

# **The Use of Multiple Hypotheses as a Risk Mitigant Get A Second (Or Third) Opinion! Using Multiple Hypotheses\***

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## **Abstract**

Uncertainty is routinely associated with petroleum exploration ventures. Most key geotechnical parameters must be estimated (not measured) – but cognitive bias flourishes in such circumstances and needs to be recognized and addressed.

Cognitive biases often produce significant inconsistencies that can lead to suboptimal exploration decisions.

Being overconfident in our assessment of uncertainty has significant impact on the exploration decisions and prospect evaluation. The use of multiple “experts” can help to reduce the degree of overconfidence compared with only a single expert.

Of course, this is not limited to the oil and gas sector: in my personal life, I was diagnosed with Stage IV cancer in 2012. After the initial shock and “why me” reactions, I utilized decision trees to plan the identification, diagnostic, and treatment options (it also helped to reduce the emotional stress). In order to reduce the cognitive bias (and obtain a better treatment outcome) of the medical teams, I undertook diagnoses and gained recommended treatment protocols from highly respected hospitals in Singapore, Sydney, and Baltimore. All of these individual institutions, even though they had a common thread of medical knowledge (and the same data set), nevertheless were subject to biases from their different training and implementation cultures.

This paper will describe the same philosophy of using multiple diagnostic interpretative hypotheses by using by different mindsets and thought processes to reduce the uncertainty in oil and gas exploration. Unfortunately, such creative methods are usually frowned upon by Government regulators. An exemption to this is the Norwegian Petroleum Directorate (NPD), who has released a report describing an analysis that compared company assessments of discovery size and the probability of success for mapped prospects with post-drilling discovery sizes and success rates. This analysis found that the industry overestimated resources expectations and understated the probability of success

Cognitive bias - usually over-optimism – affects initial estimates of geotechnical parameters underpinning exploration projects. If left undetected, this leads to poor or disappointing project outcomes. When such cognitive bias is endemic in a company's portfolio of Exploration and Production (E & P) ventures, this portfolio underperforms, and the company's annual performance suffers. Shareholders are usually unhappy with this outcome.

Most experienced petroleum geoscientists understand Cognitive Bias - after all, they have experienced the business pressures that stimulate it, as well as the inevitable consequences of succumbing to it. They have also been exposed to many geologic "salesmen" in action, trying to sell over-hyped and carelessly researched exploration prospects.

The five most prevalent cognitive biases in E & P work are:

- Confirmation bias - Ignoring data that do not fit our theories (or the desired outcome).
- Overconfidence - Predictive ranges are too narrow, leading to many bad surprises.
- Representativeness - False analogs.
- Anchoring - Initial estimating and adjustment process is incomplete.
- Motivational bias – Where personal self-interest influences technical estimates.

Confirmation bias is the tendency that influences all of us to put more faith in information that agrees with what we already believe, and discount opinions and data that disagree with our beliefs.

Confirmation bias explains in part why it's nearly impossible to present enough factual evidence to convince a staunch Democrat or Republican that their candidate has flaws. Confirmation bias can creep into every decision we make - employee performance evaluations, major purchases, management actions, and so on – and in our business, exploration decisions.

There's a lesson here for all of us - to avoid making bad decisions about investments, political candidates, exploration prospects, and many other topics, we must do two things:

1. Be aware of the danger of confirmation bias and acknowledge that our judgment can be clouded by it.
2. Aggressively seek out and understand information that disagrees with our existing belief.

The second step may involve talking to people who do not share our opinion and listening to their reasoning rather than arguing our own point. It could be as simple as reading some of these opposing views. Regardless, it's important to evaluate the information as rationally as possible and avoid one's impulse to explain why it's wrong.

Warren Buffet identifies his own confirmation bias and actively seeks alternative views - so hopefully our industry can do the same.

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**AAPG**

**Technical Symposium Bogor,  
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**THE USE OF MULTIPLE  
HYPOTHESES AS A RISK  
MITIGANT**

***Peter Cockcroft***

**GET A SECOND (OR THIRD)  
OPINION!**

**Using multiple hypotheses**

# My background in risk

In 2004-5 I was a SPE Distinguished Lecturer on the subject of:

*"A Prescriptive View of Risk"*

**SPE 29254**

**APPLICATIONS OF RISK ANALYSIS IN PETROLEUM EXPLORATION AND PRODUCTION OPERATIONS**

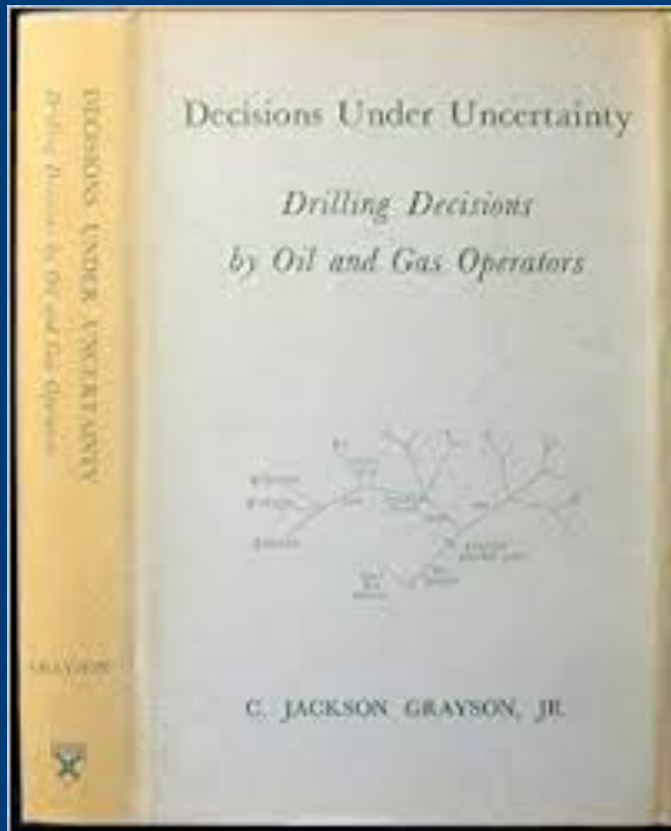
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# This is an old topic – recommended re-reading



Ed Capen: "The difficulty of assessing uncertainty"

Jim Murtha: "Decisions involving Uncertainty"

Patrick Leach: "Why Can't they just give me a number"

Daniel Tearpock: "Applied Subsurface Geological Mapping"



# Risk $\neq$ Uncertainty



Risks are those factors which could influence the achievement of business objectives. This definition includes both the 'upside' opportunity and the 'downside' hazard.

It is important to identify, assess and determine appropriate ways of responding to upside risks in pursuit of opportunity and value. It is also important to identify, assess and determine appropriate ways of responding to downside risks which could hinder performance or result in losses.

# **Multiple Diagnoses**

**In 2012, I was diagnosed with Stage IV cancer, and given 6 months to live.**

# Tools used

1. Read Stephen Jay Gould's paper – “the Median isn't the Message”.
2. Did a decision tree analysis of every step, without focusing on probabilities, but using VOII thinking
3. Had diagnoses in three different locations
  - Singapore General Hospital
  - Royal Prince Alfred Hospital, Sydney
  - Johns Hopkins Hospital, Baltimore

# LNG Companies Use Multiple FEEDS



# Exploration Risk

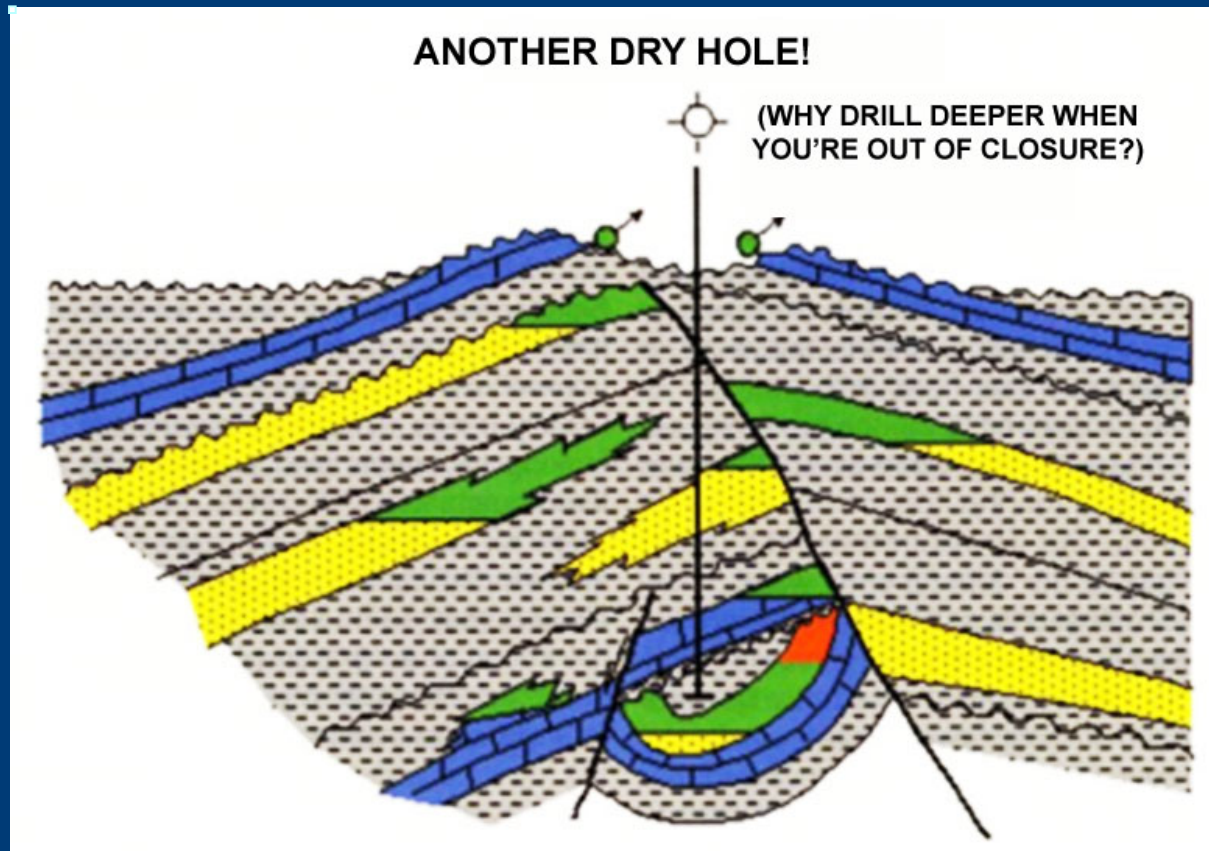
- They may be looking in the wrong place





# Geological Risk

- The Geological Interpretation may be wrong



# We are all biased.....

Using different opinions to reduce your personal and corporate bias:

- As Bob Shoup mentioned, using the independent expert method – “Delphi” technique
- Peer reviews – but make sure that they are genuine, not just a corporate governance exercise
- Multiple hypotheses use different exploration teams (with different backgrounds) to interpret the data, or use your JV partners



But regulators and finance guys think that additional people are an unnecessary expense:

**But not as expensive as a dry hole!!**

**A TEST OF YOUR BIAS**

# Carbonates

1. It is recognized that most carbonates are preferentially oil-wet
2. Wettability affects the log characteristics – for example one Berea Sandstone example with induced oil wettability produced a “n” of 4.45
3. Wettability greatly affects the fluid contacts

**So why aren't you using different evaluation methods for carbonates in Indonesia?**

# Fresh water

Tertiary formations are predominantly a fresh water environment (usually less than 10,000ppm).

We know that the Archie formula breaks down in fresh water.

So why use Archie-derived petrophysical methods?

# Hydrodynamics

Agus Ramdan talked about the hydrodynamic influence on Indonesian reservoirs earlier today.

We have documented giant fields in Indonesia that have hydrodynamic trapping in Indonesia (Peciko, Tunu, for example)

**So why don't every company use hydrodynamics as part of their exploration toolbox – maybe because it isn't in Petrel?**



"There are risks and costs  
to  
a program of action.

But they are far less than  
the  
long-range risks and costs  
of comfortable inaction".

*John F Kennedy*

**What – me worry?**



**Famous “Mad” magazine comic strip character**



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