MITIGATION OF MAJOR CAPITAL INVESTMENT COST & SCHEDULE OVERRUNS

DECISIONS WITH CONFIDENCE

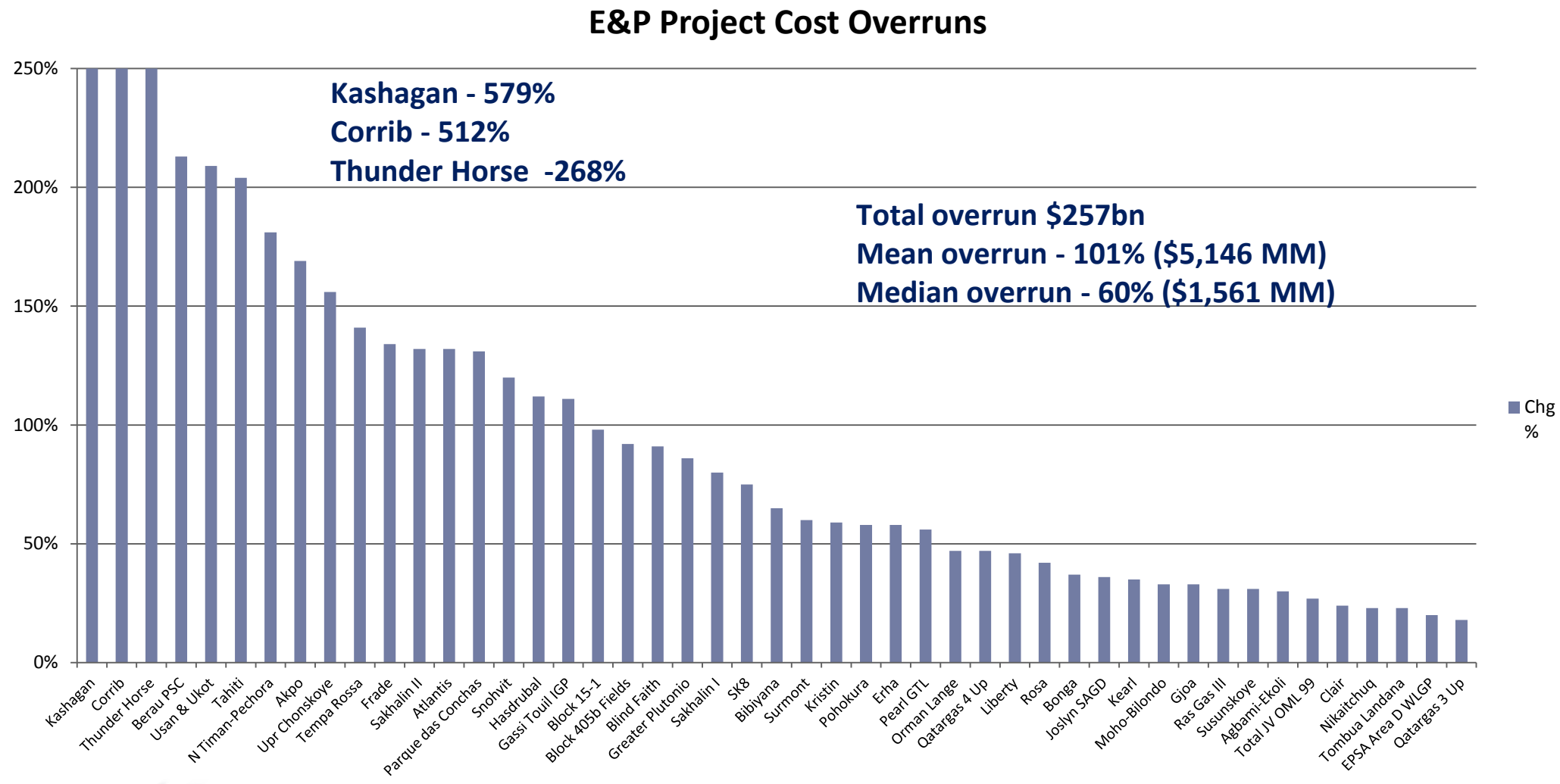
RISC

OVERVIEW OF CAPITAL INVESTMENT DECISIONS

Fact:

- The vast majority of recent E&P capital projects over-run FID budgets and are delivered late.
  - Analysis of 50 projects compiled from Wood Mackenzie data spanning the last 10-15 years indicates significant cost overruns

50 PROJECTS; AVERAGE COST OVERRUN 101% ;



OVERVIEW OF CAPITAL INVESTMENT DECISIONS

Fact:

- The vast majority of recent E&P capital projects over-run FID budgets and are delivered late.
  - Analysis of over 50 projects compiled from Wood Mackenzie data spanning the last 10-15 years indicates significant cost overruns

Proposition:

- E&P company Boards are not justified in having a high level of confidence in the costs and schedule for capital investment proposals when taking investment decisions
- Considerable shareholder value is being lost through inadequate recognition and management of project risks and uncertainties

An opportunity exists for companies proposing major capital investments to improve the understanding of and uncertainty associated with cost and schedule estimates and reduce risk/increase value of projects.

AND GOVERNMENTS ARE ALSO CONCERNED

Norwegian Petroleum & Energy Ministry catalogue of project cost blowouts for 2013 draft Budget.

- Talisman Energy's YME scheme; budget increase of 188%,
- BP's Skarv project; estimated overrun of Nkr11.5 billion ($2 billion) – > 32%
- BP's Greater Valhall project; 86% increase from the original budget to Nkr46. Field facilities alone have soared from Nkr15.5 billion to Nkr23.5 billion, 55%
- Eni's Goliat field; 20% increase in cost to Nkr37.1 billion, cf budget Nkr30.9 billion
- Statoil Aasgard gas compression; Nkr2 billion increase on the Nkr15.7 billion budget
- Det norske oljeselskap, Jette; up Nkr319 million increase dget to Nkr2.9 billion.
- BG,Knarr project; increase of Nkr90 million to a budget of Nkr11.5 billion.
- Lundin Petroleum, Brynhild project; up Nkr351 million

QUALITY OF CORPORATE DECISION MAKING

A survey of survey of 2207 executives involved in 1048 strategic decisions produced the following findings#:

- Good quality strategic decisions – 28% of respondents
- Bad decisions as frequent as good ones - 60% of respondents
- Good decisions altogether infrequent - 12% of respondents

Dan Lovallo, Professor at University of Sydney and a senior research fellow at the Institute of Business Innovation at UCA and his co-author Olivier Sibony published in No 2 2010 edition of the Mckinsey quarterly,

WHY ARE COST ESTIMATES SO OFTEN WRONG?

Final costs may be higher than budget due to a number of factors that are known to be outside of, or not completely under the control of the project, e.g:

- Equipment costs
- Material costs
- Labour costs
- Transportation costs

However as it is standard practice to base FID budgets on vendor quotations, and draft, but fully documented contracts these items are not usually subject to significant variations.

At FID typically around 30-50% of costs will be “fixed/lump-sum” – only subject to specification/variation changes which can be very expensive!

The balance of the budget estimate is therefore responsible for most of the overruns identified.

WHY CAN COST ESTIMATES BE WRONG?

It is the following factors which have much greater impact:

- Confusing accuracy with confidence as information increases
- Believing sophistication reduces risk
- Under-estimation of time to complete tasks, eg drilling a well, laying a pipeline, commissioning a plant. (Schedule delays can cause large cost increases due to the high cost of specialist installation and commissioning personnel and equipment.)
- Scope changes due to; poor system definition, lack of rigour in gated process, poor "project/operations" communication, preferential engineering
- Ignoring dependencies and inter-dependencies
- Poor risk management; lack of contingency plans, ineffectual contractual protection
- Inadequate project management; interface management ineffective, poor communications, low resource utilisation, etc

A common denominator in all these factors is that ***cognitive biases*** lead to over optimism and disregard of risk.

COGNITIVE BIAS

Cognitive bias is a function of many distortions in the human mind that:

- are difficult to eliminate
- lead to perceptual distortion
- can result in inaccurate judgment or illogical interpretation

RECOGNISED COGNITIVE BIASES

There are over 100 recognised and defined Cognitive Biases; commonly classified in 4 groups:

- Decision Making Biases
  - These directly affect decision making quality, and include:
    - Illusion of control; wishful thinking; omission; planning fallacy
- Probability/Belief Biases
  - These distort the underlying information base of decisions, and include:
    - (positive) outcome bias; overconfidence; Optimism; Anchoring
- Social Biases
  - These distort the decisions by adjusting results to be “socially acceptable”, and include:
    - In/out group bias; (false) consensus; superiority bias
- Memory Bias
  - These influence decision making through previous experiences (good or bad), and include:
    - Hindsight bias; false memory; suggestibility; self-serving bias

RISC VIEW OF PRIMARY BIASES AFFECTING E&P PROJECTS

- **Overconfidence effect** – “We are 90% certain that it will cost...”;
  - studies show peoples confidence consistently exceeds accuracy or people are more sure that they are correct than they deserve to be
- **Anchoring** – “But it used to cost less than that...”;
  - occurs when individuals overly rely on a specific piece of information to govern their thought-process, often the first information learned about a subject can affect future decision making and information analysis
- **Optimism bias** – “that won’t happen to us!”;
  - causes a person to believe that they are less at risk of experiencing a negative event compared to others,

RISC VIEW OF PRIMARY BIASES AFFECTING E&P PROJECTS

- **Hindsight bias** – "We know what they did wrong...";
  - the inclination to see events that have already occurred as being more predictable than they were before they took place
- **Planning Fallacy** – "I can do that in no time!";
  - a tendency for people and organizations to underestimate how long they will need to complete a task, even when they have experience of similar tasks over-running.
- **Superiority Bias** – "we can do it better than anyone else"
  - causes people to overestimate their positive qualities and abilities and to underestimate their negative qualities, relative to others

HISTORICAL RECOGNITION OF THIS....1976

"…Is there some deep psychological phenomenon that prevents our doing better? Because we are paid to know do we find it difficult to admit that we don't know? Or can we find salvation through knowledge? As we are trained to handle certainty can we also find a better way to estimate our uncertainty?"

The Difficulty of Assessing Uncertainty; Ed Capen; SPE Paper August 1976;

MORE RECENTLY...2010

"…Recent studies of engineers and geoscientists working in the oil and gas industry show that they are still grossly overconfident…"

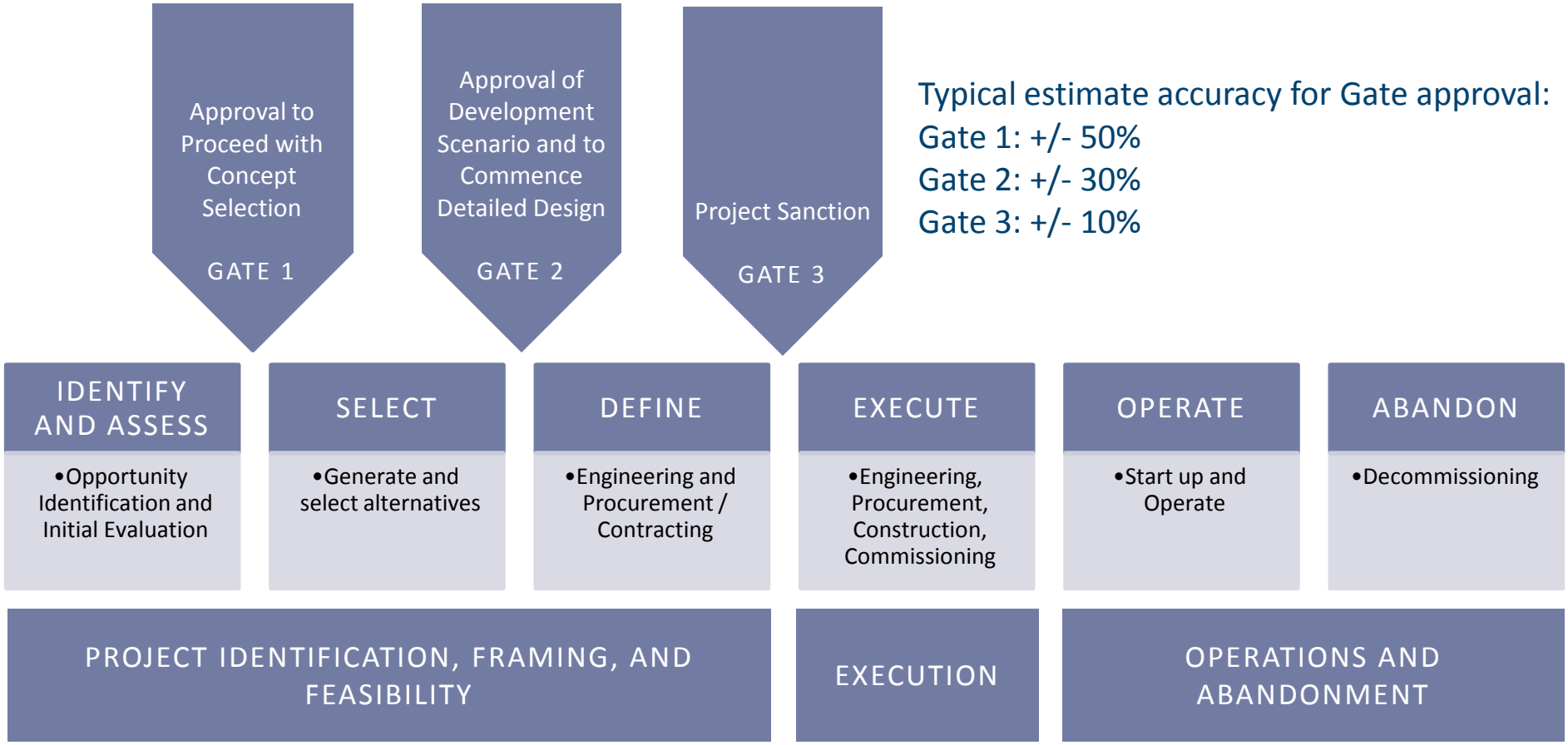
Steve Begg; April 2010 SPE Journal of Economics and Management

WHY CAN COST ESTIMATES BE WRONG?

However there is one other fundamental factor:

- Most companies require obligatory compliance with the gated process; i.e. typically +/-10% estimating accuracy at FID

GATED PROCESS



Typical estimate accuracy for Gate approval:
Gate 1: +/- 50%
Gate 2: +/- 30%
Gate 3: +/- 10%

WHY CAN COST ESTIMATES BE WRONG?

However there is one other fundamental factor:

- Most companies require obligatory compliance with the gated process; i.e. typically +/-10% estimating accuracy at FID.
- But for many greenfield projects in new areas, employing different technology, developing reservoirs without analogues or volatile labour markets a +/-10% confidence level in final costs and schedule is unrealistic.

The criteria generates wrong behaviours!!

The way the Gated Process is used by some companies is fundamentally and critically flawed

WHAT IS THE SOLUTION?

Provide a ***process*** which forces greater thought and recognition of the risks and uncertainties which characterise activities that have a large impact on costs

•Explicit recognition of the impact of potential risks improves decision-making affecting the control of those risks

•Upfront recognition of critical issues and proactive management of those issues

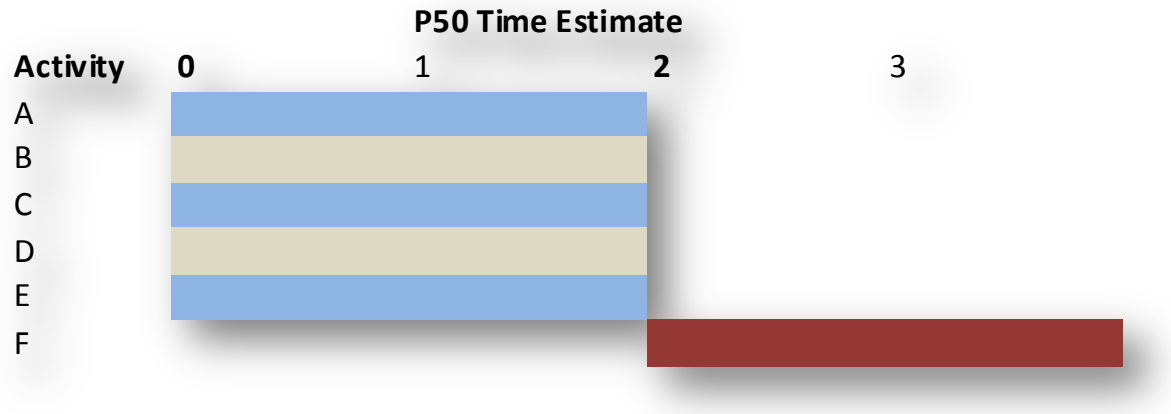
Probabilistic planning, for example and when used properly, can be one way of doing this

In scheduling for example better planning results in shorter project lead schedules:

1. Fewer surprises and better preparation, quicker response to the “unplanned”.
2. Ability to move (many) potential risk events off the critical path
3. Tasks are stripped of the “arm wraps” associated with some activities and over-optimism of others.
4. Contingency aggregation allows it to be managed at the project level item, rather than dispersed to every resource in your project

Overall financial viability of the project becomes more robust.

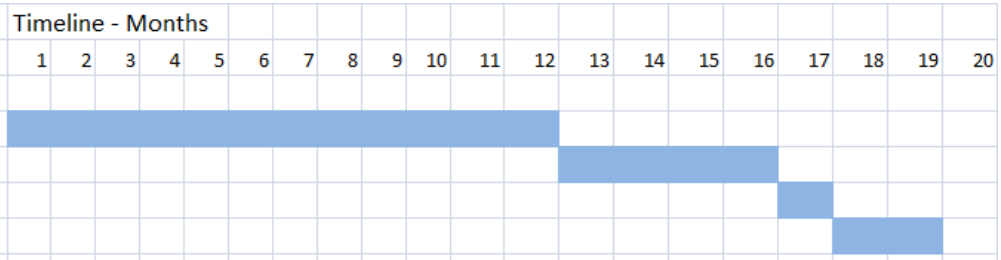
PROBABILISTIC SCHEDULING 1.01



All activities are planned to finish at the same time however due to number of concurrent activities the probability of Activity F commencing at Time 2 is 3%!

DETERMINISTIC APPROACH

No	Activity	Time months P90	P50	P10		Dependencies
1	Construct/Install jacket	10	12	18		Start Day 0
2	Install topsides	3	4	6		1
3	HU flowline	0.5	1	1.5		2
4	Comission facilities	1.5	2	3		3
			Total project time		**19.0**	**months**

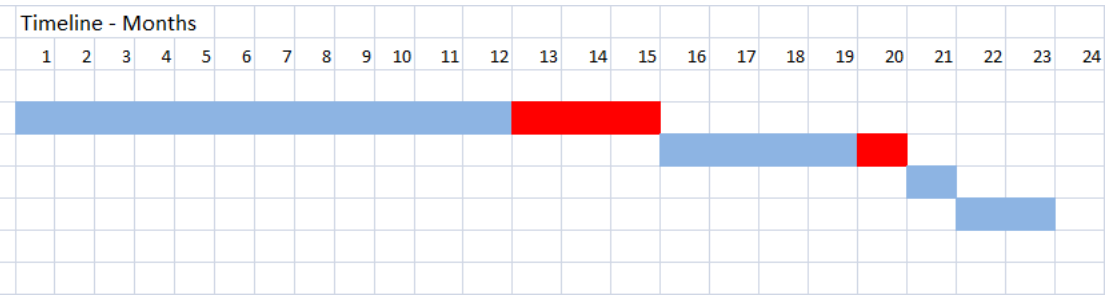


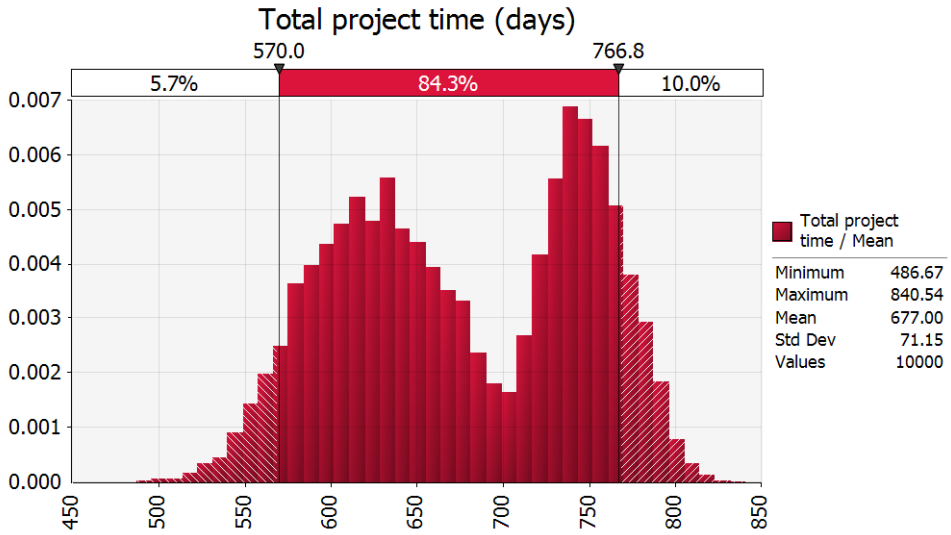
Use P50 time estimates to get assumed project duration

Expected time to complete 19 months (570 days)

THE PROBABILISTIC APPROACH

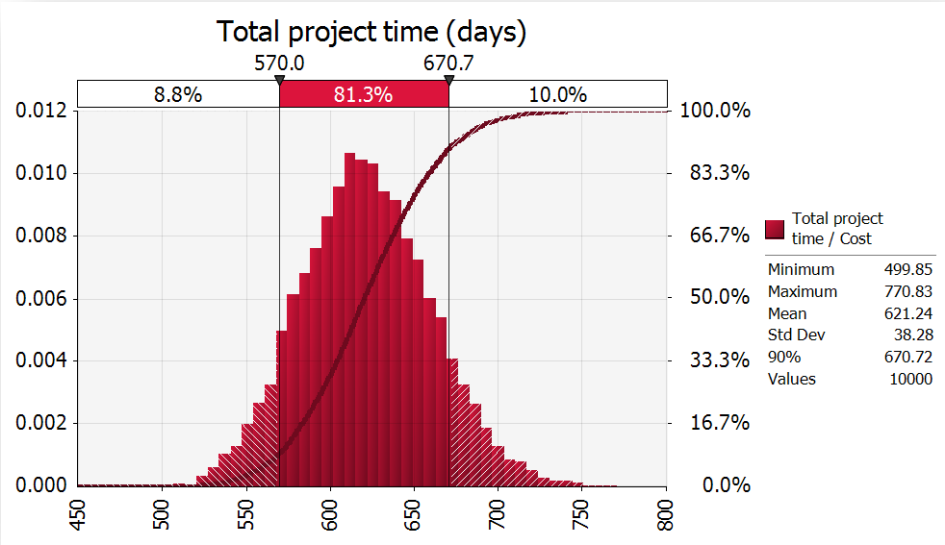
No	Activity	Time months P90	P50	P10	Dependencies
1	Construct/Install jacket	10	12	18	Start Day 0
2	Install topsides	3	4	6	1
3	HU flowline	0.5	1	1.5	2
4	Comission facilities	1.5	2	3	3
	Total project time			22.5	months

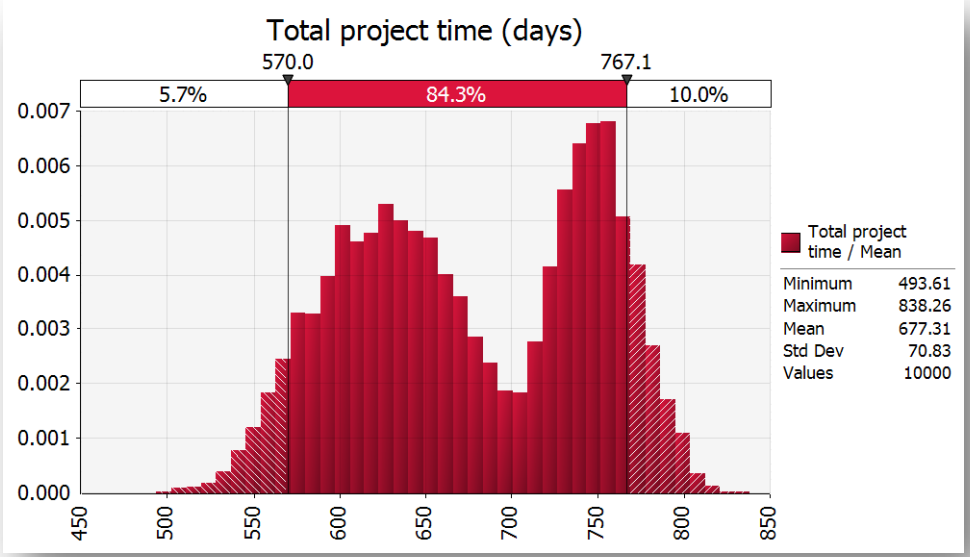




- Use appropriate distributions on range of estimates for each task to get probabilistic estimate of project schedule
- Mean time to complete now 22.5 months (677 days), a 20% increase!
- Initial estimate has only a 5.7% chance of being achieved
- P90 time to complete is 25.5 months (767 days)!

It’s the Process which is important!





- Project probabilistic schedule with beta distribution example
- P90 schedule is 670 days
- Original deterministic schedule was 570 days, 8.8% probability

- Project probabilistic schedule with discrete distribution example
- P90 schedule is 767 days (>3 months later than beta example)
- Original deterministic schedule of 570 days now sits at only 5.7% probable

CRITICAL SUCCESS FACTORS

- Acceptance that boards, JV partners, shareholders and governments have a right to confidence in major capital investment cost and schedule estimates
- Obtaining acceptance that at least part of the problem is inadequate identification, evaluation and management of risk and uncertainty
- **Educating project teams to recognise their biases and over-confidence**
- **Implementing a process which is sufficiently practical/utilitarian to be adopted**
- Getting management buy-in to changing FID cost/schedule estimating range of uncertainty from a prescriptive range to the requirement to define the actual range

RISC AND KPMG

The Alliance

- Strategic alliance between KPMG and RISC combines, seamlessly, selected services from each organisation to support clients to make judicious decisions.
- Formalised in 2002

Key benefits to our clients

- A non-exclusive arrangement providing choice for our clients:
- Holistic view - of business decisions and opportunities based on the technical, financial and commercial skills of our combined teams
- Competitive alternative to managing separate “expert advisors” teams on projects
- Global reach and experience in strategic commercial centres and in remote locations

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