



University of
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Decision-Making in Oil & Gas - The Good, Bad, and the Ugly

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What is the Basis for my Discussion?

- Have spent close to 30 years in oil & gas working as a roughneck, reservoir engineer, geostatistician, executive, and academic
- A set of formal and informal polls and questionnaires addressing oil & gas professionals (engineers, geoscientists, economists – managers and non-managers)
- Experience drawn from having provided short courses and consulting services to a large number of oil & gas companies

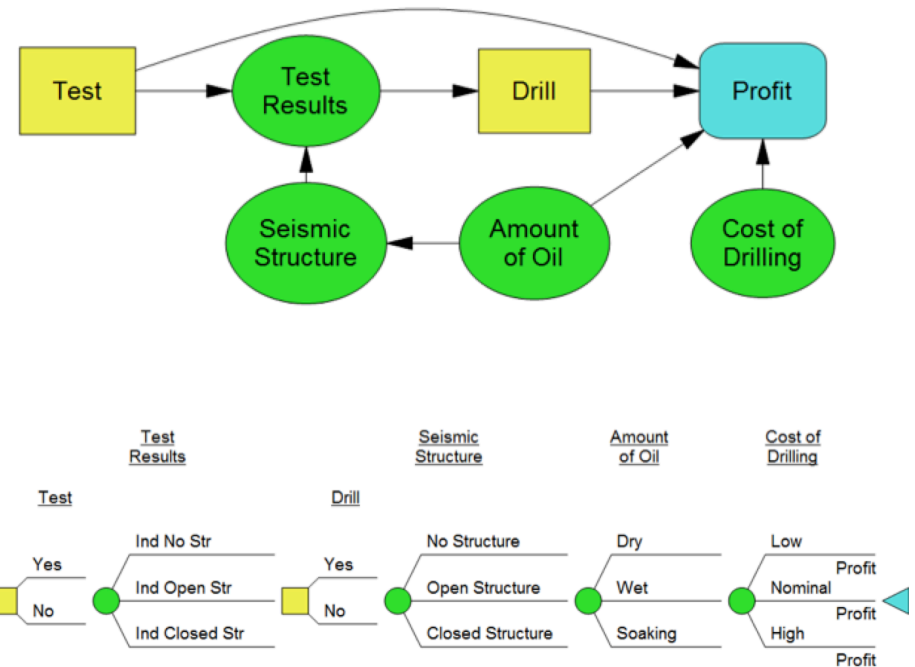
Oil & Gas is often referred to as an industry where Decision Analysis is broadly and successfully adopted

Chevron won the Decision Analysis Society Award in 2010

Chevron uses DA “because it works.”



Raiffa's Oil Wildcatter



The use of probabilistic modeling in the oil and gas industry has increased significantly over the last 20 years

- Has the decision quality in the oil & gas industry improved as a result of this?

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311

From Uncertainty Quantification to Decision Making in the Oil and Gas Industry¹

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In this paper, we present the findings of a large (N = 494) survey of oil and gas professionals that addressed the following two questions: Has uncertainty quantification improved in the oil and gas industry over the last five years? Has this improvement translated into improved decision making? Our results suggest that the answer to the first question is an unequivocal “yes,” but that the answer to the second is qualified “no.” How could this be?

Decision making ability does not appear to be increasing in tandem with uncertainty quantification

Decision Analysis in Oil & Gas

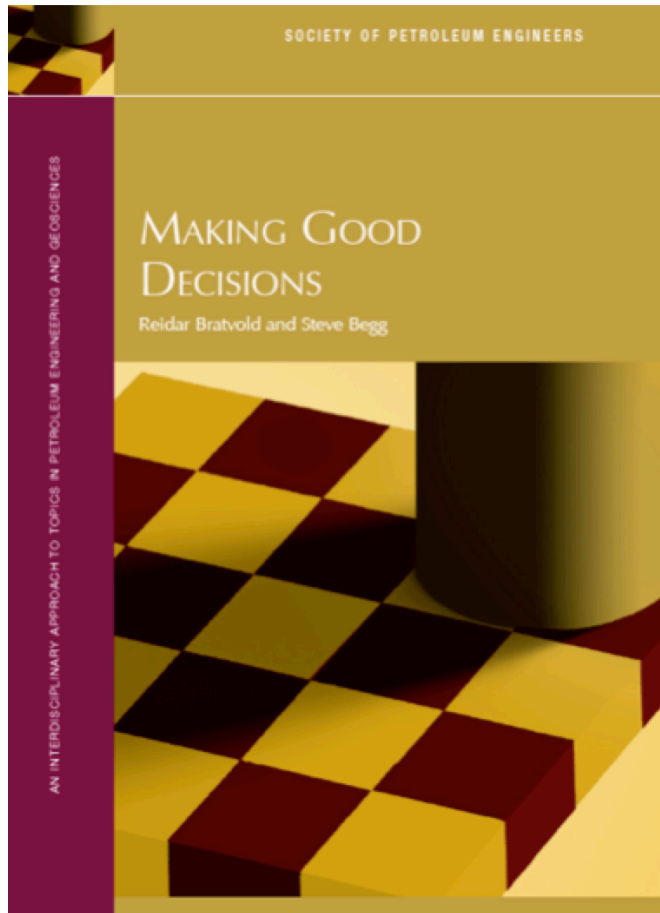
The Bad
(Ugly) Stuff



The Good
Stuff

- Relative to what?
- Need a basis for comparison
- We will use the logical steps imbedded in the discipline of Decision Analysis as our benchmark

If you need to read up on Decision Analysis ...



Making Good Decisions

Reidar B. Bratvold and Steve Begg

2010

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Society of Petroleum Engineers

***** reviews

The Bad Stuff



- Lack of decision oriented project management processes
- Lack of clarity and priority of objectives
- Poor understanding of the purpose/role of technical work
- Confusing uncertainty reduction with improved decision making
- Limited and poor understanding of behavioral biases
- Incentive systems that reward decision outcomes rather than decision quality
- Poor understanding of the relationship between risk-attitudes and decision making
- Poor understanding of the nature probabilities
- The use of overly simplistic valuation methods
- “Valuing” information outside decision contexts
- Use lots of models without investigating whether they actually work or not
- Limited interest in learning from our mistakes

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The main role of a Geoscientist or Engineer is to inform decision-making

- Technical work in the oil & gas industry is fundamentally about uncertainty assessment for the purpose of making decisions
- First priority: Accurate (=unbiased) uncertainty assessment
- Second priority: Uncertainty reduction – but **only** if it is value adding in the context of the decision(s) at hand

Many oil & gas professionals consider uncertainty assessments to be of secondary importance – something that can be added after the main (deterministic) work is done

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We often forget that the goal is to make good decisions which will lead to good outcomes – *not to reduce uncertainty*

The main enemy of good decision making is uncertainty **bias**, not the uncertainty being too large

- Bias in central value (mean):
 - usually optimism, sometimes pessimism - both destroy value!
- Bias in width of distribution:
 - assessing the range of uncertainty to be much less than it really is with respect to your true state of knowledge (overconfidence)

- An “uncertainty reduction” view often leads to unnecessary detailed and complex uncertainty models

...the real problem in decision analysis is not making analyses complicated enough to be comprehensive, but rather keeping them simple enough to be affordable and useful. Howard

The Bad Stuff



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Most O&G companies use of overly simplistic valuation methods

- For most firms, valuation begins and ends with NPV from a set of calculated cashflows
- Companies invest significant resources estimating costs, schedules, and production rates
- Many companies put significant thought into how fiscal regimes may evolve
- Oil & gas price-decks are given to project teams from the “CFO-team”
- Finally, a single risk-adjusted discount factor, usually provided by the “CFO-team,” is used to assess the value of the risky cashflows

Year	0	1	2	3	4	5
Remaining Total Reserves (MMbbls)		118				
Remaining Oil Reserves (MMbbls)		88.5	78.7	70.3	63.0	56.6
Oil Production Level		9.7	8.4	7.3	6.3	5.5
Remaining Gas Reserves (B-Btu)		171.1	161.9	154.9	149.6	145.6
Gas Production Level		9.2	7.0	5.3	4.0	3.1
Oil Price (\$/bbl)	80.0	79.49	79.09	77.33	96.26	96.89
Gas Price (\$/MMBtu)	10.0	11.45	11.59	12.26	12.35	12.16
Revenues		878.9	748.7	631.3	661.1	570.8
Variable Op Cost Rate	35.0	36.6	36.7	36.7	39.4	37.1
Fixed Production Cost		66.7	66.7	66.7	66.7	66.7
Cash Flow		775.7	645.4	528.0	555.0	467.1
Profit Sharing		-349.1	-290.4	-237.6	-249.8	-210.2
Net Cash Flows		426.6	354.9	290.4	305.3	256.9
Invest =		(840.0)				
NPV =		979.5				

Hydrocarbon prices are recognized as a significant source of uncertainty, but little energy exists for modeling them in greater detail.



Rate the following sources of uncertainty in terms of impact on investment performance. (scale 1-5)

To what degree are improvements warranted to increase the level of detailed used to quantify uncertainty. (scale 1-5)

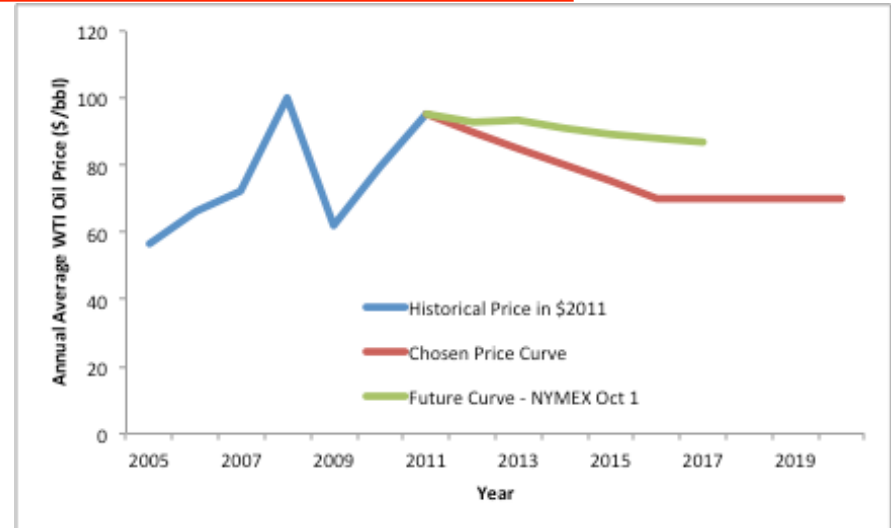
Uncertainty Source	Average Score	Important/ Significant
Subsurface	4.4	82%
H. Carbon Prices	4.3	78%
Reserves	4.1	71%
Drilling	3.9	67%
Capital	3.9	66%
Schedule	3.6	57%
Production	3.5	53%
Facilities	3.5	52%
Operating Costs	3.5	51%
Fiscal Terms	3.4	46%
Geopolitical	3.2	43%

Uncertainty Source	Average Score	More than Minor Improvements Warranted
Subsurface	3.5	47%
Reserves	3.5	45%
Schedule	3.4	41%
Drilling	3.4	41%
Capital	3.3	36%
Production	3.3	36%
Op Costs	3.2	34%
Facilities	3.2	30%
H. Carbon Prices	3.1	29%
Geopolitical	2.9	24%
Fiscal Terms	2.8	20%

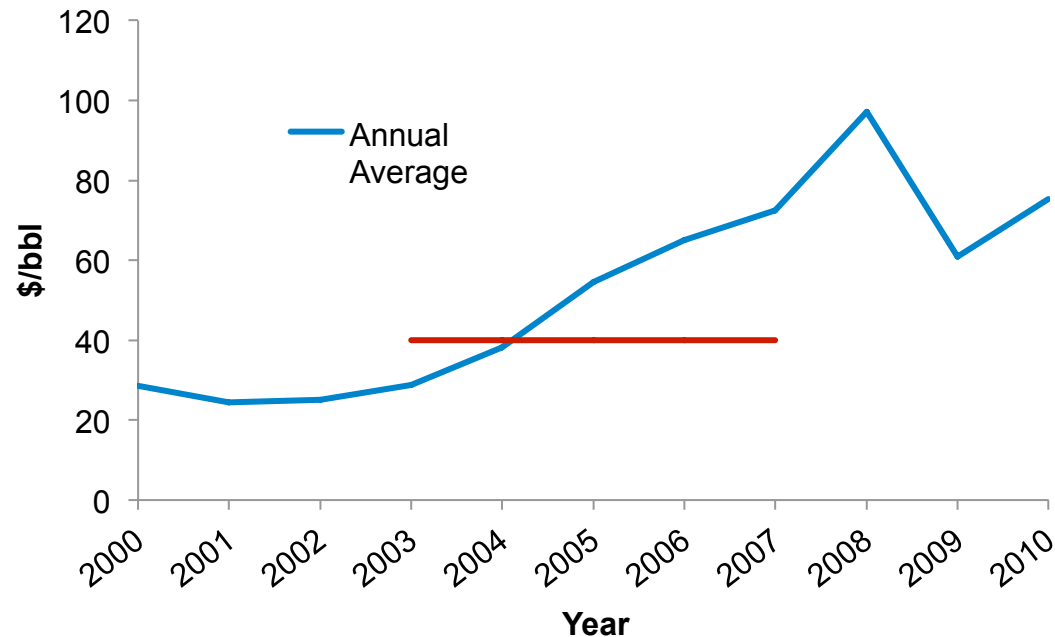
From Bickel & Bratvold, 2008

Most companies use an “expected” future price curve

- Sometimes with a transition from current spot price
- The curves are not actually expected prices nor are they market based forward curves
- The logic is that by using a conservative price, firms can be sure that the funded projects are robust
- By doing this, firms mix expected costs with risk-adjusted prices to generate a set of cashflows that are neither explicitly risked nor expected
- They then double-dip in risk by using risk-adjusted discount rates with their well known limitations
- Finally, companies often add an additional layer of risking by using a hurdle rate well above their WACC (or opportunity rate)



Using conservative price curves does not ensure robustness



Ed Merrow, Managing Partner of IPA (March 8, 2010):

“Although many companies used corporate planning prices in the \$35 - \$50 range in the 2004 – 2007 period, they struggled to make profits when the oil price fell after the 2008 peak and equilibrated in the \$60 - \$80 range in 2009 and 2010. In my mind, this is a clear indication of poor management.”

The Good Stuff

- 2010 DA Practice Award to Chevron



Decision Analysis Practice Award for 2010 was given to Chevron

Chevron uses DA “because it works.”



The Decision Analysis Practice Award is given annually to the best decision analysis application, as judged by a panel of Society members. The intent of this award is to recognize, promote, and publicize good decision analysis practice.

The Good Stuff



- 2010 DA Practice Award to Chevron
- Increasingly accepting the existence, if not quantification, of uncertainty
- Islands of advanced uncertainty modeling skills within many oil & gas companies
- Conferences, Forums, and Workshops focused on DA (sort of)
- Increasing number of oil & gas focused research papers discussing DA (sort of)

Concluding



- The oil & gas industry is *not bad* in terms of its willingness and ability to implement decision analysis but ... also *not great*
- Other industries are probably as good or better; e.g.
 - Automotive
 - Armed forces
 - Pharmaceuticals
 - Others ??