EAGE

INCLUDING SPE EUROPEC

78th EAGE Conference & Exhibition

VIENNA 2016

Efficient Use of Technology - Unlocking Potential

30 May – 2 June 2016

www.eage.org/events/vienna-2016

***RISC* Advisory** : Common misconceptions in risk analysis

decisions with confidence

Common Misconceptions in Subsurface and Surface Risk Analysis

Gavin Ward RISC Advisory, London, UK

Simon Whitaker RISC Advisory, Perth, Australia

Disclaimer

The statements and opinions attributable to the presenter and RISC Operations Ltd (RISC) in this presentation are given in good faith and in the belief that such statements are neither false nor misleading.

In preparing this presentation RISC has considered and relied solely upon information in the public domain. This information has been considered in the light of RISC's knowledge and experience of the upstream oil and gas industry and, in some instances, our perspectives differ from many of our highly valued clients.

RISC has no pecuniary interest or professional fees receivable for the preparation of this presentation, or any other interest that could reasonably be regarded as affecting our ability to give an unbiased view.

Agenda

- **Describing the problem**
- **Impact of problem**
- **Small Samples**
  - Wrong Tool (EMV) & Theory of Inevitable Disappointment
- **Large samples & portfolio effect**
  - Would you invest in this company?
- **Conclusions**
- **Suggestions to improve decision making**

Decision Making

Decision Makers

Grey Area

$2 + 2 = 4$ ✓

$2 + 2 + a = x$?

$2 - 2 = 4$ ✗

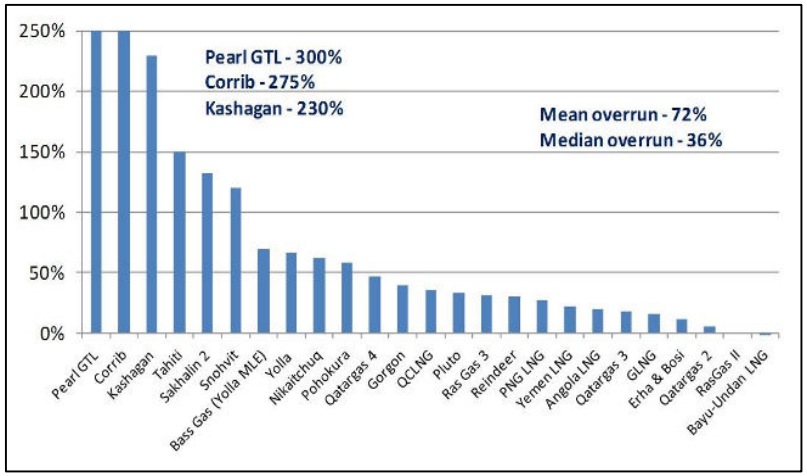
- Requires management to steer towards required outcome
- Poor estimating
- Wrong decision tools

The Problem : Poor Surface Estimating

COST

E&P Project Cost Overruns :

25 major projects since year 2000

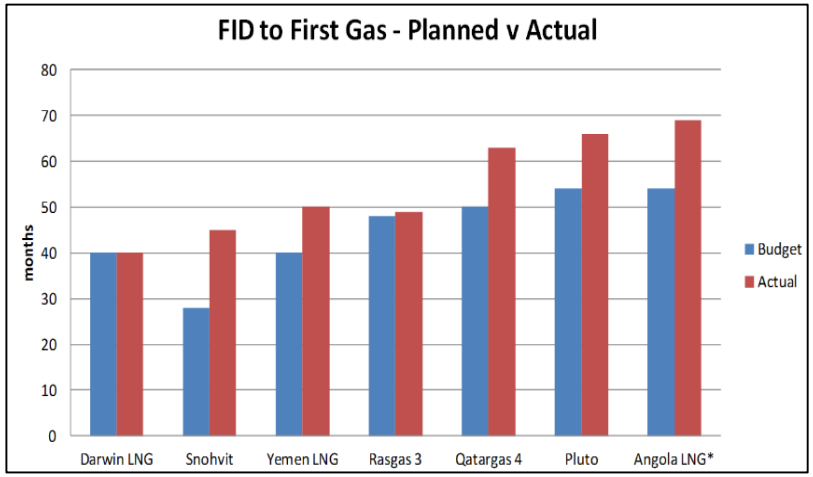


TIME

FID to RFSU Avg. Overrun : 10 months (23%)

1 project (Darwin LNG) came in on schedule

RFSU = Ready For Start Up

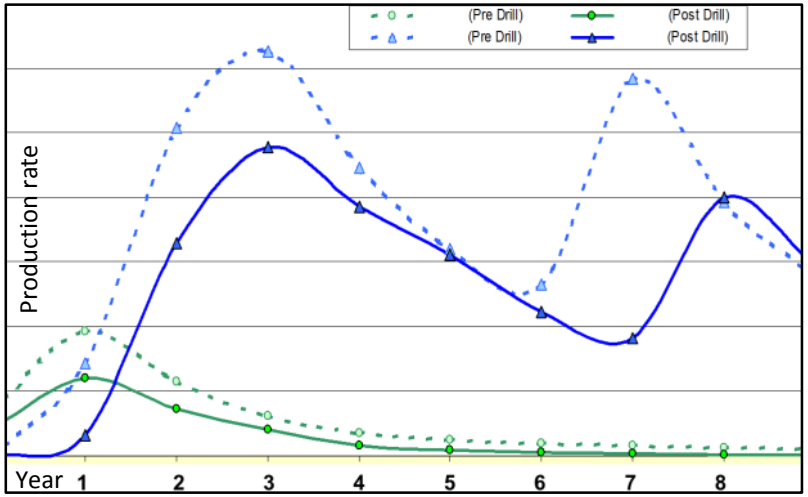


Comparison of targeted FID date to actual FID date for ten Australian LNG projects

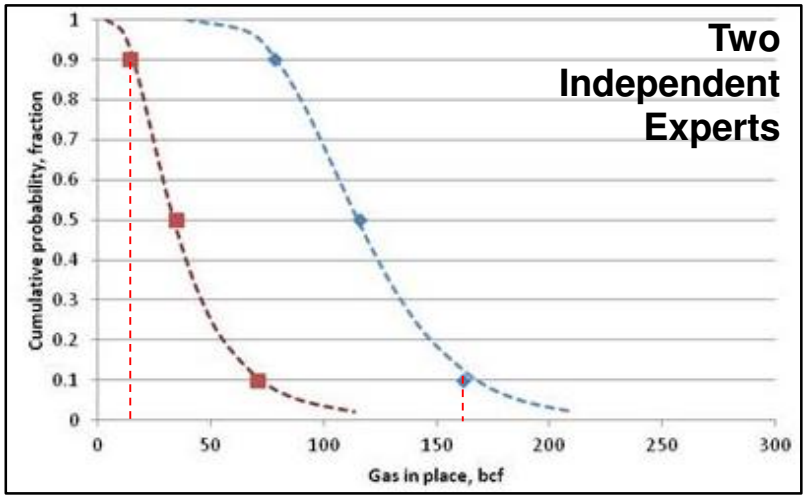
Project	Operator	Target FID	Actual FID
Pluto 1	Woodside	2007	August 2007
Gorgon 1-3	Chevron/Exxon/Shell	2004/2008	September 2009
QC LNG	BG Group	Early 2010	November 2010
GLNG	Santos/Petronas	Mid 2010	January 2011
APLNG (Train 1)	Origin/CoP	End 2010	July 2011
Wheatstone	Chevron	End 2011	September 2011
Ichthys	Inpex/Total	End 2010	January 2012
APLNG (Train 2)	Origin/CoP	End 2011 to Early 2012	July 2012
Browse		Mid 2012	TBA

The Problem : Poor Subsurface Estimating

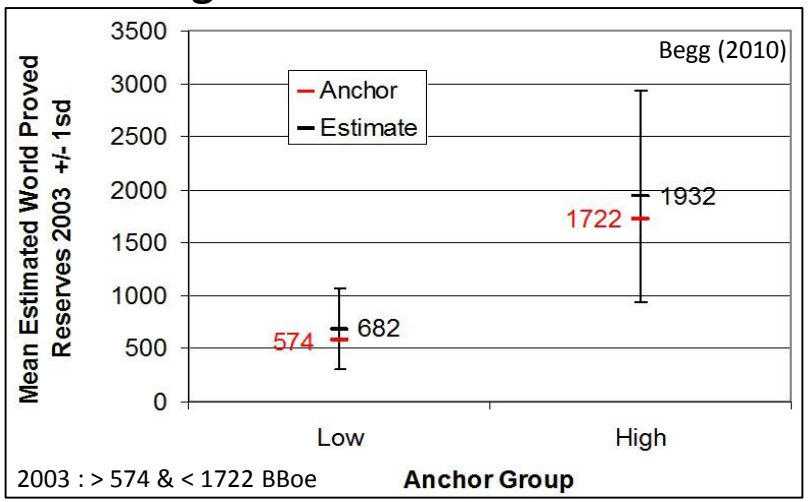
Exploration Optimism



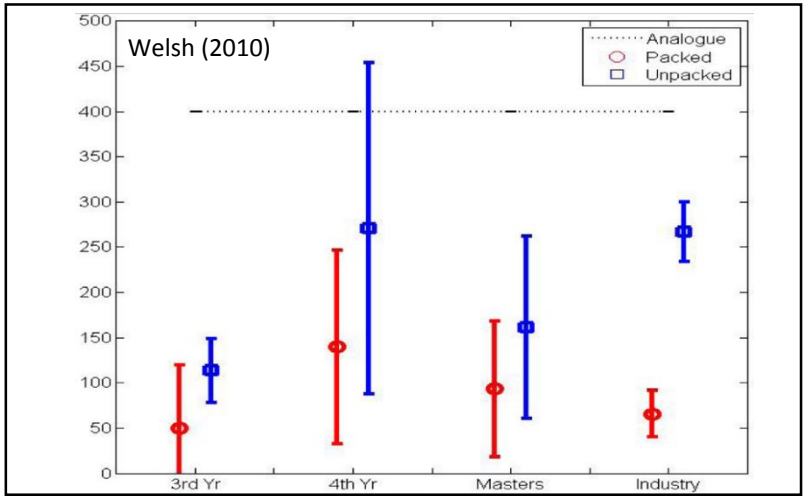
Expert Complacency



Anchoring



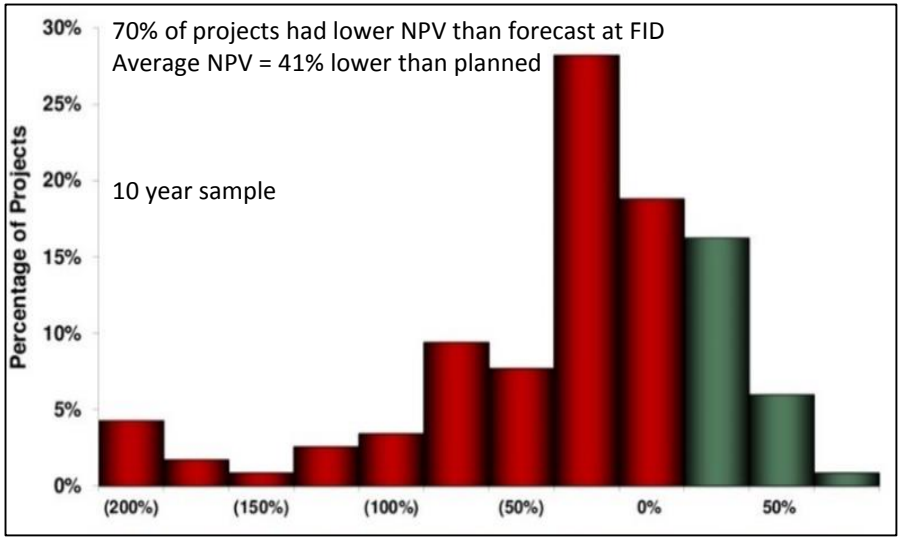
Complexity & Complacency



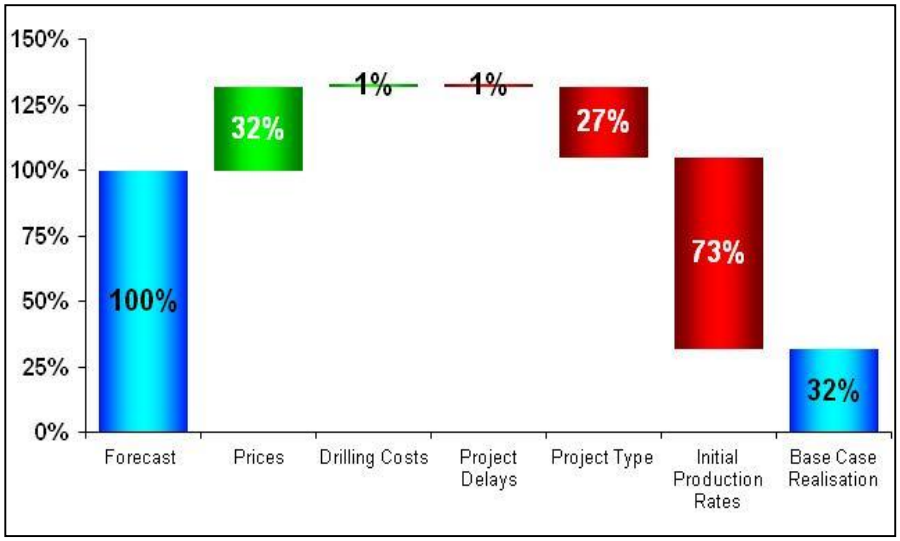
If information 'unpacked' uncertainty is recognized better

Impact of Poor Estimating

NPV gained (or lost) after two years of production relative to plan at sanction



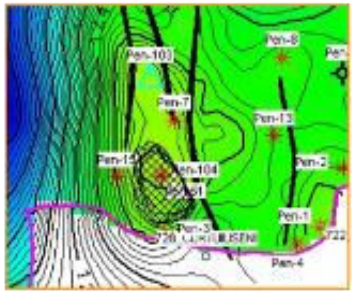
Reasons for NPV loss of 60 well programme

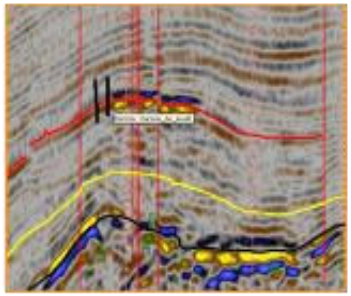


1) Poor estimate of inputs
2) Inappropriate project 'shaping' i.e. wrong development for the resource
3) Confusing accuracy with confidence as information increases
4) Believing sophistication reduces risk
5) Under-estimation of time to complete tasks
6) Scope changes: poor definition, lack of rigor in approval process
7) Ignoring dependencies and inter-dependencies
8) Poor risk management: Lack of contingency, ineffectual contractual protection

Portfolio Theory v Reality (eg: small samples)

1. Prospect Identified

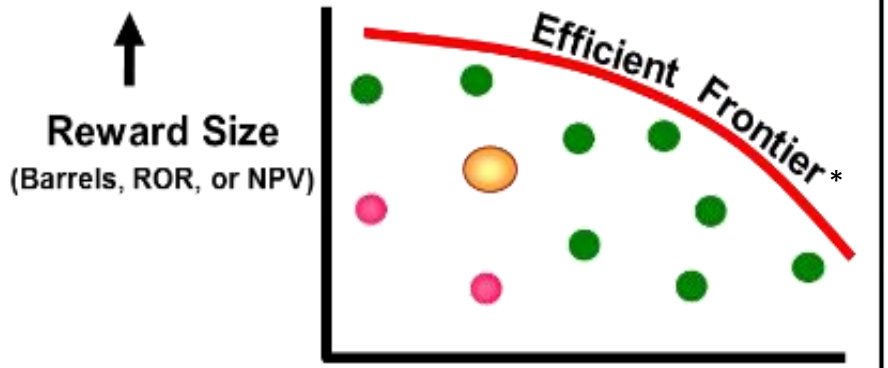




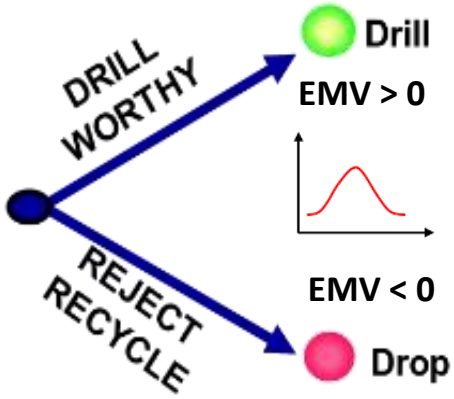
2. Probabilistic Risk and Resources Calculated with Standard Software

3. Peer Review Meeting

4. Compare to Portfolio



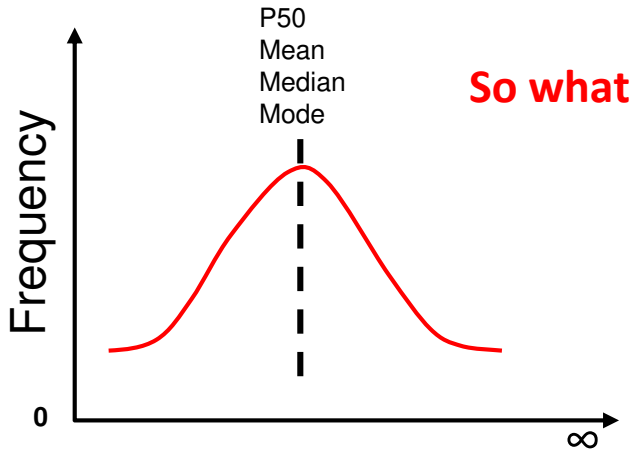
5. Prospect Technically Mature



*Markowitz (1959)

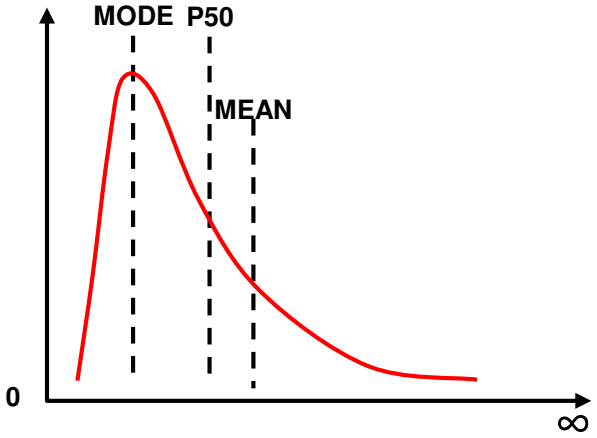
Hydrocarbon Resource Distributions are typically Log Normal

NORMAL

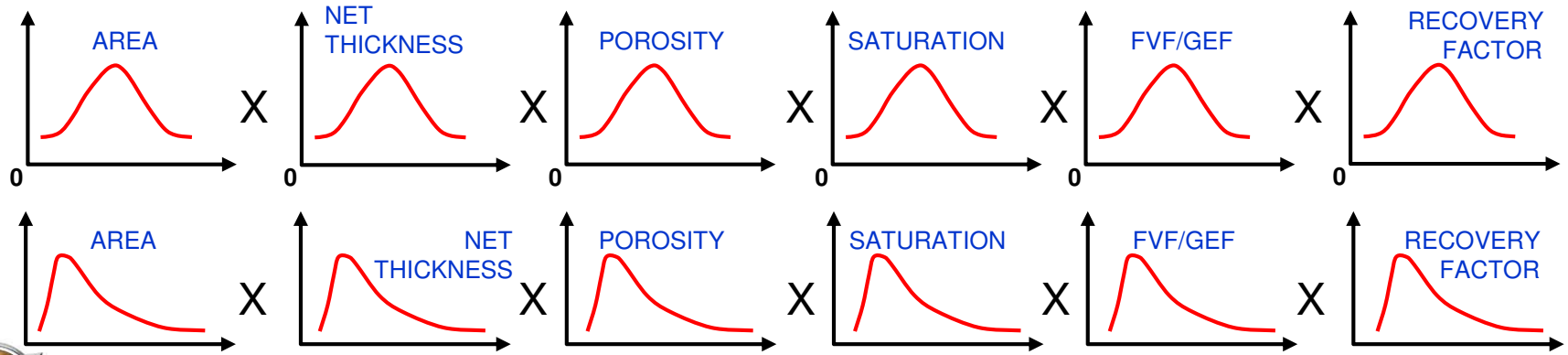


So what goes into EMV calculation?

LOG NORMAL

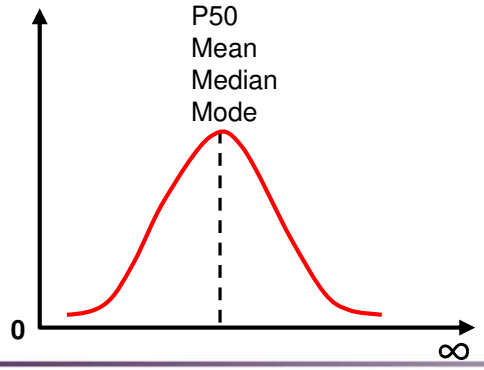


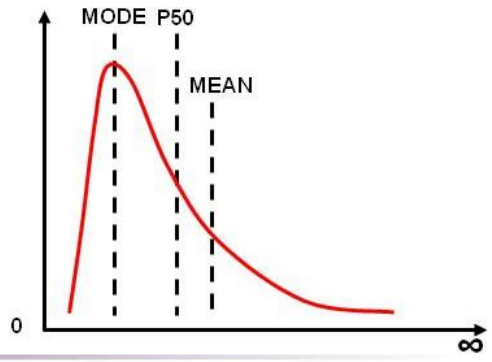
Central Limit Theorem



Expected Monetary Value (EMV)

- **EMV = (Chance of Success x NPV) – (Chance of Failure x Cost of Failure)**
- **EMV is a good tool but not understood**
- **Used as hurdle to accept/reject <u>BUT</u> used incorrectly most of time : WHY?**
- **'*Expected*' = Most Likely = Mode**
- **Mode ranges from P90 to P50 in Log Normal distributions**
- **Decisions need to understand whole distribution, not just one point**
- **Theory of Inevitable Disappointment (Horner, 1982) highlights inadequacy of using EMV and not considering whole distribution**

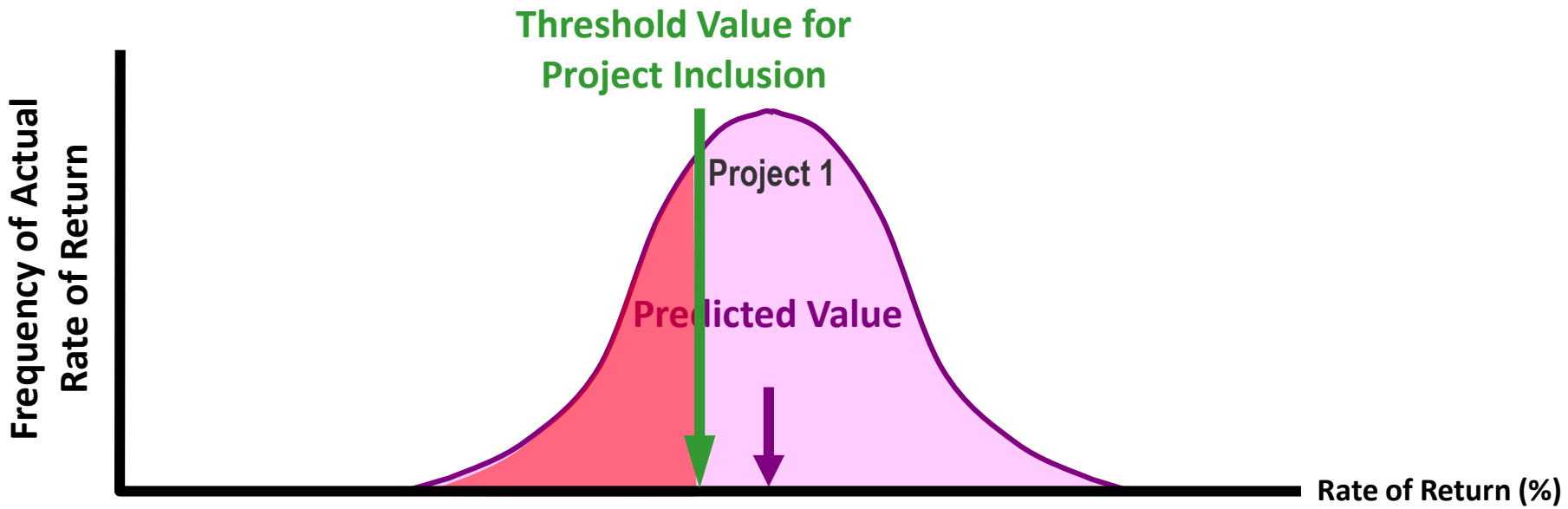




Theory of Inevitable Disappointment

Actual performance of portfolio of assets will inevitably be worse than predicted

- **Assume perfectly unbiased prediction with dispersion**
- **Projects chosen for investment in portfolio based on predicted or expected value**

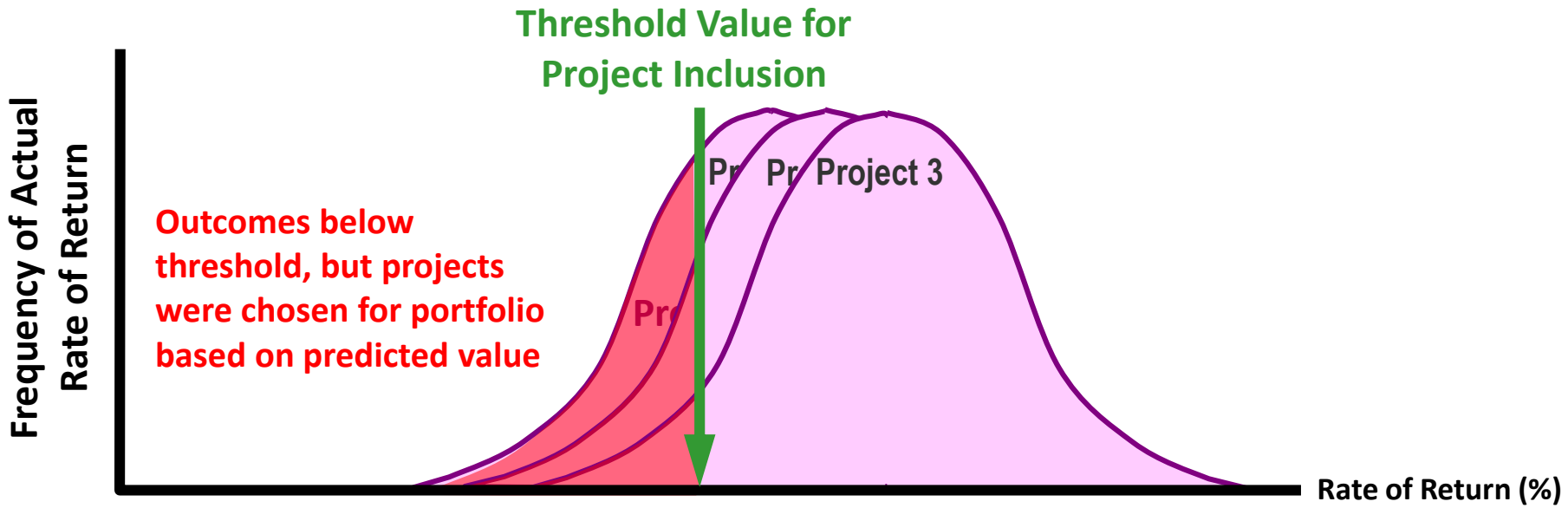


Horner (1982)

Theory of Inevitable Disappointment

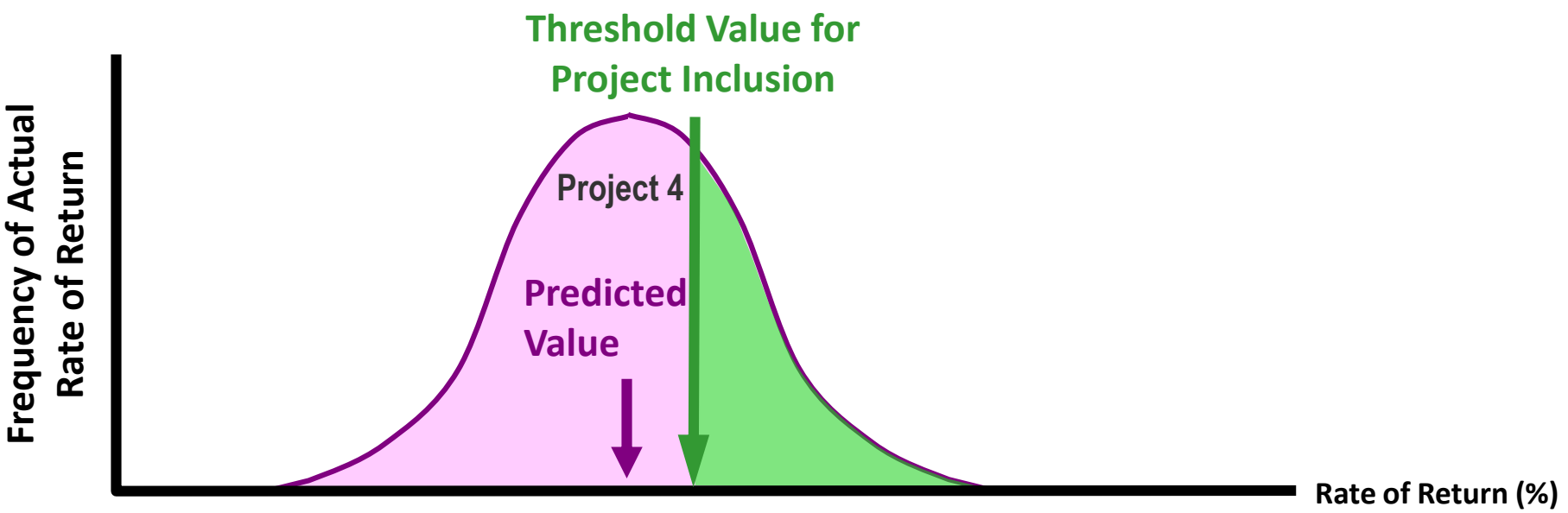
Actual performance of portfolio of assets will inevitably be worse than predicted

- **Assume perfectly unbiased prediction with dispersion**
- **Projects chosen for investment in portfolio based on predicted or expected value**



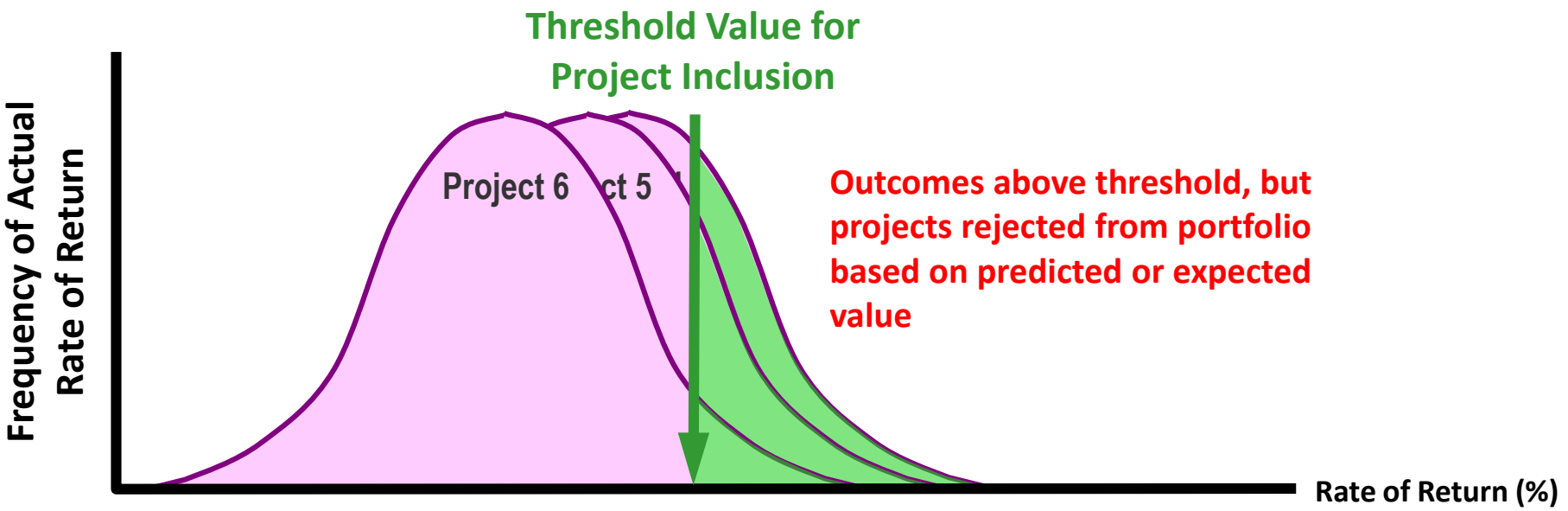
Horner (1982)

Theory of Inevitable Disappointment



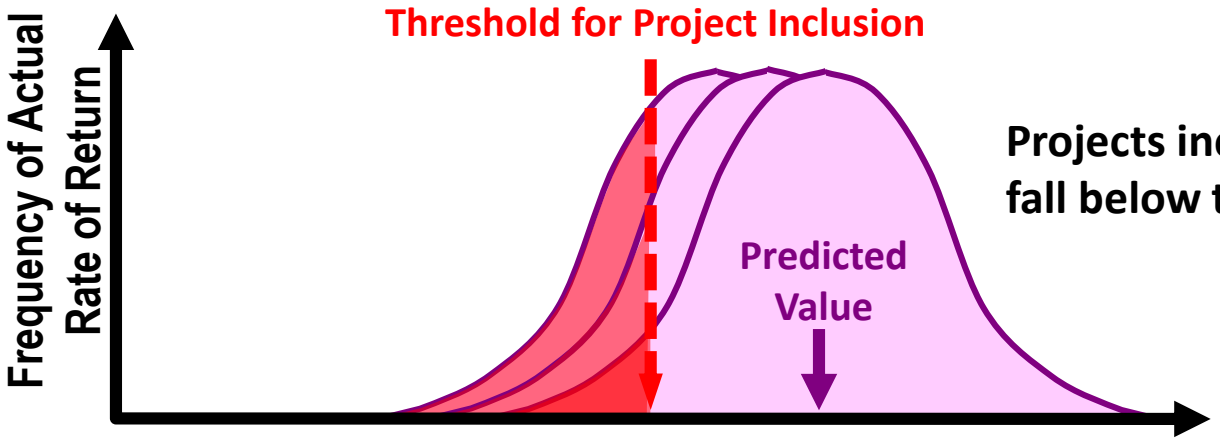
- Equally there will be portfolio outcomes above the '*company hurdle rate*'/threshold

Theory of Inevitable Disappointment

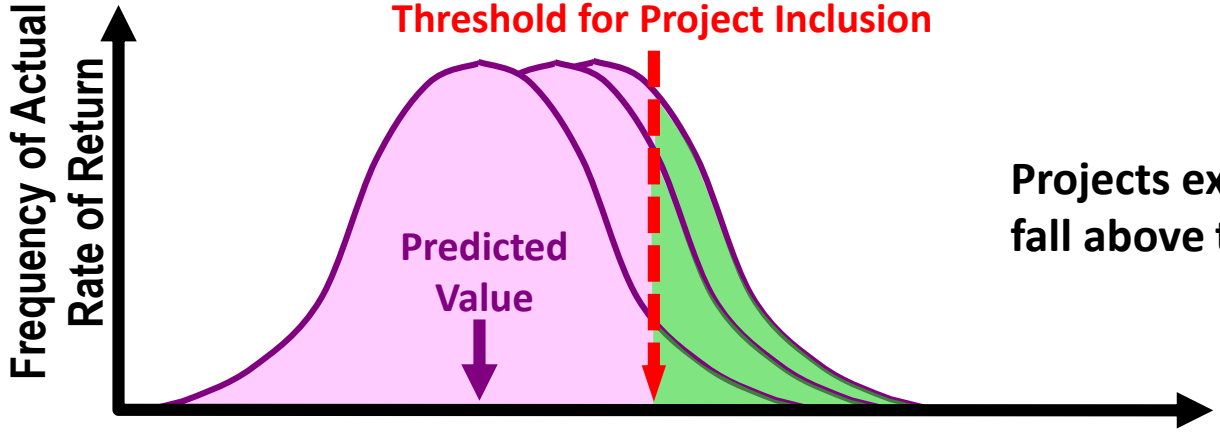


- Equally there will be portfolio outcomes above the '*company hurdle rate*'/threshold

Modelling of 255 'Normal' projects



Projects included, but can actually fall below the threshold value



Projects excluded, but can actually fall above the threshold value

Portfolio predicted Rate of Return = 27%

Actual outcome Rate of Return = 18%

Horner (1982)

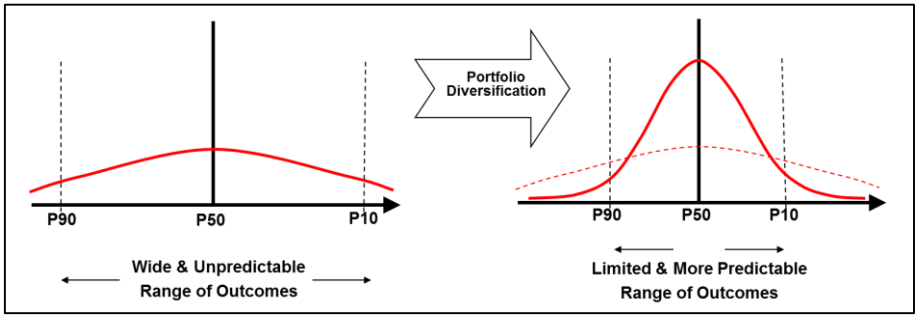
Portfolio Effect

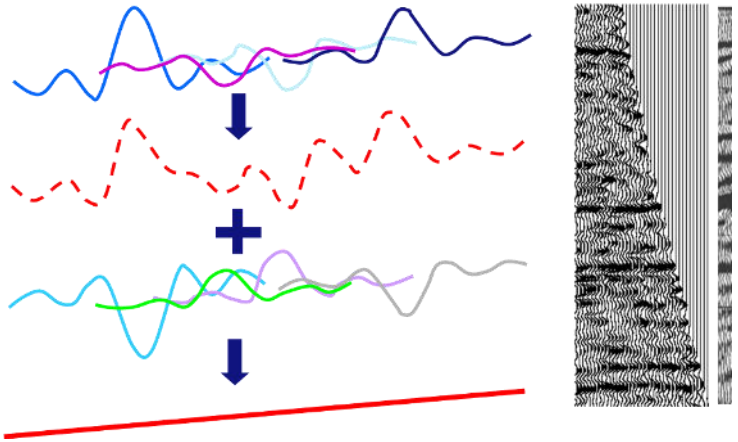
E&P projects versus stock market returns

- Normal
- Main Risk is *Volatility*

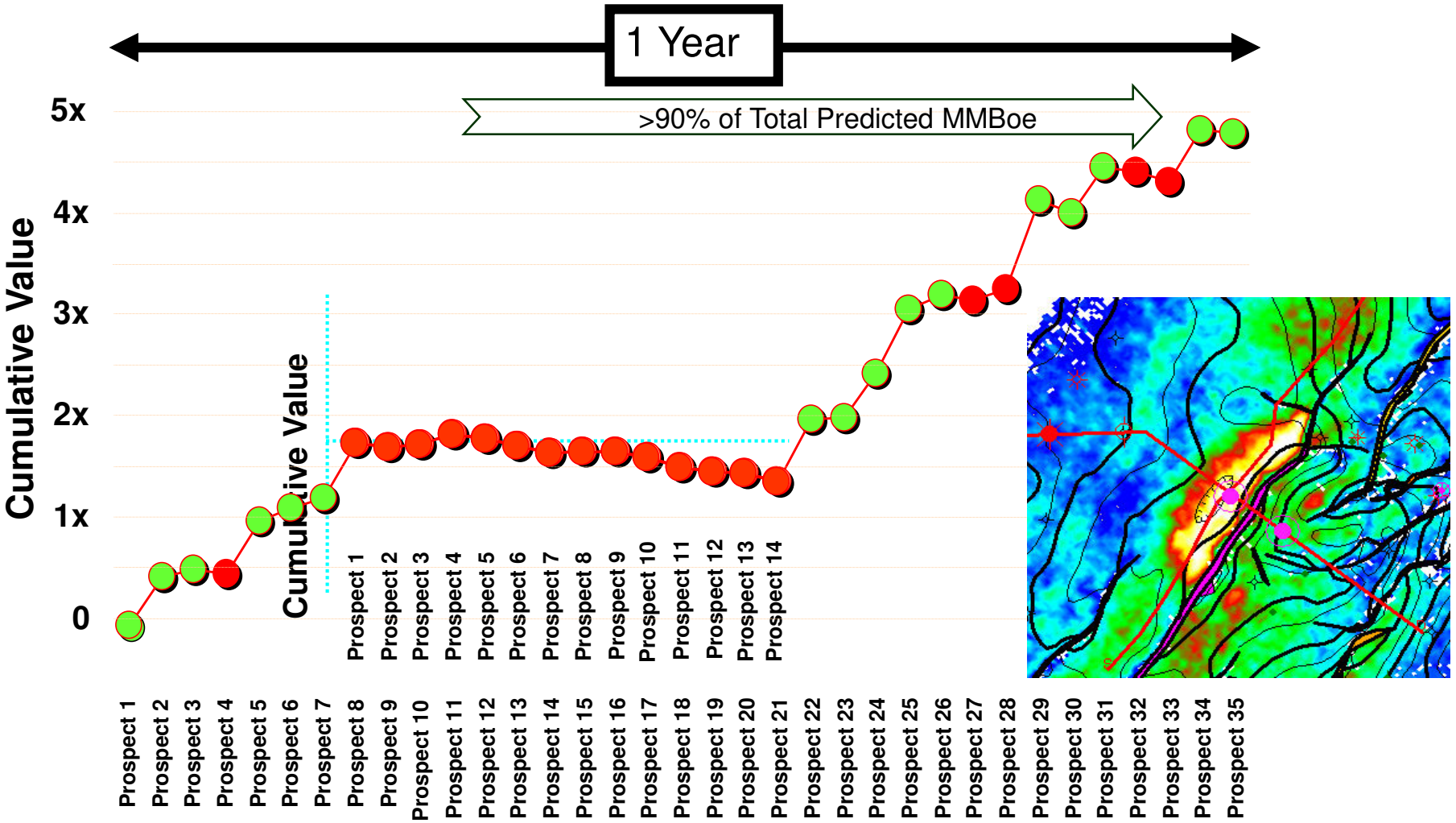
- Lognormal
- Risk of *Total Loss*

Portfolio Effect of predictability of multiple prospects/projects





Would you Invest in this Exploration Co?



Conclusions

Major components of flawed thinking relevant to project related cost/time estimates can be grouped into the following:

- **Pragmatic** : Focus on these which have biggest impact
- **Overconfidence** : People tend to think they are better than most
- **Anchoring** : Reliance on a few (not necessarily representative) data points
- **Packing** : Answer depends on how question is presented
- **Availability** : Skewed by recent or more vivid events
- **Social biases**: Human tendency to conform to views of group to which we belong
- **Planning Fallacy** : Tendency to hold a confident belief that one's own project will proceed as planned, even while knowing that the vast majority of similar projects have run late

Suggestions to improve decision making

RISC has evaluated hundreds subsurface (reserves and resources) & surface (costs and schedule) projects over twenty years.

- No one individual or company has all the answers
- Same mistakes keep being made and repeated – We learn but also forget
- Recognise “black swan” events & make allowance with contingency
- Be wary of over confidence & experts: use genuinely independent peer reviewers
- Be aware of culture of many organisations that suppresses uncertainty & reward behaviour that ignores it (e.g. an executive who shows greater confidence in a plan is more likely to get it approved than one who lays out all the risks and uncertainties)
- Awareness of the effect of heuristics and biases on our decision making abilities
- Learn from previous experience (feedback/post-mortems), **calibration is KING**

RISC

Thank you to my current & former colleagues Simon Whitaker & Henry Pettingill for their contributions

Perth
Level 3
1138 Hay Street
WEST PERTH WA 6005
P. +61 8 9420 6660
F. +61 8 9420 6690
E. admin@riscadvisory.com

Brisbane
Level 10
239 George Street
BRISBANE QLD 4064
P. +61 7 3025 3369
F. +61 7 3188 5777
E. admin@riscadvisory.com

London
4th floor Rex House
4-12 Regent Street
LONDON UK SW1Y 4RG
P. +44 203 795 0430
F. +44 203 542 0701
E. riscuk@riscadvisory.com

Dubai
Suite 503, Shangri La Offices
Sheikh Zayed Road
DUBAI UAE
P. +971 4 401 9875
F. +61 8 9420 6690
E. admin@riscadvisory.com

Jakarta
Alamanda Tower, 25th Floor
Jl. T.B. Simatupang, Kav. 23-24
JAKARTA 12430 INDONESIA
P. +62 21 2965 7823
F. +62 21 2965 7824
E. admin@riscadvisory.com

www.riscadvisory.com

decisions with confidence