Presenting:

Making better Appraisal & Development Decisions Using Decision Risk Analysis & Value of Information

by Pete Naylor

DAAG Conference 2017

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Making better Appraisal & Development Decisions Using Decision Risk Analysis & Value of Information

Pete Naylor
Aims of this presentation

• To introduce Decision Risk Analysis (DRA)

• To provide an understanding of ‘value of information’ (VOI) analysis
  – When?
  – Why?
  – How?
Statistics

• 1,051 attendees
  – Maximum attendance 149
  – Minimum attendance 15

• 20 presentations

• 16 countries

• 1 straw poll
  – Who has heard of DRA?
  – Who has used DRA?
  – Who has undertaken VOI?
Overall responses

- Who has heard of DRA?
- Who has used DRA?
- Who has undertaken VOI?

Overall responses distribution (Percentage of attendees): 0% 20% 40% 60% 80% 100%
Who has heard of DRA?

Percentage of attendees

Who has heard of DRA?

Overall    Individual talks
Who has used DRA?

Percentage of attendees

0% 20% 40% 60% 80% 100%

Who has used DRA?

Overall

Individual talks
Who has undertaken VOI?

Percentage of attendees

<table>
<thead>
<tr>
<th>Percentage of attendees</th>
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<td>0%</td>
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Who has undertaken VOI?  

- Overall
- Individual talks

Overall: 20%
Individual talks: 80%
### Detailed responses

<table>
<thead>
<tr>
<th>Location</th>
<th>Who has heard of DRA?</th>
<th>Who has used DRA?</th>
<th>Who has undertaken VOI?</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Overall</td>
<td>33%</td>
<td>19%</td>
<td>17%</td>
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<tr>
<td>London, UK</td>
<td>95%</td>
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<td>Farmington, USA</td>
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<td>Rio de Janeiro, Brazil</td>
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<td>Lima, Peru (am)</td>
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<td>Dublin, Ireland</td>
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<td>Mexico City, Mexico</td>
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<td>Aberdeen, UK</td>
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<td>Stavanger, Norway</td>
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<td>Macae, Brazil</td>
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<td>Campania, Romania</td>
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<td>Lima, Peru (pm)</td>
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<td>Manila, Philippines</td>
<td>13%</td>
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<td>0%</td>
<td>~80% were students</td>
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<td>Hammamet, Tunisia</td>
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<td>9%</td>
<td>8%</td>
<td>Oil &amp; Gas Summit</td>
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<td>Seria, Brunei</td>
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<td>Dhaka, Bangladesh</td>
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<td>Edinburgh, UK</td>
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<td>Actuary Conference</td>
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SPE Distinguished Lectures relating to DRA

• 2015-16
  – The Value of Assessing Uncertainty (What You Don’t Know Can Hurt You); Duane McVay
  – Making better Appraisal & Development Decisions Using Decision Risk Analysis & Value of Information; Pete Naylor

• 2016-17
  – Fooled by Randomness - Improving Decision Making With Limited Data; James Gouveia
  – Creating Value From Uncertainty and Flexibility; Reidar Bratvold
Aims of this presentation

• To introduce Decision Risk Analysis (DRA)

• To provide an understanding of ‘value of information’ (VOI) analysis
  – When?
  – Why?
  – How?
What is Decision Risk Analysis?

• A structured process to help stakeholders optimise their decision making in the face of risks & uncertainties
• Involves a combination of
  – Facilitation
  – Modelling
• Term first used by Ron Howard in 1966
What is Decision Risk Analysis?

- A structured process to help stakeholders **optimise** their decision making in the face of risks & uncertainties
- Involves a combination of
  - Facilitation
  - Modelling
- Term first used by Ron Howard in 1966

**Why is DRA not used more widely?**
Barriers to using DRA

Lack of understanding
- statistics
- P10/P50/P90
- don’t trust it
- smoke & mirrors
- used it once & got a dry well

Inertia
- loose control of decision
- too complicated
- don’t need a workshop because everyone knows what I’m doing
- it’s a black box

Attitude
- making decisions is MY job
- not worth the effort
- it will never work
- too busy with the standard work to bother with this new stuff

we are alright as we are thanks
- need too many people to agree
- bad experiences in the past
How can you deliver superior performance…?

![Graph showing market capitalisation vs market cap growth factor from 2002 to 2012. The graph indicates a trend where market capitalisation (in December 2002) decreases as the market cap growth factor increases. A highlighted area on the graph indicates the "Best in class" performance.](image)

Best in class
A great answer to the wrong question is useless.

Secure consensus amongst stakeholders.

Too complex for intuition?

Eg: early production vs NPV.

Allow for risks & uncertainties correctly.

If there is only one choice then there is no decision.

Decision Quality

- Appropriate frame
- Useful information
- Achievable alternatives
- Clear values & trade-offs
- Sound reasoning
- Commitment to action

Matheson & Matheson 1998
A range of decision making approaches are available

- Voting
- Threat/benefit log
- Weighted ranking
- Absolute ranking
- Probability x impact ranking
- Cost/schedule risking
- Value of information analysis
- Fully integrated asset modelling

Increasing effort

Qualitative

Quantitative
When **might VOI analysis be valuable?**

- Facing multiple decision options
- Outcomes are uncertain
- Opportunity to acquire additional information
- Information costs money and/or time

**Is the additional information worth the cost?**
Why might VOI analysis be valuable?

- The additional information might reduce future uncertainties
- The best decision option might change in the light of the new information

If no decisions change, think carefully about acquiring the new information
Key questions

• How much does the information cost?
  – Acquisition, analysis, delay to development

• How reliable is the information?
  – Will the measurement fail?
  – False results (imperfect information)?

• How useful is the information?
  – How significant is the parameter(s)?
  – What difference will the information make?
How do I undertake a VOI analysis?

- Case example
  - Should an appraisal well be drilled in the North Extension?
  - Should the North Extension be developed?

- A new user took < two hours to learn the software & complete this analysis
Influence diagram

Lays out the components of the frame
Reserves = Presence * GIIP * Recovery Factor

Base case: Yes + Nominal + Nominal
Base case: reserves for North Extension

This should not be the basis of your business case

Base case = 78MMboe
Risk profile: reserves for North Extension

- Probability of no hydrocarbons is $(1-0.65) = 0.35$
- Expected value = 40MMboe
- Base case = 78MMboe

Illustrates the range of possible reserves
Influence diagram

**KEY**

- Decision
- Chance
- Value

- Actual hydrocarbon presence
- RF
- Actual GIIP
- Reserves
Influence diagram extended to include appraisal

Measured HCP depends on actual state of nature
Conditional probabilities: hydrocarbon presence with perfect information

Captures the reliability of the measurement
Conditional probabilities: hydrocarbon presence with imperfect information

Captures the reliability of the measurement
Conditional probabilities: hydrocarbon presence with no information

Captures the reliability of the measurement
Influence diagram

Initial decision

Measured hydrocarbon presence

Sanction development?

Actual hydrocarbon presence

RF

Actual GIIP

Measured GIIP

Actual GIIP

Reserves

Initial decision

Measured hydrocarbon presence

Sanction development?

Actual hydrocarbon presence

RF

Actual GIIP

Measured GIIP

Actual GIIP

Reserves
Influence diagram extended to include economics

Net Present Value = Reserves*(OpsNPV/boe) - capex

Which decision options give the best NPV?
Decision tree

Actual hydrocarbon presence

Yes

No

Actual GIIP

Low

Nominal

High

RF

Low

Nominal

High

NPV

NPV

NPV

Actual hydrocarbon presence

Low

Nominal

High

NPV
Decision tree extended to include appraisal

Captures the time order of events
NPV risk profile: develop now

Illustrates the range of possible NPVs

- Develop @ $300MM & find no hydrocarbons
- Expected value = $60MM
NPV risk profile: appraise, no information

Spend $40MM on appraisal but get no information

NPV decreased by $40MM
NPV risk profile:
appraise, perfect information

With perfect information only develop when net gain
NPV risk profile: appraise, imperfect information
Risk appetite: which choice would you make if appraisal cost $80MM?

What NPV would you sacrifice to avoid downside?
Two-way rainbow diagram

Green is where appraisal gives highest expected NPV
Summary: Decision Risk Analysis

- DRA can help you optimise not just satisfy
- Select an appropriate decision making approach
- Focus on delivering decision quality
Summary: Value of Information (1)

• When?
  – Facing a number of decision options
  – Outcomes are uncertain
  – Opportunity to acquire additional information
  – Information costs money or time
Summary: Value of Information (2)

• Why?
  – Additional information might reduce future uncertainties
  – Best decision option might change with new information

• How?
  – Invest two hours and get a Decision Analyst to show you how
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