower value than the P50 value. Often referred to as the Median.

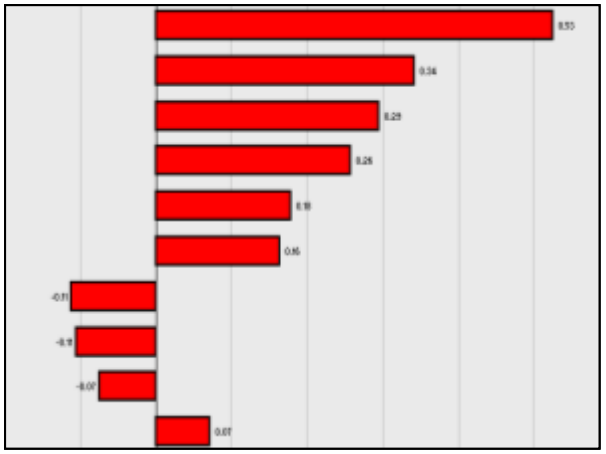
Probabilistic approach



SIMULATION

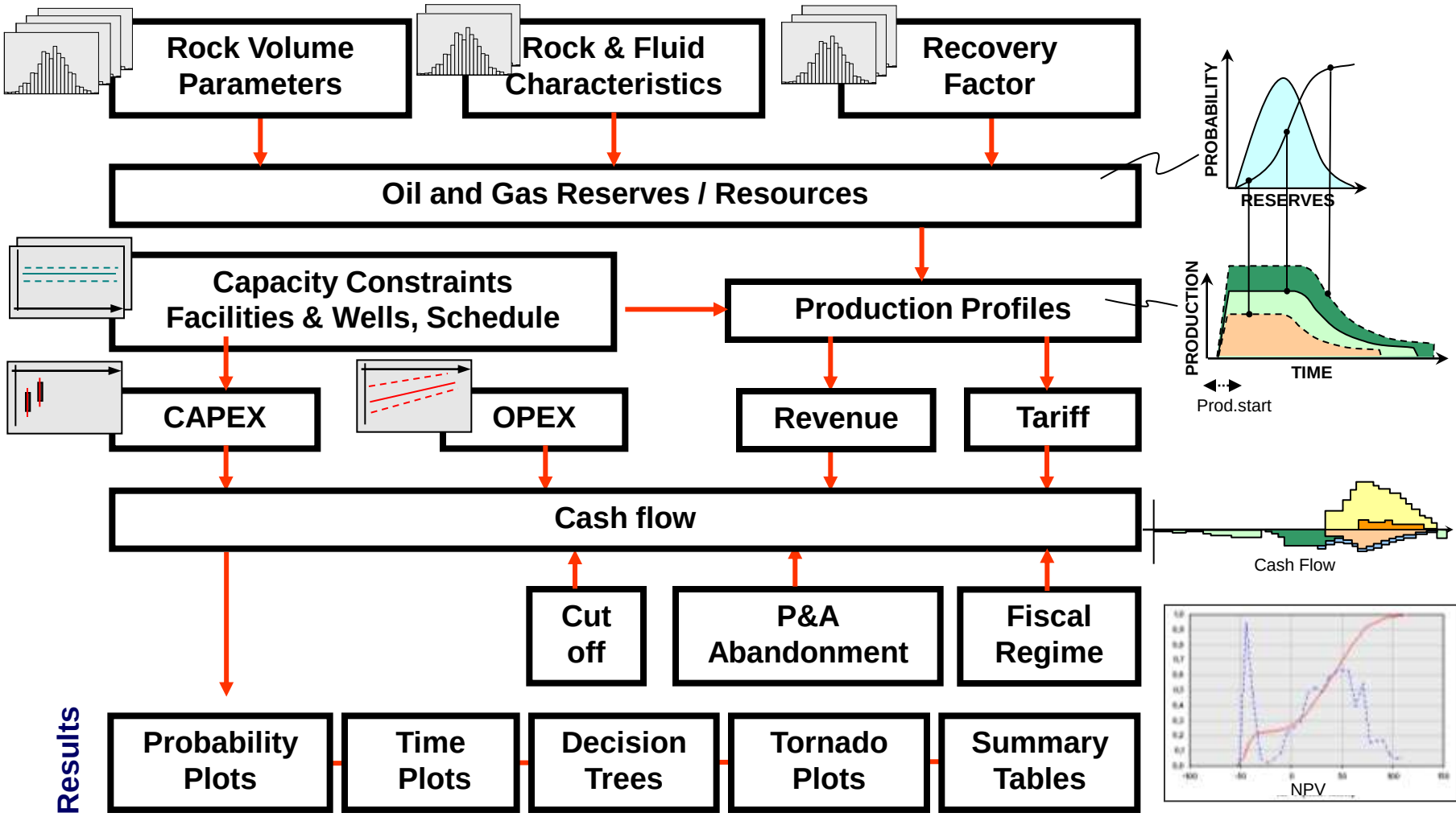


Presents full range of possible outcomes

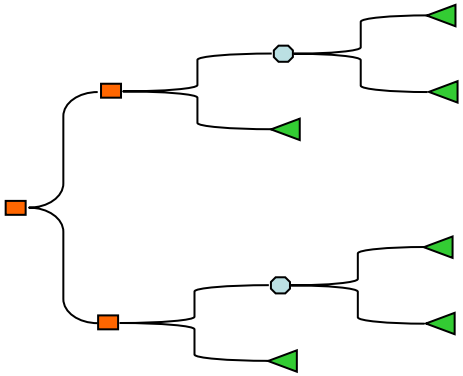


Key factors contributing to overall uncertainty

Decision support tool outline – consistent approach

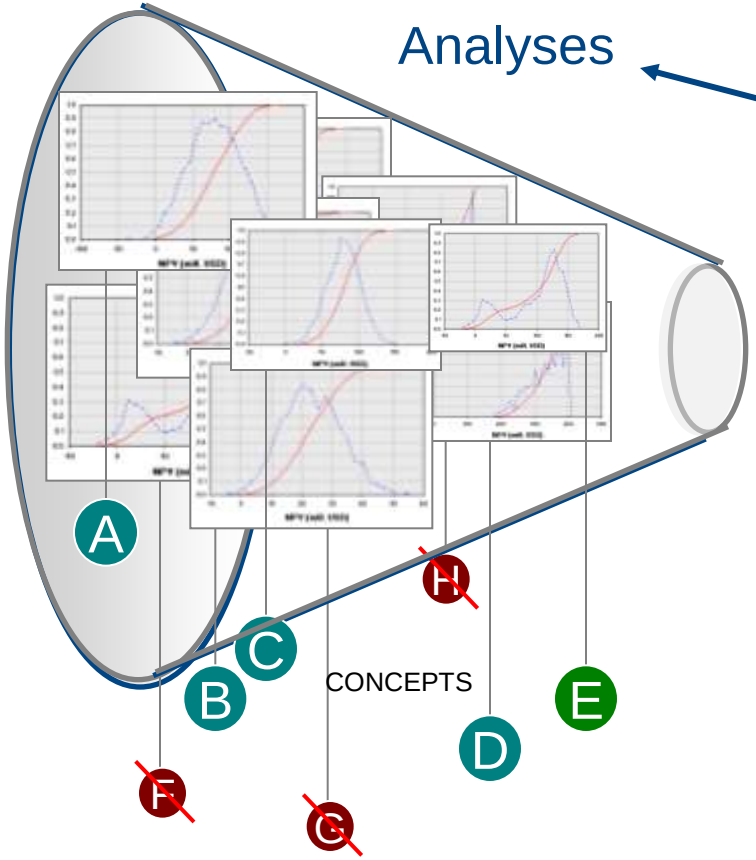


Compare and rank

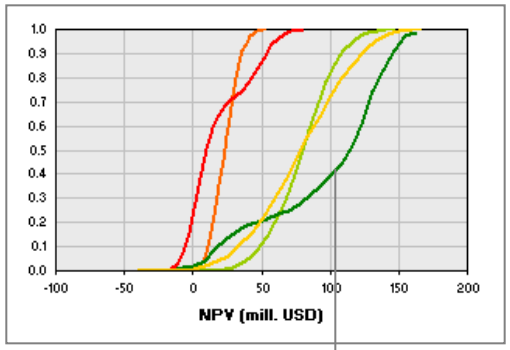


Concept scenario analyses

Analyses



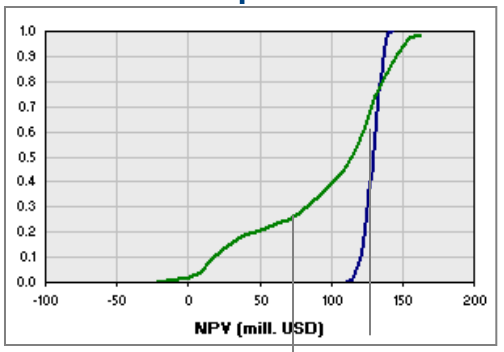
Compare and rank



E

HIGHEST EMV

Optimize and update

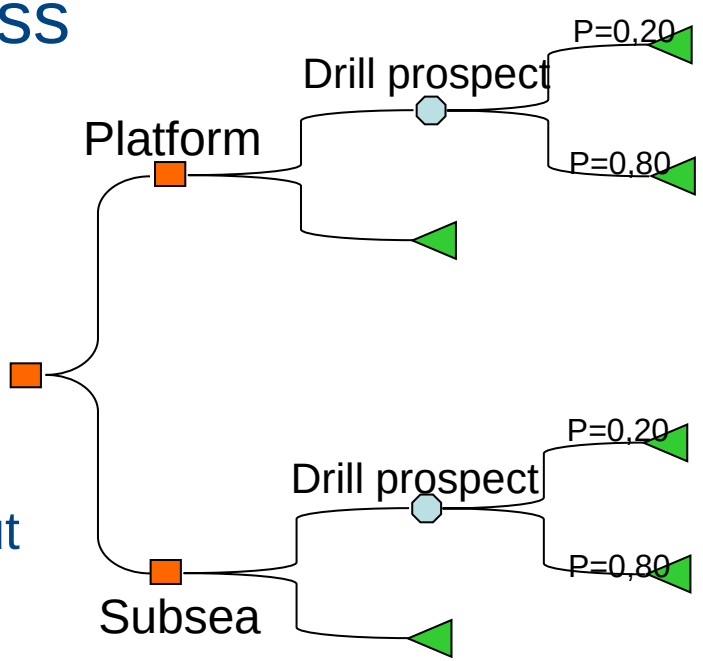


E

E'

Value of ”best branch” basis for bid

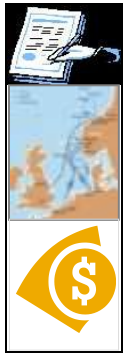
Proposed decision-making process



1. Frame the decision using a decision tree
2. Select a base (reference) analysis
3. Model key uncertainties and risks for all disciplines (starting with the base analysis)
4. Run probabilistic simulation sampling all input distributions
5. Inspect results and refine model if necessary
6. Model the range of options that exists (use the base model as starting point)
7. Solve decision tree with price simulation and as part of portfolio
8. Review and decide

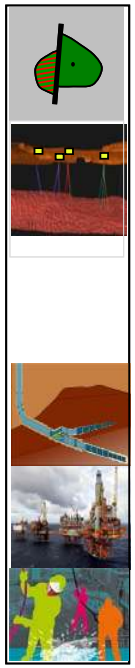
Portfolio effects on risk

Systematic risk

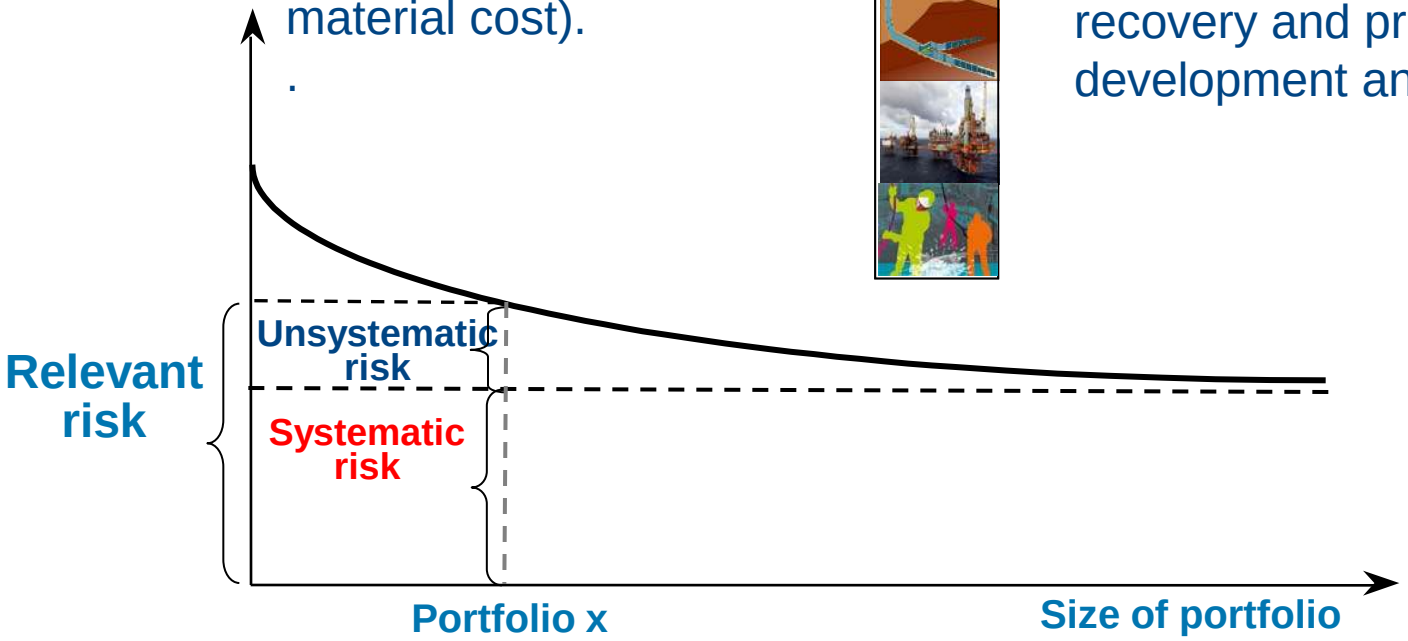


Cannot be reduced by diversification. Risk associated with market, (price,currency,inflation, material cost).
.

Unsystematic risk

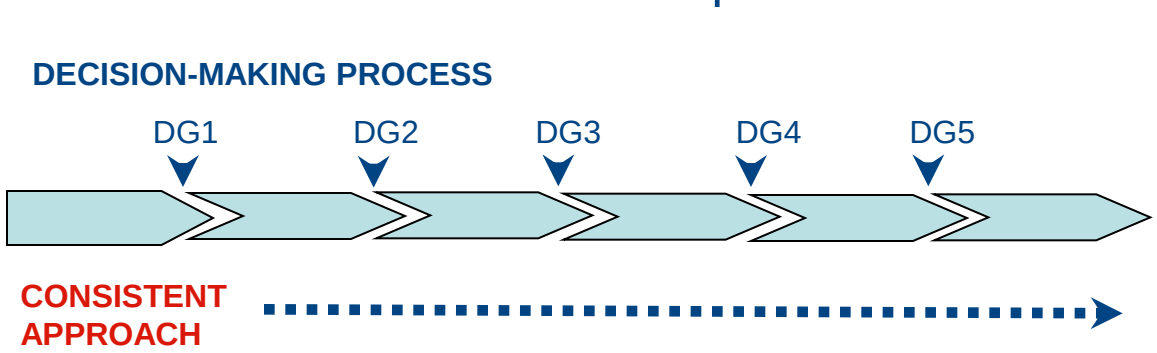


Can be reduced or eliminated in a portfolio of assets through diversification. (Spesific risk). Risk associated with exploration, recovery and production, development and operation.



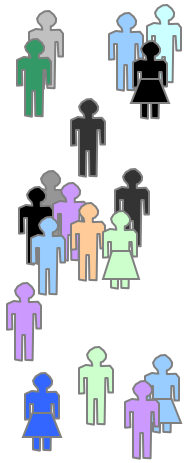
Decision support tool - benefits

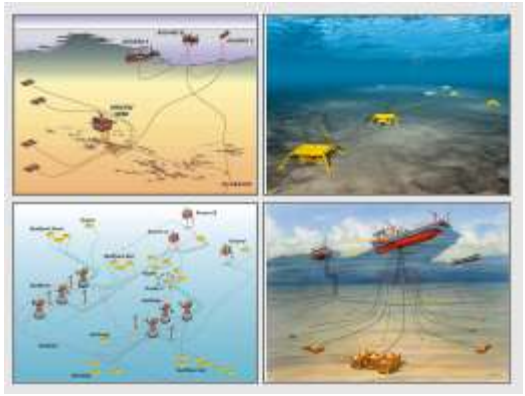
- Consistent approach assures consistent and comparable results
- Provides for full data capture and results in full range of possible outcomes (probabilistic simulation)
- Helps to make complex situations clear and readily understood
- Fast updating of projects
  - Can be used under negotiations
- Results in improved decision making over time, which maximizes the value of the portfolio

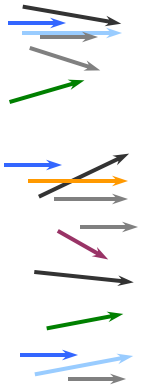


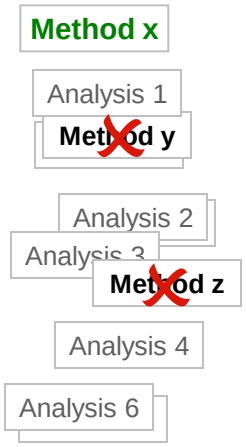
Conclusion

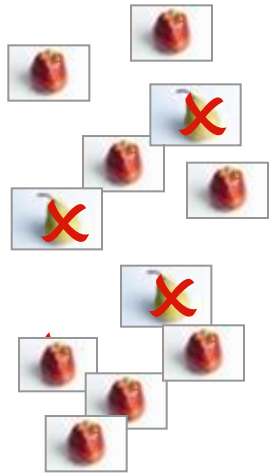
EXPERTS	PROJECTS	DATA	ANALYSES	DECISIONS









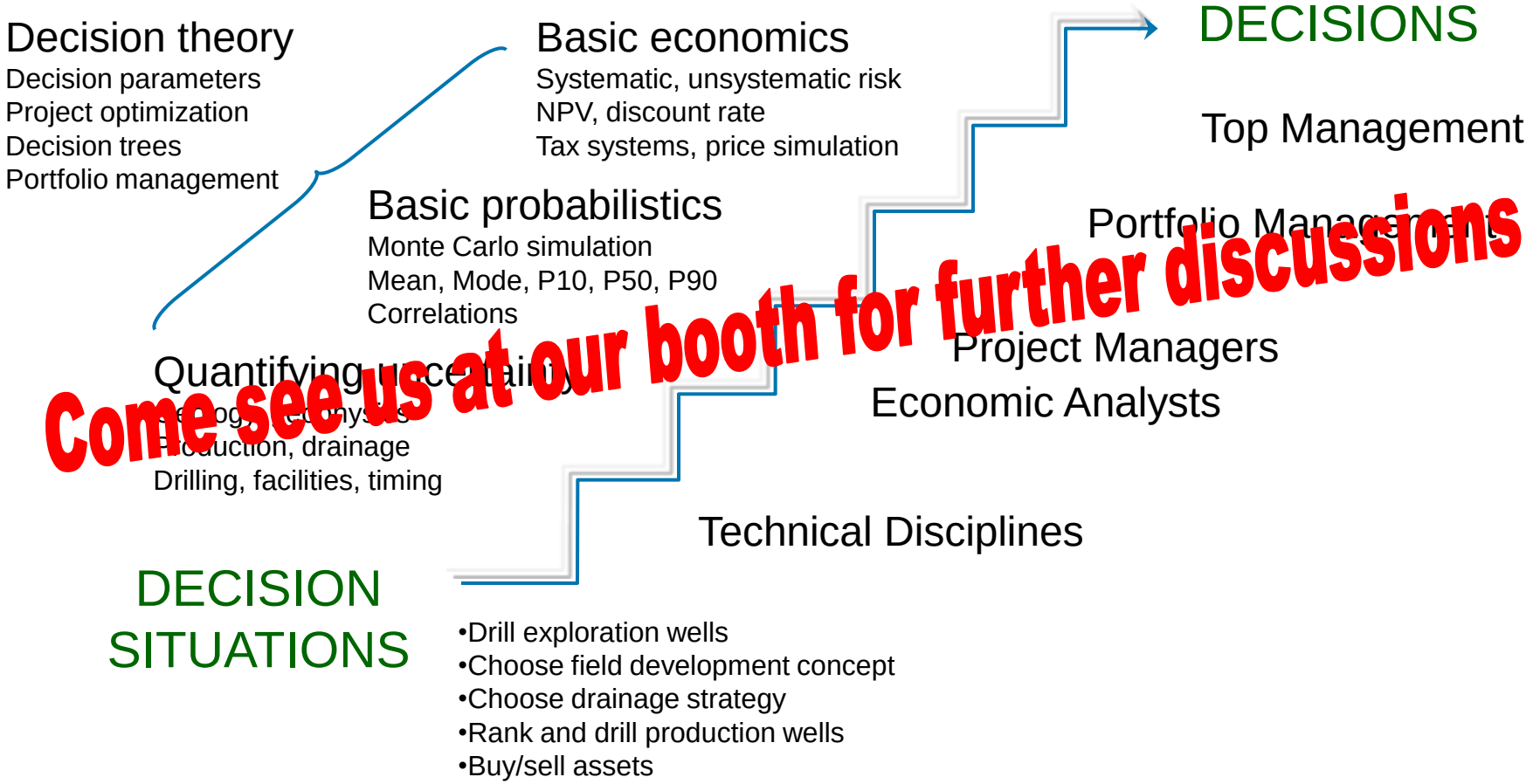


DECISION-MAKING PROCESS

PORTFOLIO

CONSISTENT APPROACH → IMPROVED DECISIONS

Decisions generate money!



Come see us at our booth for further discussions

Backup

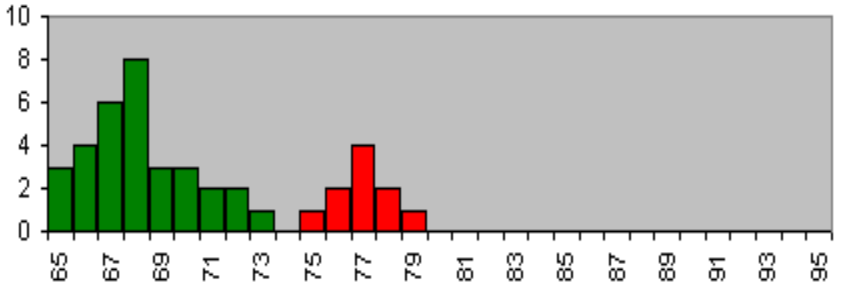
IPRES

‘Mean’ for decision-making

- A serious problem (10 days delay)has a ~25% chance of occuring.
- However, additional information indicates a possible delay of ~20 days.
- Both cases were run through a Monte Carlo simulation.
- Mode and P50 are identical in the two Monte Carlo evaluations.
- Mean increases from 70,3 to 73,4 days.
- Only the Mean takes into account that the problem is more serious than what was first assumed.

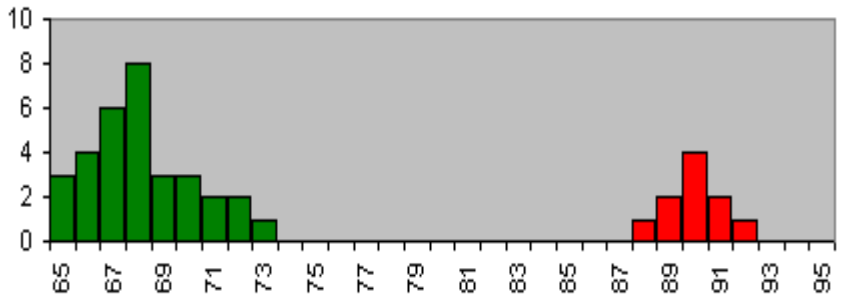
Evaluation 1

Mode: 68,0 d
P50: 68,5 d
Mean: 70,3 d



Evaluation 2

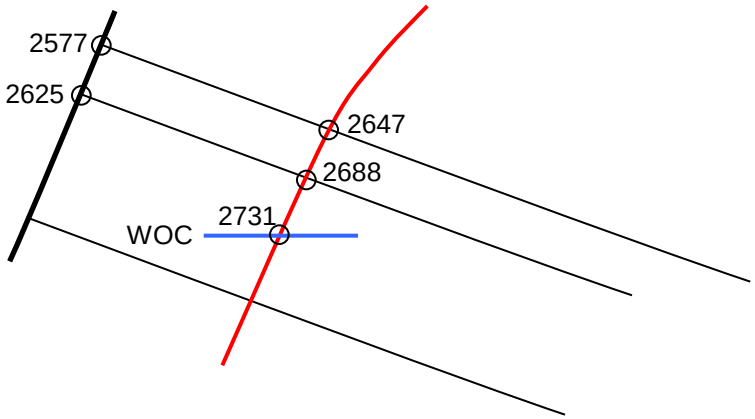
Mode: 68,0 d
P50: 68,5 d
Mean: 73,4 d



Example Contact Uncertainties

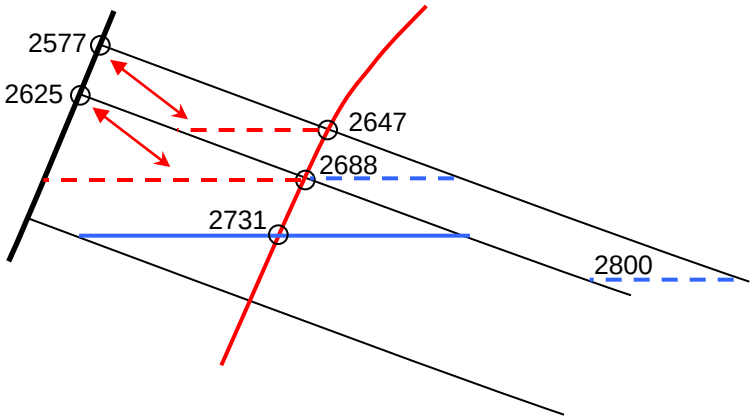
On a piece of paper:

- Sketch the most optimistic case with respect to reserves
- Sketch the most pessimistic case with respect to reserves
- Sketch a base case with respect to reserves

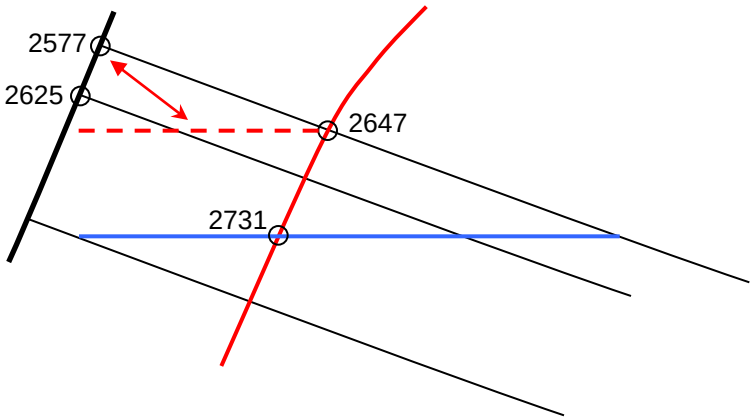


Example Contact Uncertainties - Cases

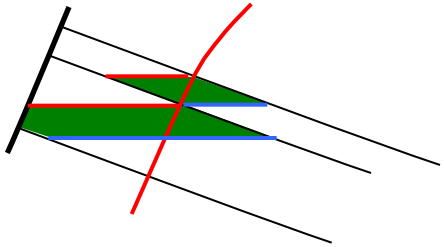
Non-communication



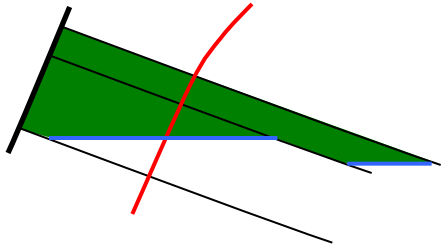
Communication



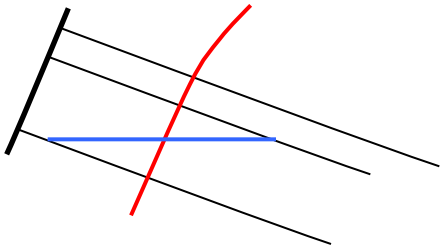
PESSIMISTIC



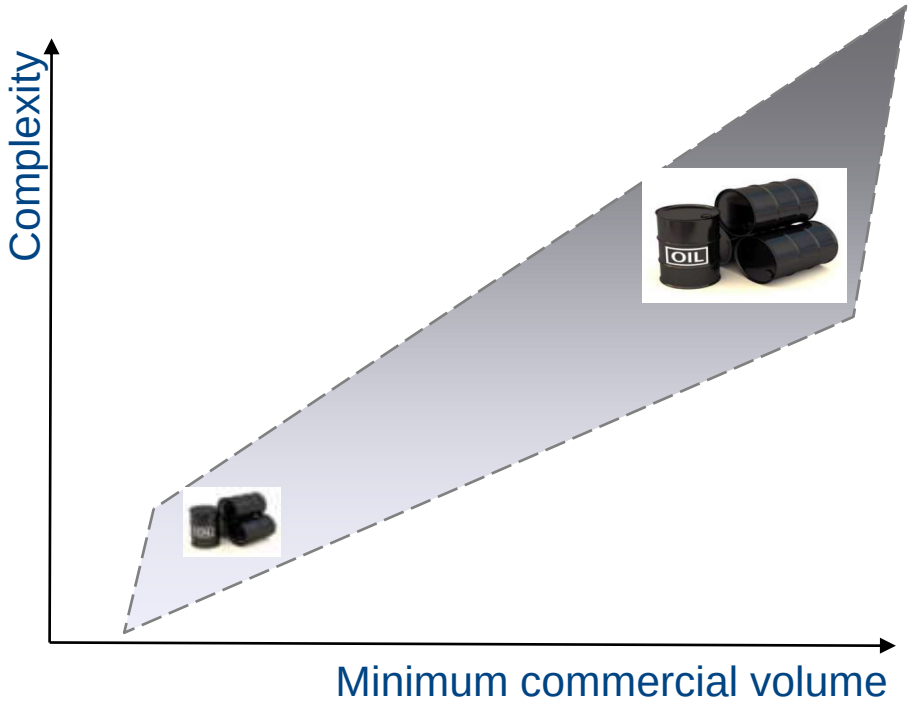
OPTIMISTIC



EXPECTED CASE???



Economic potential



Influence on commerciality

- reservoir depth
- production /well
- water depth
- technology
- logistics
- costs
- tax and other fees
- oil and gas price
- etc.