



PPSDM Jakarta, November 1st, 2017

Company decision-making for geothermal projects

(GEOCAP course 1.07)

Topic: Psychology, bias, estimating uncertainty range

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

Contents – Wednesday 1 Nov 2017

- Bias
- Overconfidence
- E&P track record
- Post mortem analyses – learning from experience
- Exercise

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Case: Oil&Gas E&P Performance

underperformance due to bias &
unwillingness to learn from past &
accept new methods

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Our biased track record (SPE 15358, “North Sea Scorecard”, G. Castle, 1986)

- 87% of the fields studied had cost overruns.
- 87% have not produced the quantity of oil and gas through the end of 1983 as was originally expected.
- 52% are not expected to achieve the peak levels of production originally forecast.
- 83% have spent more on operating costs through the end of 1983 than was originally expected
- 26% of the fields never (over the entire life of the field) achieve (on a cumulative basis) a positive pre tax and pre interest cash flow.
- Another 17% of the fields (in addition to those above) earn less than \$100 million of cumulative pretax and pre interest cash flow.
- Only four fields out of a sample of 23 show a (before tax) rate of return which is higher than 25%.



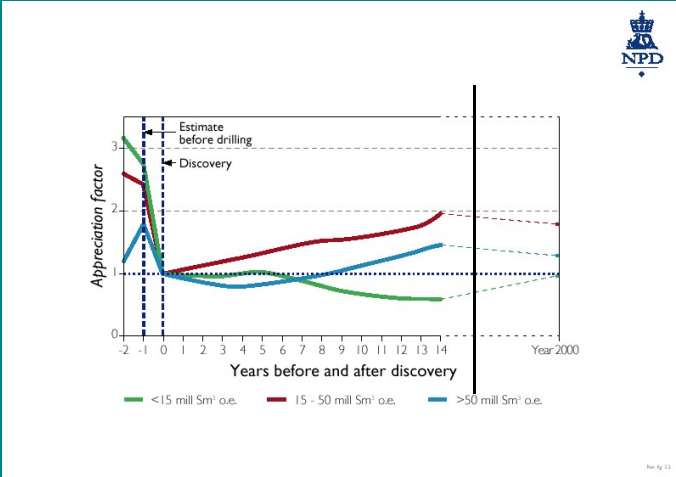
Apparently, E&P had trouble learning from past mistakes pre-1986. Did it become any better post-1986?

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The appreciation factor in relation to discovery volumes (NPD)



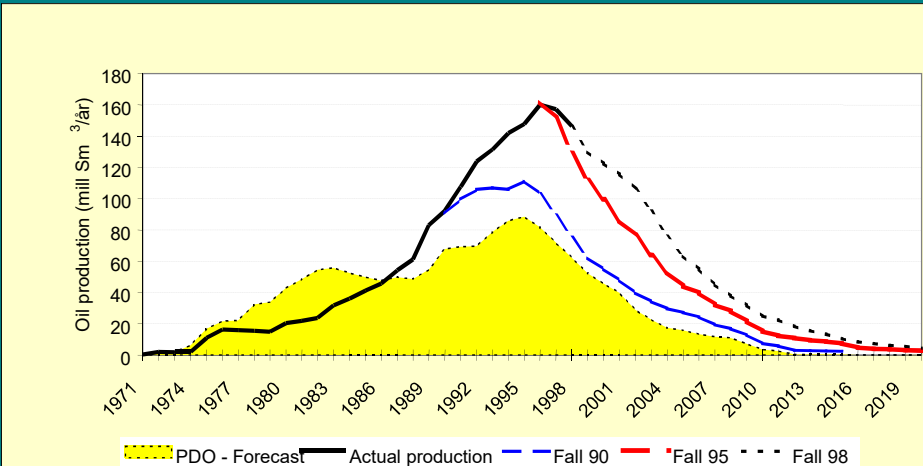
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Oil Production Forecast NCS

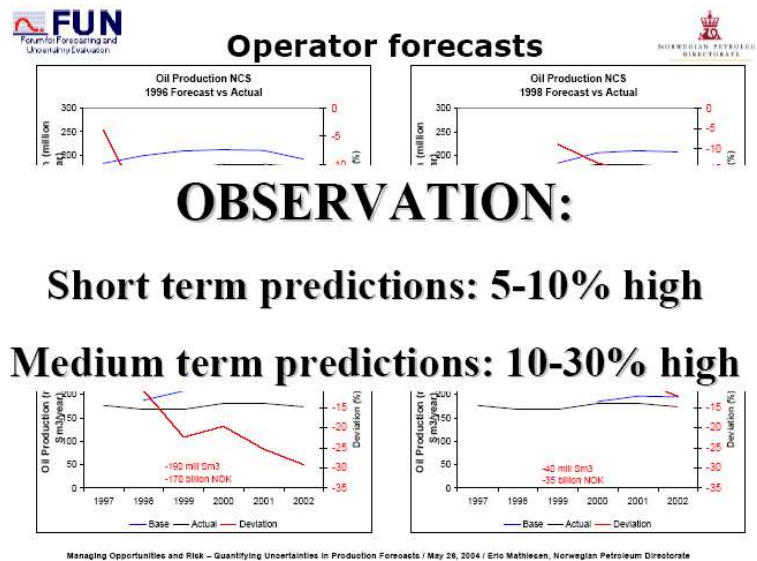
22 fields in production



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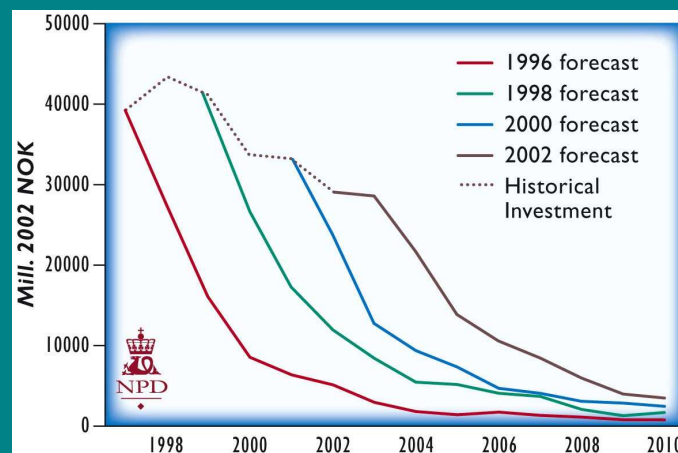


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Comparison of investment forecasts for fields approved before 1997

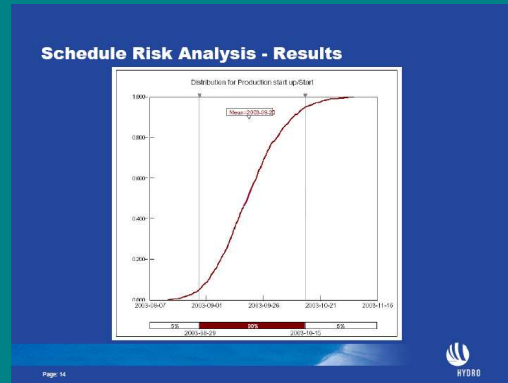


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Cost & Schedule risk



- Schedule uncertainty usually poorly managed, incl. correlation to costs!
- Opex only treated superficially: we tend to forget implications!
- Later, incremental investments not properly planned: real options, corrective actions etc. + incremental costs not formally included.

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Intuition vs. Analysis

QUICKVOTE

When making a critical business decision, I primarily use:

☐ My gut feeling and experience.

☐ A model and verifiable information.

[Submit Vote](#)

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QUICKVOTE

When making a critical business decision, I primarily use:

My gut feeling and experience. (156) 53% **12MANAGI**

A model and verifiable information. (138) 47% **12MANAC**

Total Votes: 294

Enter your comments: [GO](#)

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Some pertinent questions

- Should we rely less on our intuition?
- Could this biased track record be related to the way we do our work?
- Is common practice = best possible practice?
- Is this degree of systematic bias unavoidable and do we have to accept it as the nature of our business?
- Are we locked in a wrong paradigm / mind set?
- Do we grab existing technological opportunities to reduce bias?
- If not, what is preventing us from doing so?

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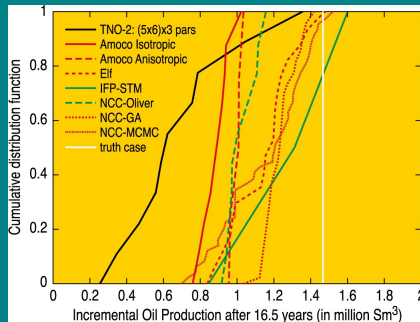
Prevailing paradigms and “mind sets”

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Dynamic earth model uncertainty, case study results



History matched cdf's for the incremental recovery of 5 infill wells

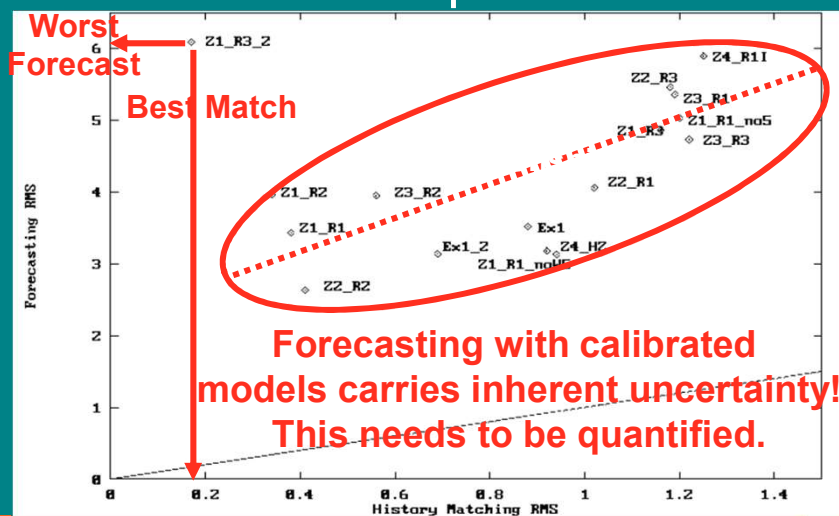
- All curves represent fully history-matched data points in a synthetic reservoir simulation study
- All curves are based on exactly the same model and the same data
- What makes them different is how the reservoir engineer (subjectively) chose his workflow !

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Calibrating reservoir models is a statistical problem



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Under-exploit available information?
Under-exploit available technology?
Over-estimate value?

Under-estimate risk?
Mis-allocate capital?

Yes...

*Is there a business case for
enhancing capital efficiency?*

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Psychology

Bias, Overconfidence,
Hurdles to Technology Acceptance

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Famous words

- That idea is so damned nonsensical and impossible that I'm willing to stand on the bridge of a battleship while that nitwit tries to hit it from the air.
- *Newton Baker, U.S. secretary of war in 1921, reacting to the claim of Billy Mitchell (later Brigadier General Mitchell) that airplanes could sink battleships by dropping bombs on them.*
- Heavier-than-air flying machines are impossible.
- *Lord Kelvin, British mathematician, physicist, and president of the British Royal Society, spoken in 1895.*
- A severe depression like that of 1920-21 is outside the range of probability.
- *Harvard Economic Society, Weekly Letter, November 16, 1929.*

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Famous words (cont'd)

- I think there is a world market for about five computers.
- *Thomas J. Watson, chairman of IBM, 1943.*
- They couldn't hit an elephant at this dist...
- *General John B. Sedgwick, Union Army Civil War officer's last words, uttered during the Battle of Spotsylvania, 1864.*
- Overconfidence, tunnel visions etc are costing us dearly.

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General examples: we're only human!


- Survey results: 82% of interviewees say they are in the top 30% of safest drivers
- 86% of MBA students say they are better looking than their class mates
- 68% of lawyers say they will prevail in court
- Most doctors over-estimate their ability to diagnose correctly
- The average investment advisor has a negative added value
- Most people think they are better than their peers

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Anchoring bias

- Kids estimating age of teacher
 - Suggestive questioning:
"How fast did the cars drive when they ...
into each other?"
 - **Smashed**
 - **Crashed**
 - **Bumped**
 - **Collided**
 - **Hit**
 - **Contacted**
- 
 Decreasing estimate of speed!
- **Again, we're only human!**

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The effect of question wording

Question	Mean Answer
Do you get headaches frequently, and if so, how often?	2.2/week
Do you get headaches occasionally, and if so, how often?	0.7/week
In terms of the total number of products, how many other products have you tried? 1? 5? 10?	5.2 products
In terms of the total number of products, how many other products have you tried? 1? 2? 3?	3.3 products
How long was the movie?	130 minutes
How short was the movie?	100 minutes
How tall was the basketball player?	79 inches
How short was the basketball player?	69 inches

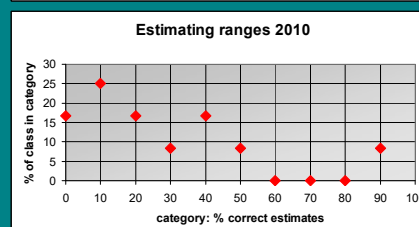
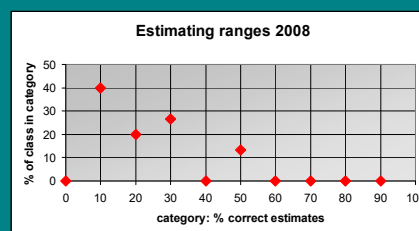
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Exercise – estimating ranges around vaguely known quantities

- For the next 10 questions, please select a lower and an upper value that will bracket the correct answer 80% of the time
 - i.e. a perfect estimator will find the correct answer lies outside his/her range twice
- Typical results: most classes are severely overconfident on average, despite begin warned before answering the questions



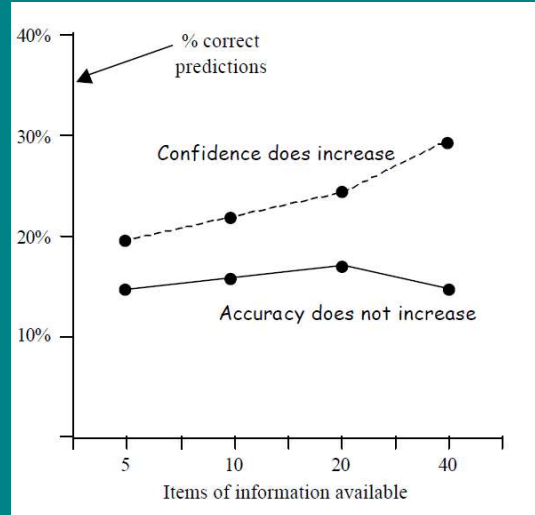
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Effect of too much information

- Will more info improve our forecasts?
- Test done on predicting horse race outcome with increasing amounts of info.
- Confidence of correct outcome increases
- Accuracy doesn't



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