Project Controls EXPO
Melbourne, Australia

Project Controls Expo – 22nd November 2018 Melbourne Cricket Ground

Topic: Project Gambling: Generating Value from Decision Making and Risk Management

Welcome:

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Passionate about improving the professionalism of project risk management and decision making.

25+ years experience in engineering and management on complex engineering and technology projects.

Principal for training company **Synchrony**
Engineers Australia CLM Committee Member ACT
AACE International Director Region 8 (Asia Pacific)

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Topics for the first session

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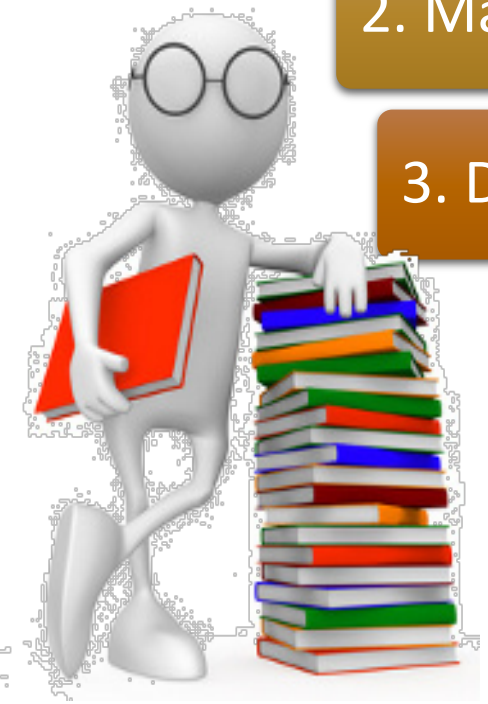
Introduction – Why its important to make Complex Projects more predictable

Followed by 5 key tips on how to make them more predictable

1. Measure what matters
2. Make it safe to fail
3. Do it virtually before the real thing
4. Mix up the team
5. Educate and influence



Introduction – Risk Management and Decision Making

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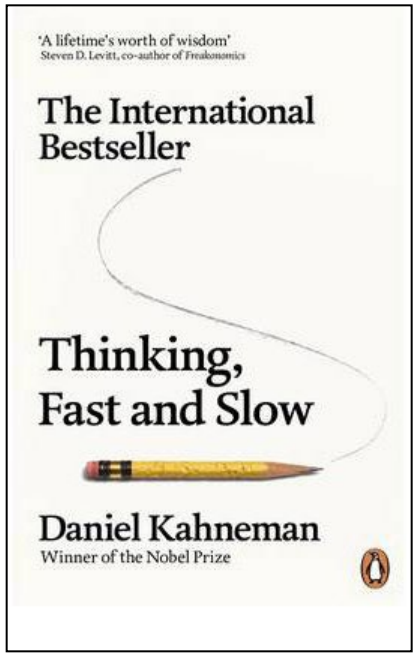
There are two ways we make choices:

- Fast, intuitive, automatic thinking (System 1)
- Slow, rational, calculating thinking (System 2)



Our minds are flawed by errors and bias. This is particular evident when dealing with risk based problems involving probability and statistics.

Complex projects by their nature involve high levels of risk.

Bias in Decision Making

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- Decision-making errors create inefficiencies in projects.
- They also help to explain irrational errors related to project selection and the resulting cost overruns.

Human psychology can have a big impact on managing complex projects.

We make ‘cognitive’ errors on a routine basis as a result of using rules of thumb and over-simplifications.

Bias in Decision Making

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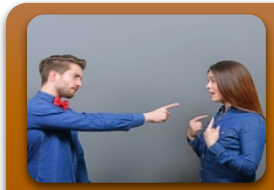
Anchoring

- Clinging to an irrelevant earlier piece of information such as a number

Framing

- Considering issues based on how they are formulated (framed)



Fundamental attribution error

- The tendency to blame others when things go wrong

Loss aversion

- Responding more strongly to losses than to gains

Herding

- Doing what everyone else seems to be doing

Decision Making Example*

- A Bat & Ball costs $110
- The Bat costs $100 more than the ball….
- How much does the ball cost?

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Decision Making Example

- A Bat & Ball costs $110
- The Bat costs $100 more than the ball….
- How much does the ball cost?

Ball cost = $5
Bat cost = $105
Bat & Ball cost = $110

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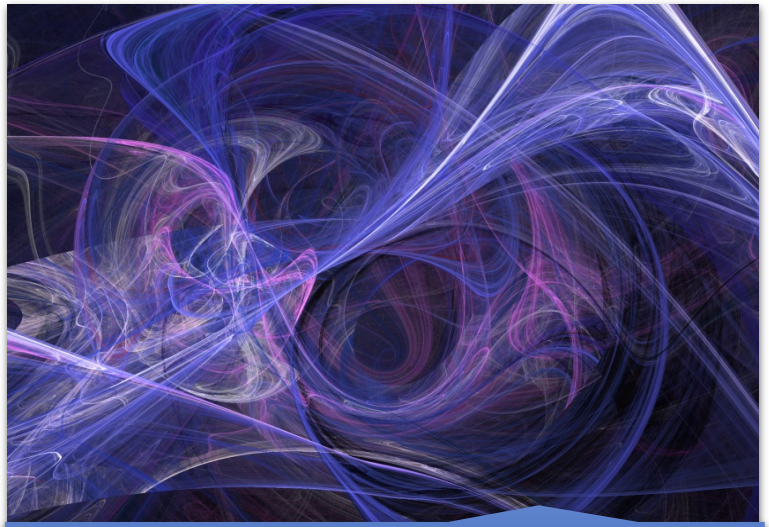
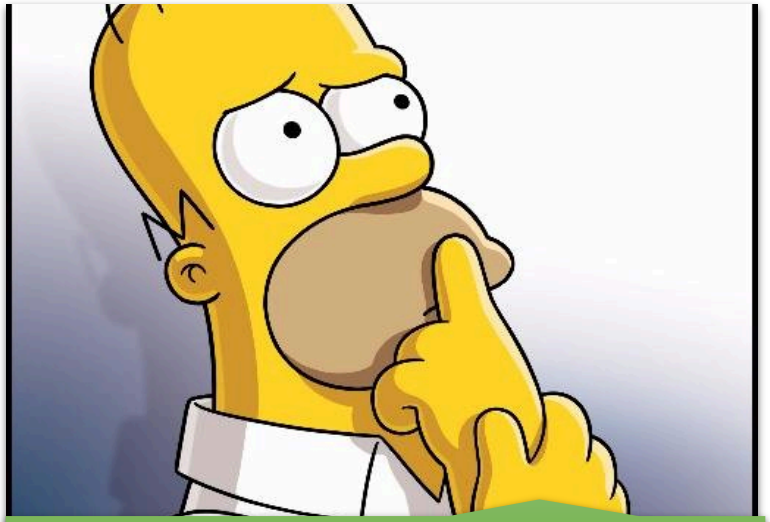
Bias in Decision Making - The Perfect Storm



Complex projects / decisions



Human biases

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Generating Value

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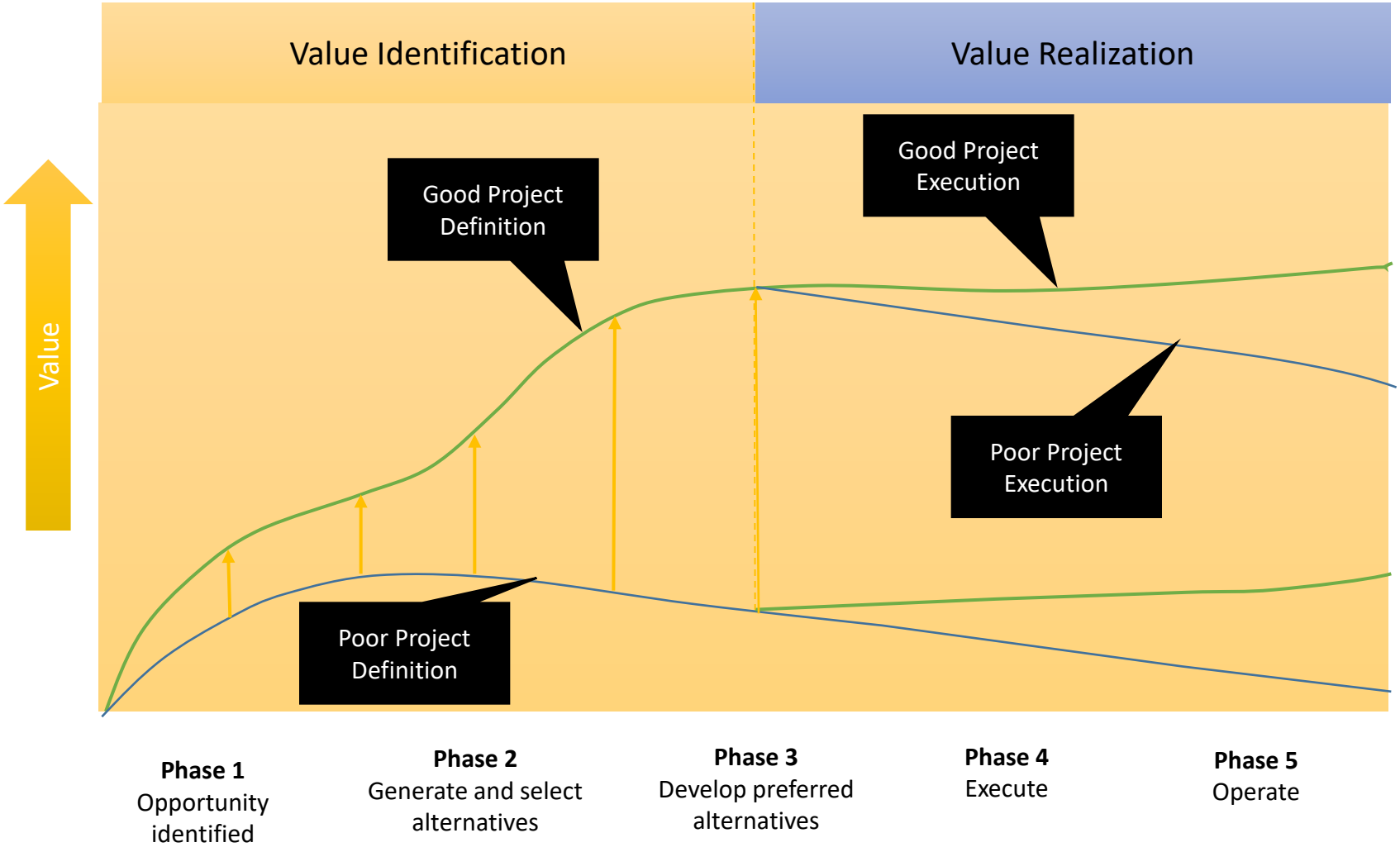
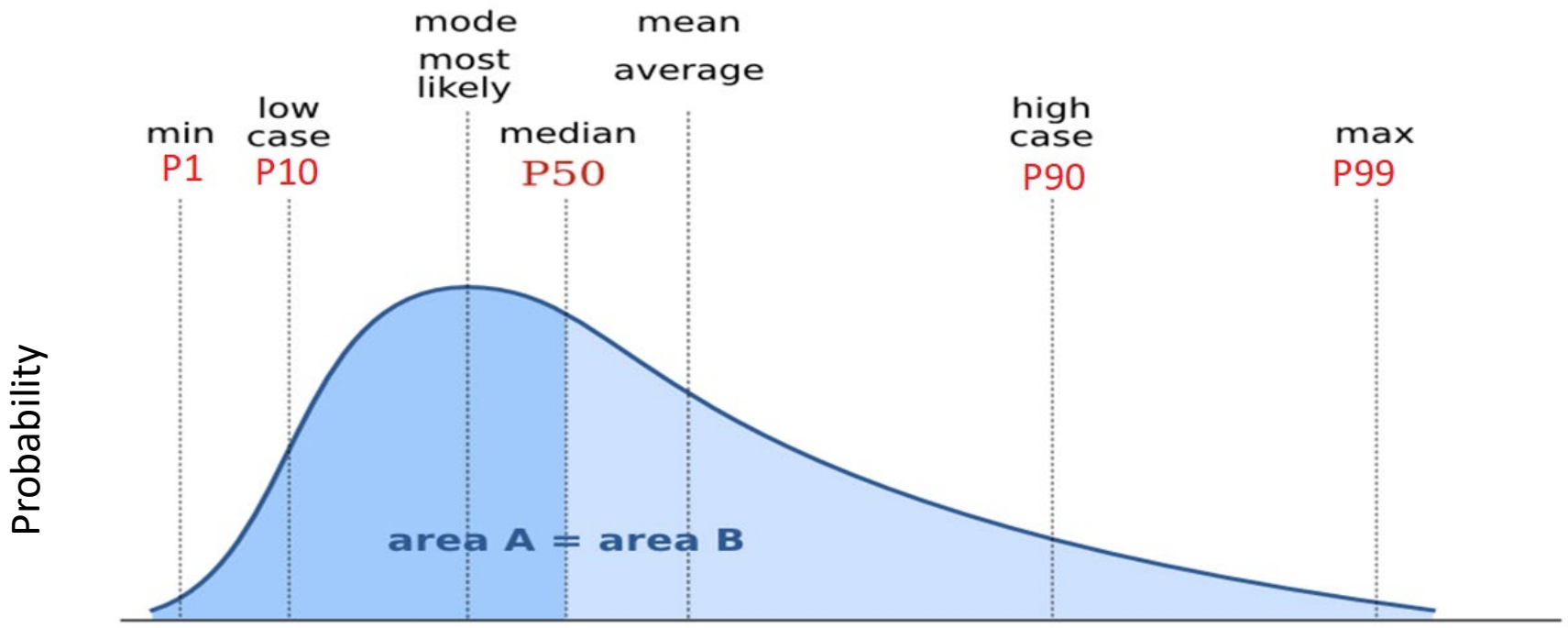


Source: Origin Energy

Thinking Probabilistically



Estimated Cost

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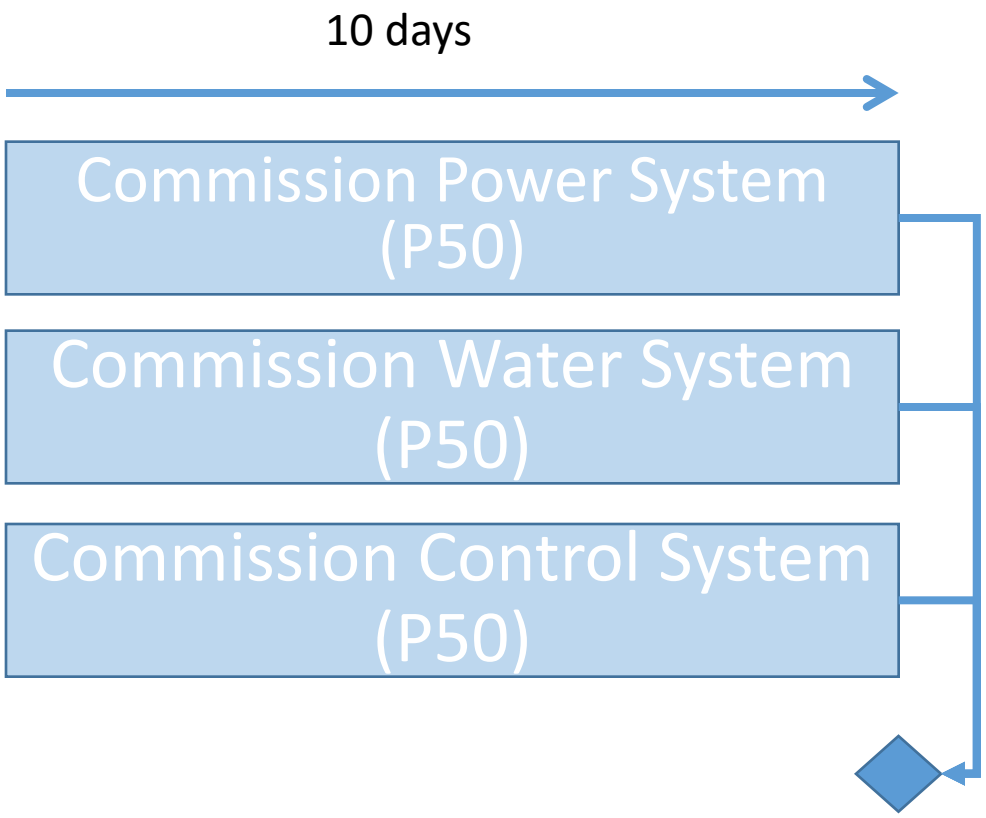
What is the probability of achieving this milestone on schedule?



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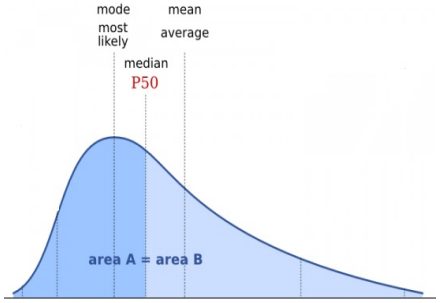
What is the probability of achieving this milestone on schedule?



10 days

Commission Power System (P50)

Commission Water System (P50)

Commission Control System (P50)

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What is the probability of achieving this milestone on schedule?

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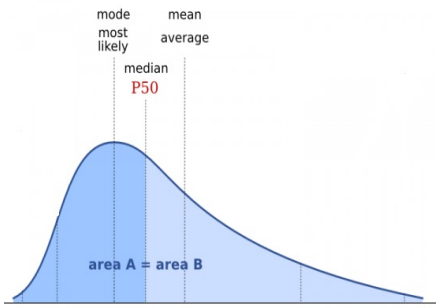


10 days

Commission Power System (P50)

Commission Water System (P50)

Commission Control System (P50)

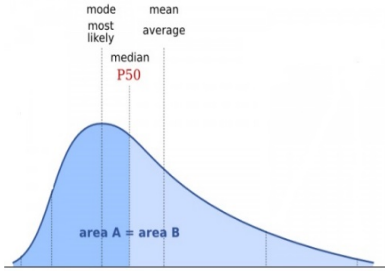
Probability of achieving this milestone on time is only 12.5%.

$(0.5^3 = 0.125)$

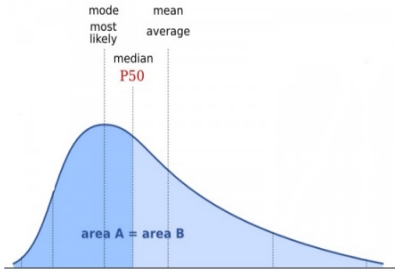
(ignoring correlation)

Monte carlo analysis helps us analyse these probabilities on complex projects.

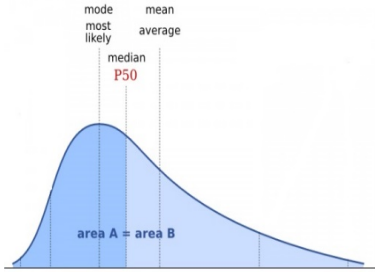
Activities in series



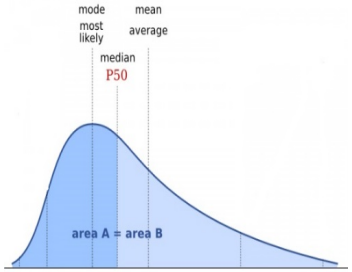
Excavate



Prepare Formwork



Install Reinforcing



Pour Concrete

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Why Conduct Risk Analysis?

- Achieve required confidence in project plans
  - Incorporating historical data and experience
  - Less reliance on “gut assumptions” and more reliance on proven statistical methods (Monte Carlo Simulation)
  - Improve Project Decision Making
- Set appropriate expectations for cost and schedule
  - Determine probabilistic start or finish
  - Manage and allocate resources accordingly
  - Improved forecasting

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Risk Outputs

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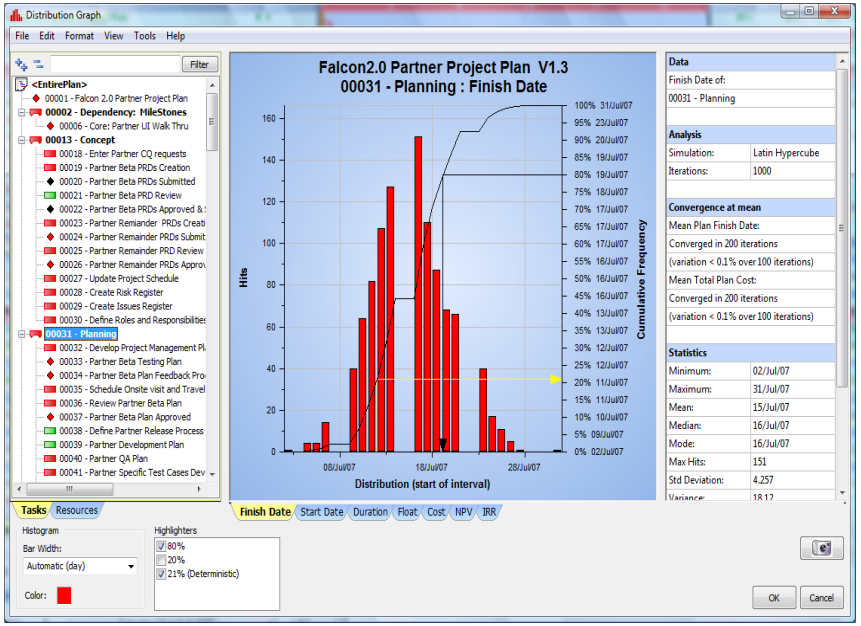
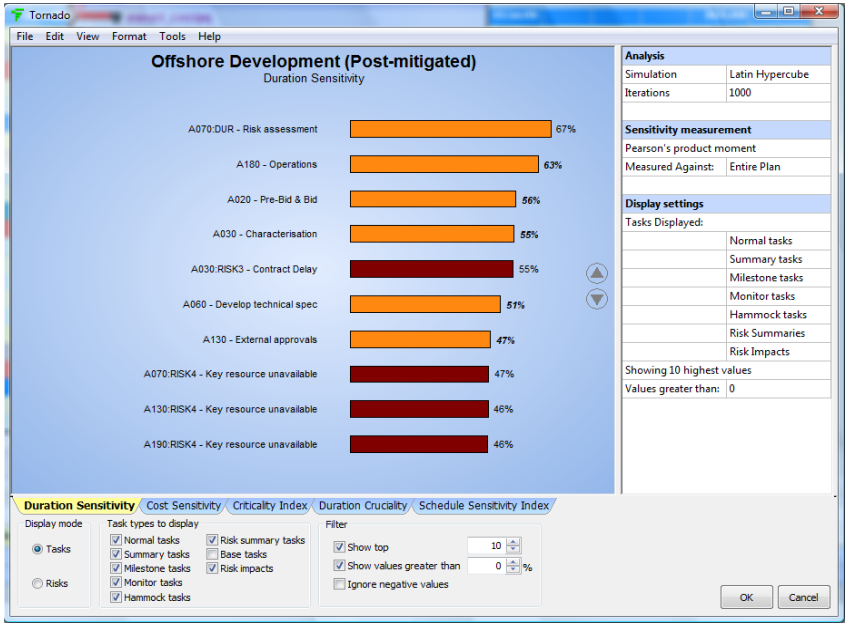
- Cumulative Frequency Histogram
- Cost & schedule impacts
- Contingency determination

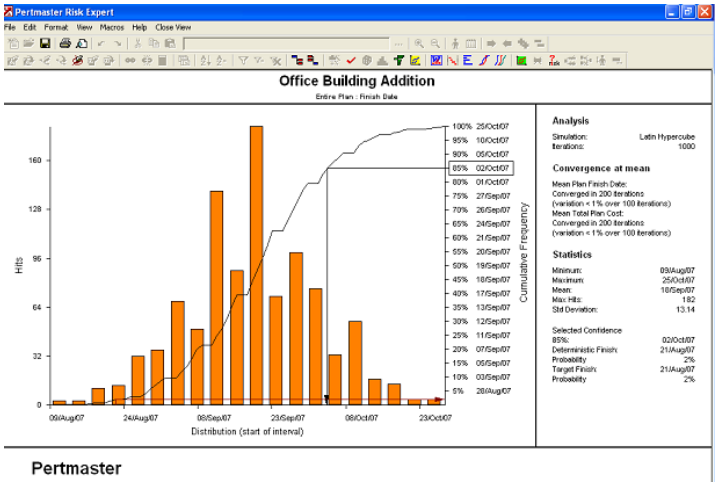


- Risk Tornado
- Determine key risk drivers
- Identify risky elements of the project

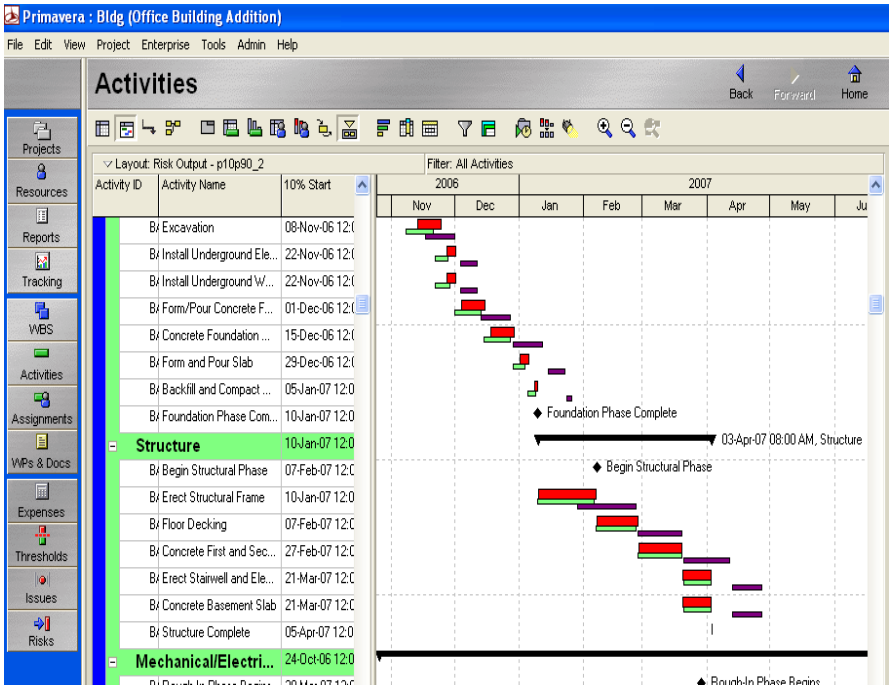


Key outputs

What is our confidence level? → **"P" schedules can be used for managing expectations with stakeholders**



Pertmaster



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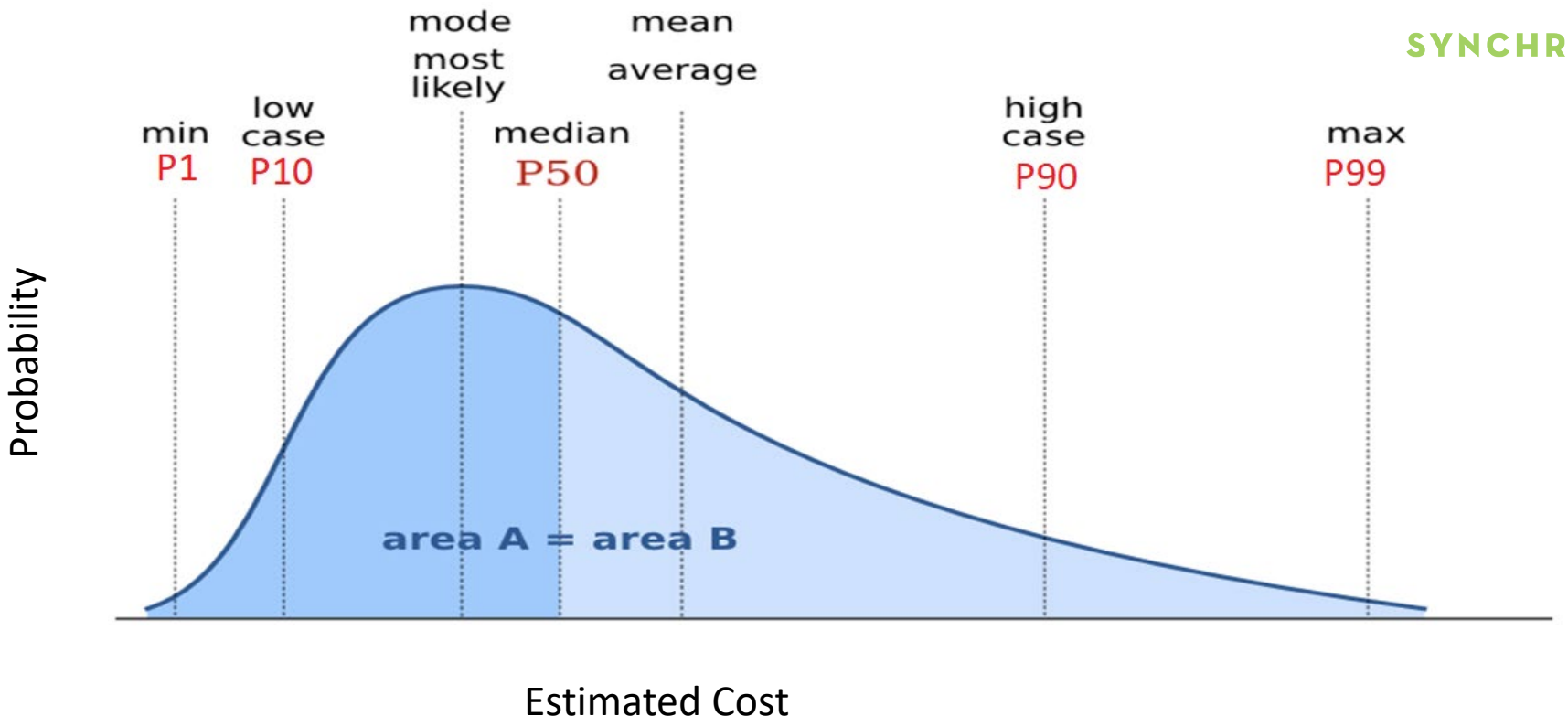
Contingency



The “P” Value indicates how confident we can be that we will achieve a particular cost or schedule target.

We allocate contingency to a project budget to allow for risks.
The amount of contingency can be set to meet the goals of the project.
“P90” is very conservative.
The Mean or average is very aggressive. .

Programs and Portfolios

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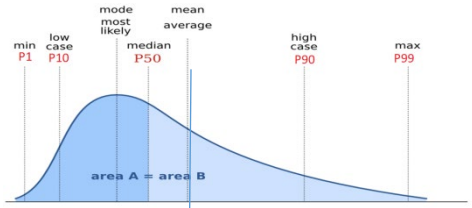
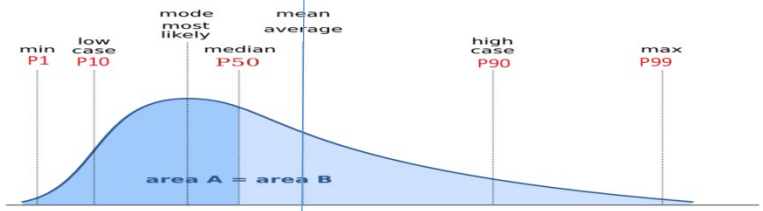
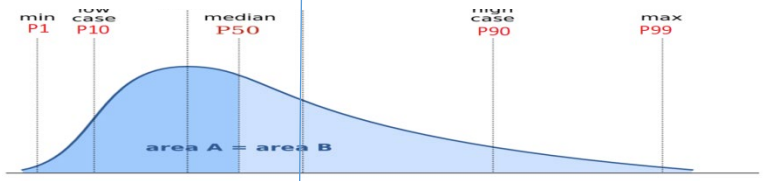
Portfolio



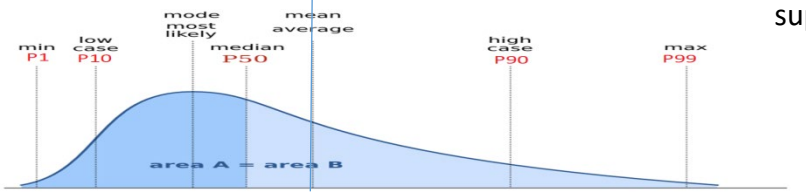
Project



Project



Project



Portfolio mean / Expected value:

$E(R) = w_1R_1 + w_2R_q + ...+ w_nR_n$

Ingoring corelation / interdependency between the projects and ignoring program/portfolio level support functions such as PMO.

The Portfolio Effect

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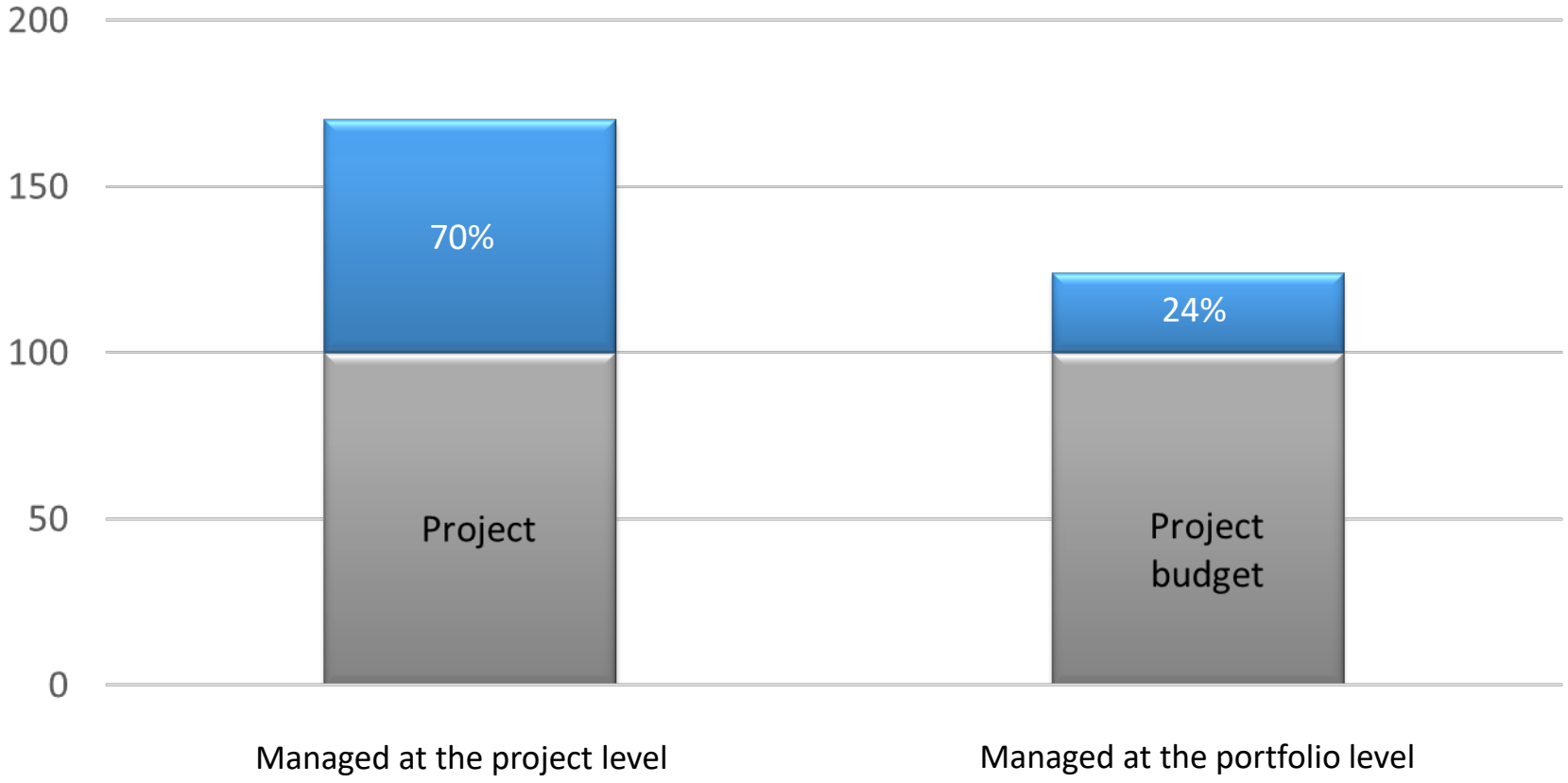
Value of the contingencies to ensure projects will finish within initial budget commitments with 90 per cent probability, per cent of initial project value.



Notes: Australian transport projects completed between 2008 and 2013.
Source: Investment Monitor; Grattan analysis.

Risk Culture

Group Exercise

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Improving Decisions

Improving Decisions with;

Integrated processes

Information and Data

But what information do we need?

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Values Based Leadership And Decisions

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When we identify and communicate our values we empower teams to make better decisions

Values

Organisations and projects place importance on project outcomes depending on their values.

Profit	Health and Safety	Reputation	Social / Community Relationship	Environment

Governance and risk processes should be designed to reflect the relative importance of these values.

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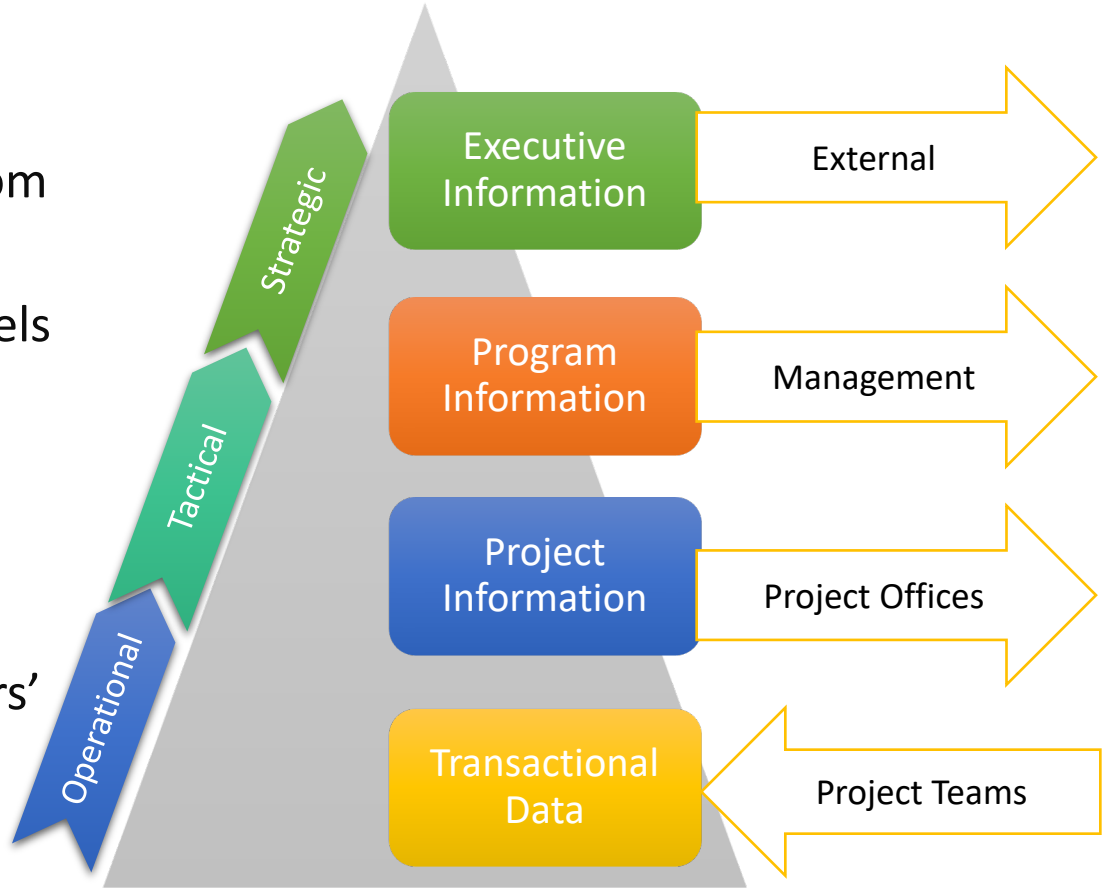
Values Expressed Through A Risk Ratings

	Value Category			
Consequence Rating	Asset / Financial	Health & Safety	Environment	Social / Community /Reputation
Catastrophic	> $10M	Multiple fatalities, multiple permanent disabilities or ill-health.	Permanent or widespread long term damage to the environment. Collapse or complete shift of ecosystem processes.	Demand for government inquiry
Major	Between $1M and $10M	Single death &/or long-term illness or multiple serious injuries	Long term, significant impact with an extreme change to both ecosystem structure and function.	Adverse and extended national media coverage
Moderate	Between $100k and $1M	Injury; Possible hospitalisation & numerous days lost	Ecosystem function altered to an unacceptable level with some function or major components now missing &/or new species are prevalent.	Adverse capital city media coverage
Minor	Between $10k and $100k	Minor injury; Medical treatment & some days lost	Maximum acceptable level of change in the environment structure with no material change in function.	Adverse local media coverage only
Insignificant	< $10k	No or only minor personal injury; First Aid needed but no days lost	Measurable but minor change in the environment or ecosystem structure but no measurable change to function	Negligible impact

Identifying The Information Needs / Reporting Requirements

- Hierarchy of data and KPIs (and KRIs)
- Agreed summarisation of data from operational to strategic
- Reporting rolled up at various levels
- Work progress, time, safety and cost data entry at bottom
- Consider Sponsor's information needs
- Consider user groups or customers' information needs



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Behaviours (Values Based)

- Best for program decisions
- Effective governance and decision making
- Shared understanding and allocation of risk
- Safe to fail (calculated risk taking, innovation)
- No surprises
- Collaboration and diverse inputs
- Performance driven
- Help needed
- Celebrate success and learn from failure

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Risk Taking

Complex projects often involve doing things that haven't been done before

Teams may need to take risks and experiment in order to do the work

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Making it safe to fail

Teams should not be punished if calculated risks fail – as long as basis for decision was ok

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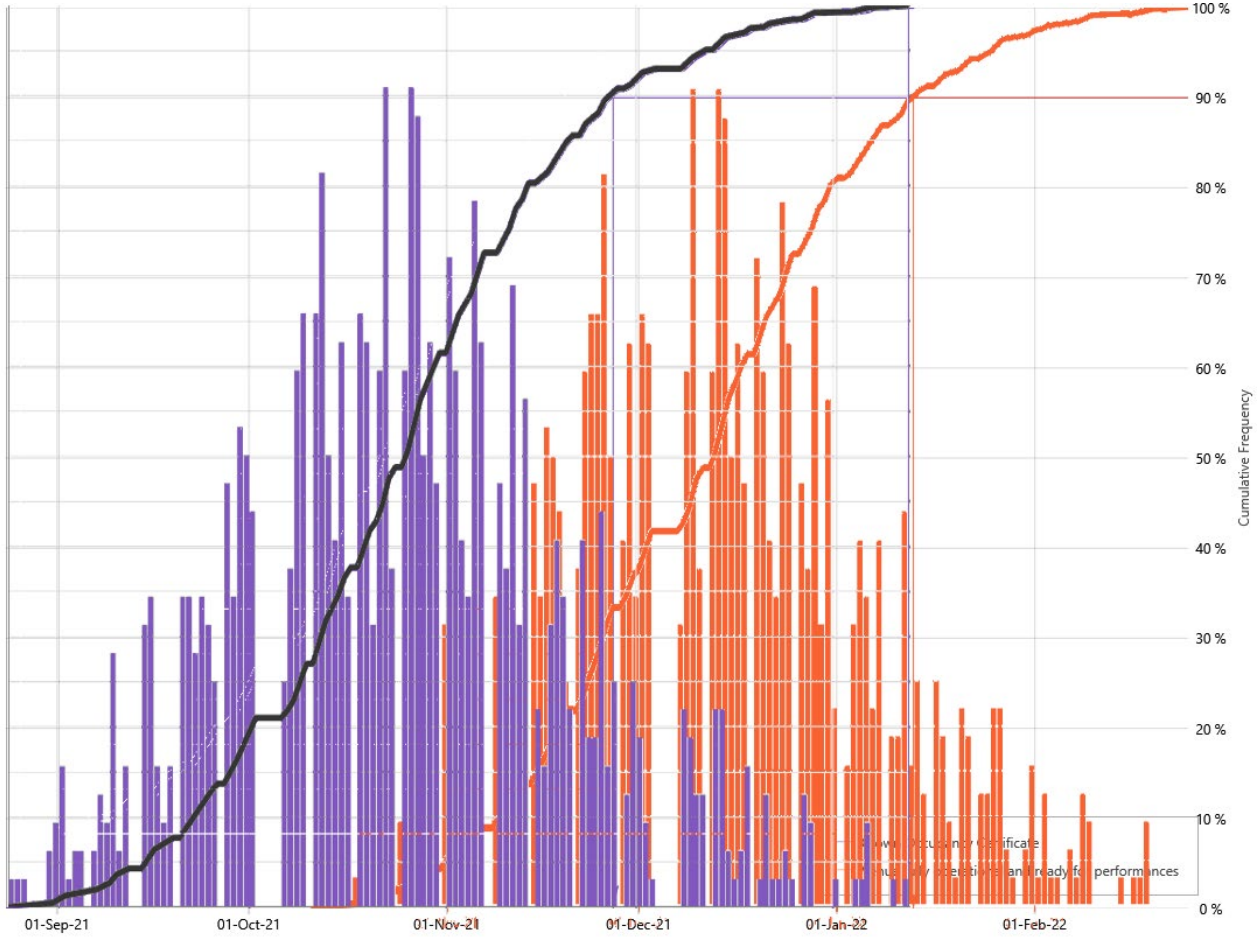
Do it virtually

P90 Schedule Scenarios before and after mitigation is applied.



AUSTRALASIAN PROJECT PLANNING
www.austprojplan.com.au

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Do it virtually

Projects can be modelled in 3D.
Scenarios can be modelled and shared virtually prior to making decisions.
Great for value engineering and constructability workshops.

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Mix up the team

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Decisions drive projects and diverse teams make better decisions.

Decision making and change management processes should consider;

- Strategic benefits
- Customer impacts (satisfaction/benefits)
- Safety
- Environment
- Other values

As well as the traditional delivery parameters of;

- Project Cost (lifecycle)
- Project Schedule
- Project risk profile

Educate and Influence

Awareness of AACE International.
Awareness of TCM.
Awareness of Certification Processes.
Awareness of tools.

Educate and Influence

- The problem - Systemic enterprise environmental factors and organisational maturity have the greatest influence on project outcomes
- The solution - Improve the team's capability in risk analysis, planning and control
- AACE certification programs are a great investment for individuals and employers!

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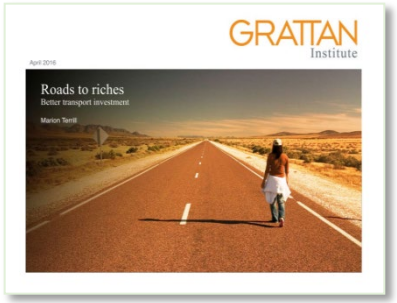
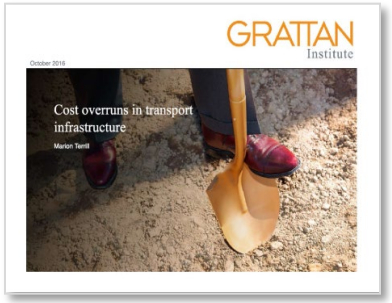
The Grattan Institute has found that Australia has a cost overruns problem



Roads to riches: ***Better transport investment***



Cost overruns in transport infrastructure

Over...

15 years

542 completed projects

+294 cancelled projects

Cost overruns cost...

$28 billion

24% of promised costs

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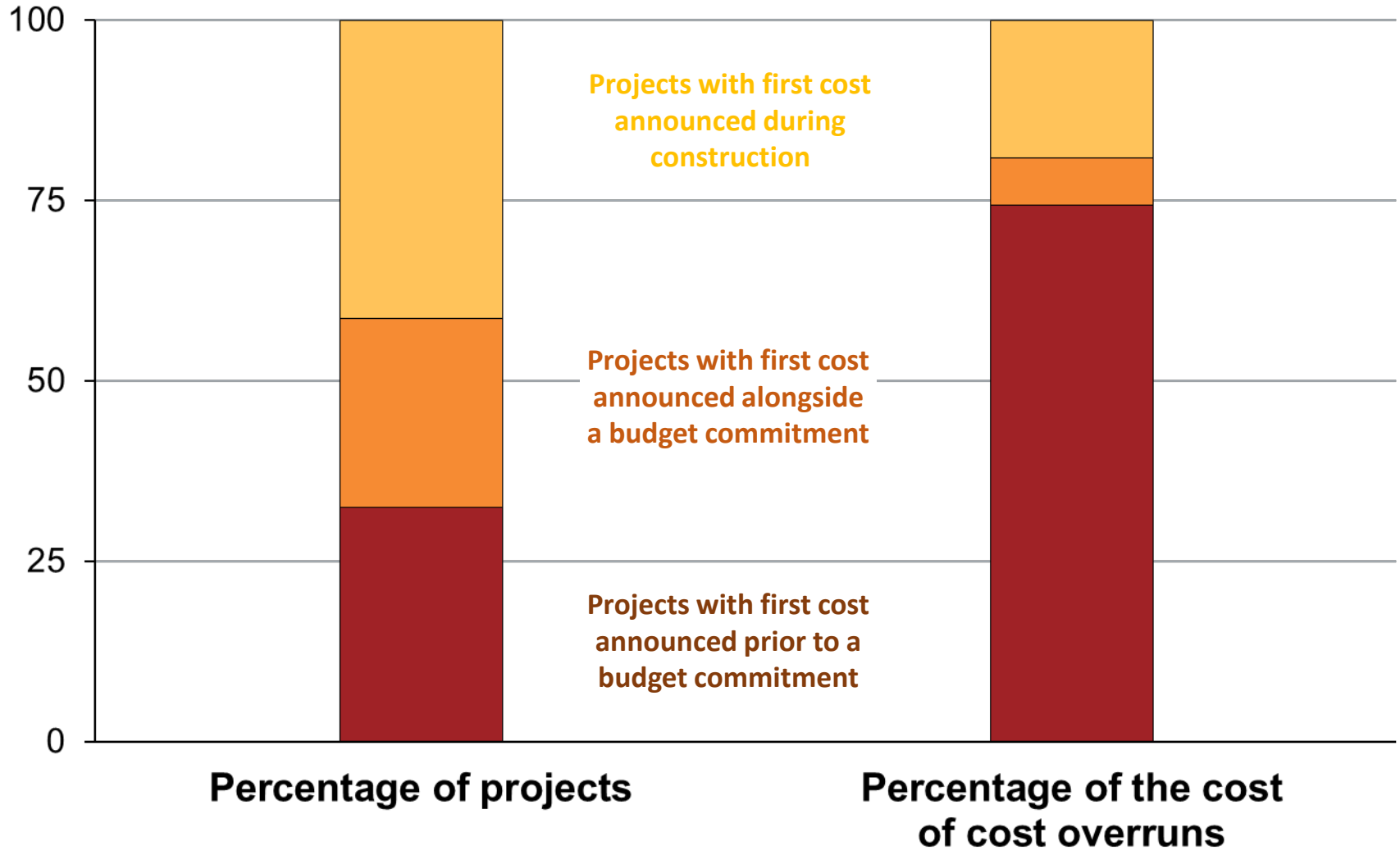
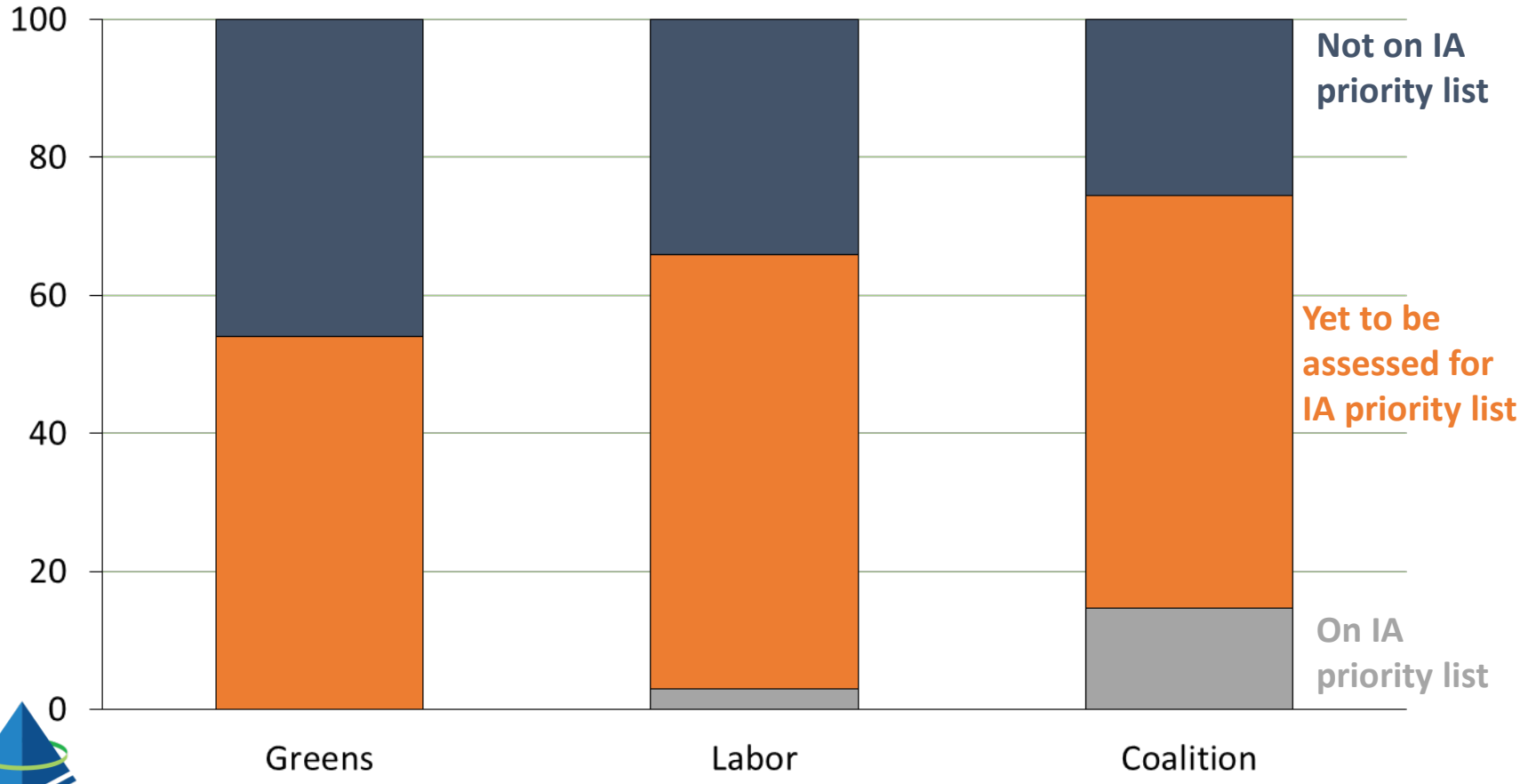
Opportunity (Source: Investment Monitor, Grattan analysis)



Notes: Australian transport projects completed between 2001 and 2015.
Source: Investment Monitor, Grattan analysis

Money committed during the 2016 election

- **Proportion of transport infrastructure election commitments by Infrastructure Australia (IA) approval status, per cent**



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Risk based estimating inadequate

		Cost estimate (nominal, $ millions)		
Project	**State**	**Median (or "P50")**	**"Worst case" (or "P90")**	**Difference**
Inland Rail	National	9 890	10 660	7.8%
Western Distributor	Vic	5 226	5 548	6.2%
Maldon Dombarton Rail Link	NSW	766	806	5.2%
Melbourne Metro	Vic	10 154	10 837	6.7%
Canberra Light Rail	ACT	759	806	6.5%
Actual average difference, all projects completed in past 15 years				**26.0%**

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Bridging the Gap

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Leadership and Management

Politicians

AACE INDIA SECTION

Government Agencies / Proponents

Opportunists

ENGINEERS AUSTRALIA

National Engineering Register

Cost Engineers
Risk Engineers
Systems Engineers
Asset Management

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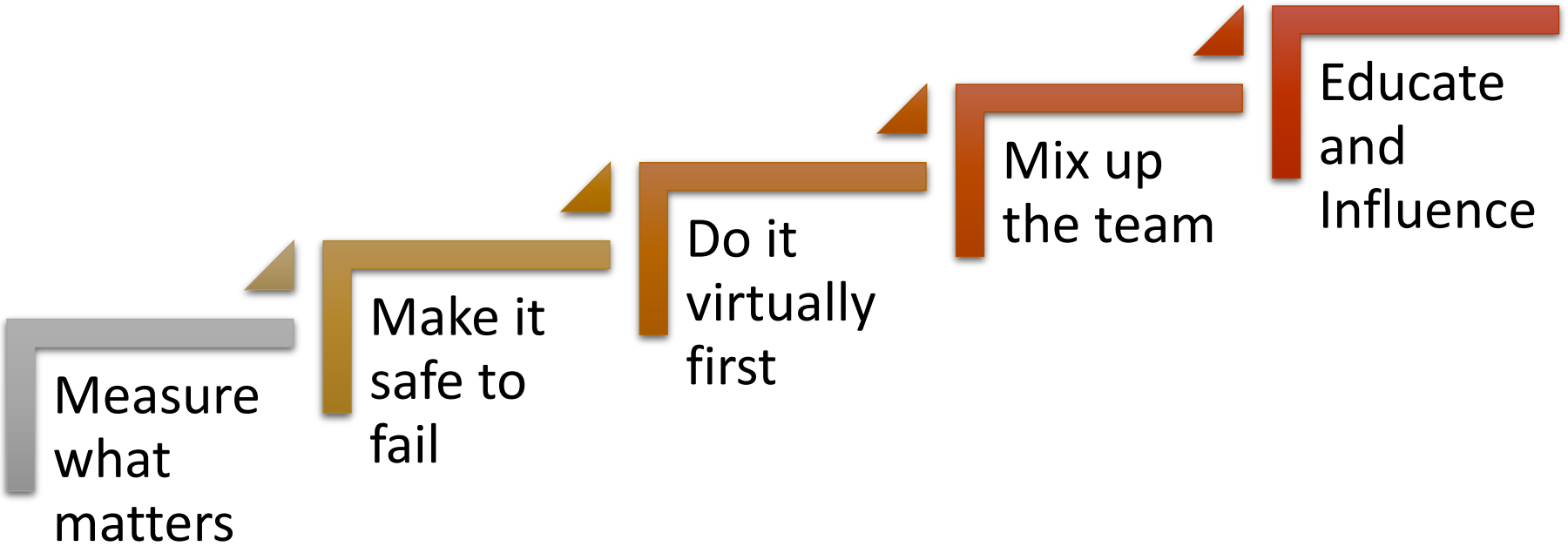
Key Steps



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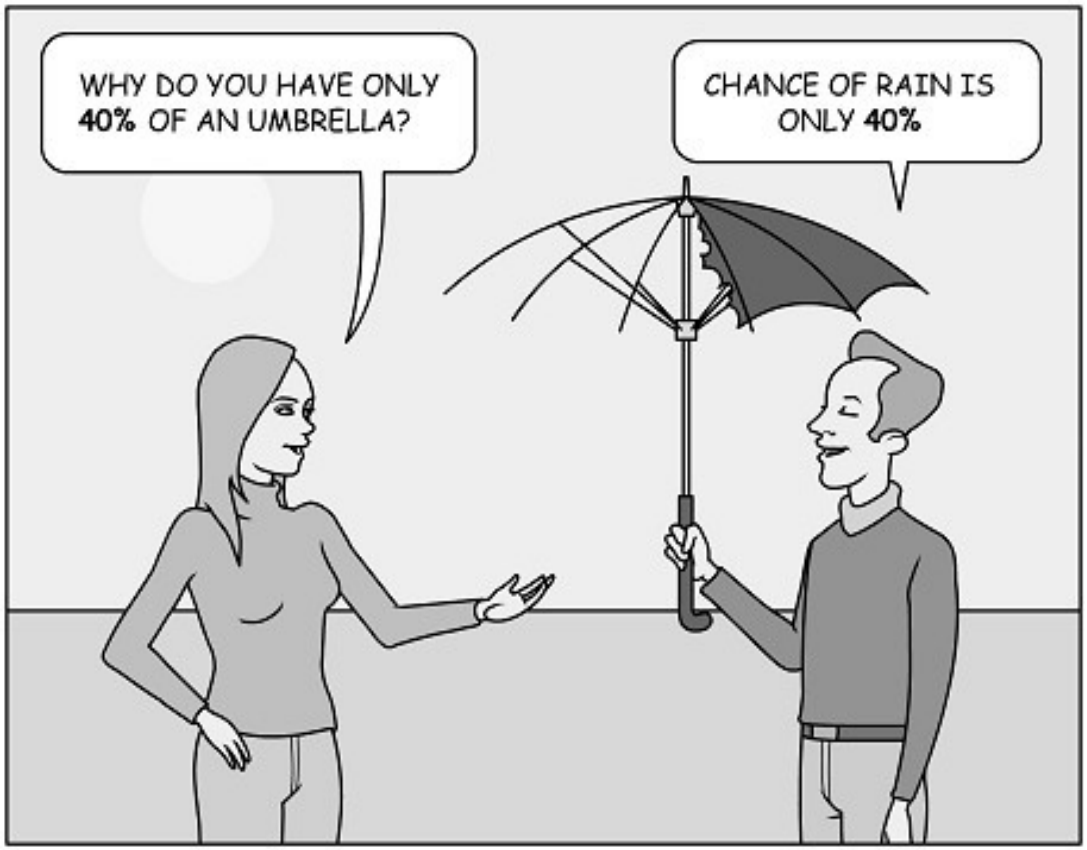
Decision Making and Risk Management for PMOs

Group Exercise



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Enjoy your morning tea!

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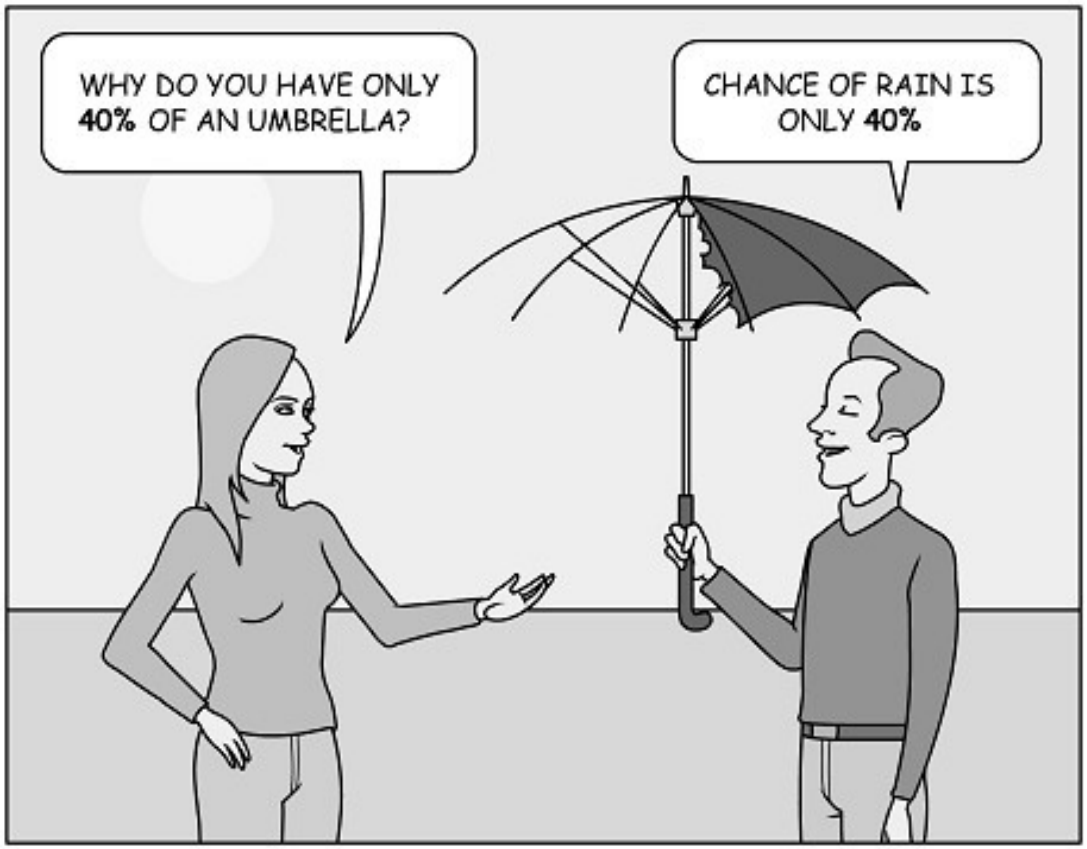
Decision Making and Risk Management for PMOs

Group Exercise



SCRAM - About the Speaker

Angela Tuffley at RedBay Consulting

- Director and Principal Consultant
- Over 35 years of industry experience, both in Australia and overseas, providing expert professional services in training, assessment and advice for the acquisition, engineering and support of software intensive systems.
- Co-developer of the Schedule Compliance Risk Assessment Methodology (SCRAM)
- Provides consultation on SCRAM, the adoption of the Capability Maturity Model Integration (CMMI) and ISO/IEC 15504 Information Technology Process Assessment (SPICE)

Schedule Compliance Risk Assessment Methodology: SCRAM

According to a Gartner Survey (2012) "The single most common reason that projects are considered a failure, is because they are substantially late".

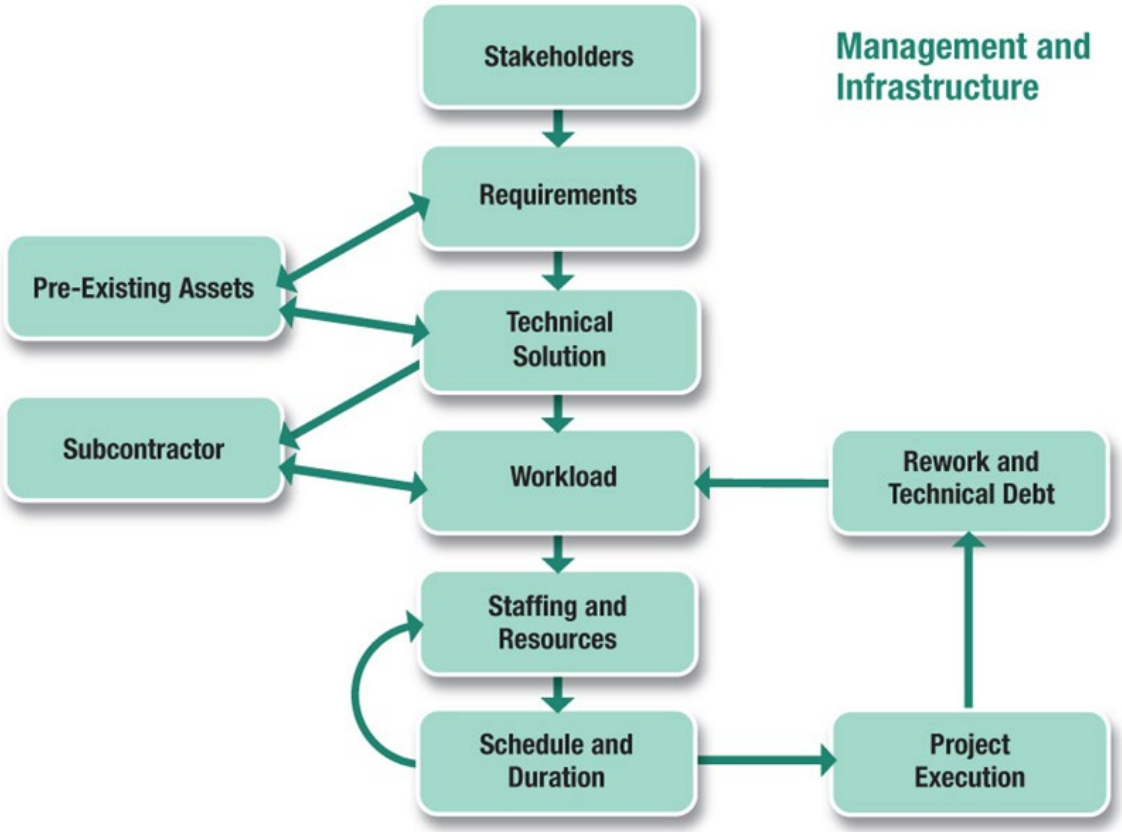
Schedule is almost always the primary concern of project stakeholders

What is SCRAM?

An independent review to identify issues and risks to schedule	• Quantifies the schedule impact of issues and risks using scientific analysis techniques
	  • Schedule Monte Carlo Simulation
	  • Software Parametric Modelling

Embodies best practices	• Systems and software engineering • Schedule development and project execution
Facilitates improved business practices	• Based on feedback from reviews • Identification of systemic root causes / issues

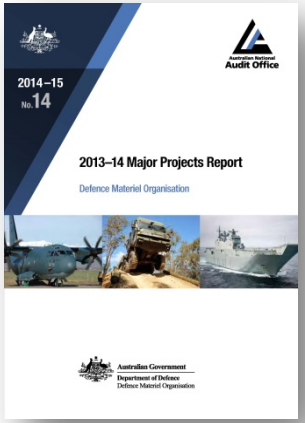
Root Cause Analysis of Schedule Slippage (RCASS) Model



SCRAM Usage

Sponsored by the Australian Department of Defence

- To improve Project Schedule Performance in response to Government concern as identified by the Australian National Audit Office (ANAO)
- Successfully applied to the F-35 JSF Program in the USA and used to monitor software development performance on the program (web search “F-35 Australian SCRAM”)



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Diversity of SCRAM Reviews

Aerospace

Satellite Ground Stations

Maritime

Enterprise Resource Planning

Telecommunications

Training Systems

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SCRAM Can be Applied Across the Project Life Cycle

SCRAM Results Target Executives

Executive Out Brief

- Executive level Bottom Line Up Front (BLUF) statement(s)
  - Identifying the most significant issues and risks and their impacts

Supported by a Detailed Report

- Detailed findings (issues, risks and impacts)
- Monte Carlo Analysis Results
- Parametric modelling forecast results
- Recommendations

BLUF Examples

Pre Contract Signature

- Assuming successful completion of negotiations, the program is well positioned for success with experienced teams, a mature COTS-based solution and co-location of the acquisition and transition organisations. However, the schedule is at risk primarily due to dependencies on external agencies' impact on delivery of facilities and a shortage of qualified staff

Pre-IBR

- The program continues to be well positioned for success with strong experienced teams implementing a mature COTS-based solution. However, the schedule is compressed with a high degree of concurrency and little time available for unplanned rework. The schedule is at risk primarily due to a shortage of qualified staff; the likely loss of experienced personnel; software development estimates inconsistent with the schedule and potential delays in completion of facilities

BLUF Examples

System Integration & Test

- While schedule is an improvement over previously delivered schedules, successful execution of it, or any schedule, will not be achieved while current attitudes and behaviours on both sides are allowed to continue

Successful System Integration & Test

- Project is currently behind schedule and the remaining schedule is considered success oriented. Schedule float has been consumed by a late requirement. However, the project is well prepared entering the Test and Evaluation Phase

BLUF Examples

Production

- Based on current performance and existing constraints, the current Production Schedule cannot be met. Despite issues, the capability is being delivered through heroic efforts of all parties involved. The current level of effort is not sustainable for the remainder of the production without risk to the health and safety of the staff; and the quality of work being performed

Successful Production

- Despite a large and complex stakeholder environment, the project has established a collaborative, outcome-focused project team and has demonstrated outstanding performance in delivering the capability in accordance with the imperative to deliver as early as possible

More information

Session C6: SCRAM: Controlling Runaway Project Schedules

- 3:15pm Case Studies Zone @Jim Stynes Room B

Contact me

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SCRAM website pages

- http://www.redbay.com.au/products/scram
- http://scramsite.org

Introduction to the Journeymap

Advancing Risk Analysis Maturity provides benefits but requires more expertise and effort

Context

- Not all organizations need to achieve the highest level of risk analysis maturity
- Although those with the lowest maturity levels will not be able to use risk analysis to determine the probability of schedule failure, identify, prioritize and mitigate project risks and calculate the impact of schedule on labor-type costs
- Higher maturity levels follow recognized principles, use modern tools and provide management with actionable information on project risk that will contribute to decision making

Journeymap - Unaware to Advanced

Level 0: Unaware of Cost and Schedule Risk

- Individuals rely entirely on the results from project scheduling software, specifically the milestone and project finish dates. They promise and defend those dates.
- Individuals are not alert to any threat to achieving the finish date produced by the schedule.
- When faced with contrary results from others, they claim “this project is different” or “it won’t happen on my project.”

Level 0: Weaknesses

- The organization may rely on the schedule software's result long after it becomes obvious the project is not performing to those dates
- Risks are not addressed so they may happen when they could be avoided or their impact on the schedule may be larger than necessary.
- Surprises and "firefighting" responses after the risk occurs are common at this level of maturity.

Level 1: Basic Risk Awareness

- This level indicates awareness of project risk as something to consider when reviewing on or reporting the project scheduling software's calculated finish date
- Risk may be discussed frequently and decisions may take account of the risk
- Characterized by the lack of a systematic way to think about risks

Level 1: Benefits / Strengths

- Assess whether the project schedule adopted may be biased (usually for shorter schedule) and review whether to replan deterministically
- Adopt a probabilistic attitude towards the project plan, project teams and management as well
  - This may take some practice

Level 1: Weaknesses

- Since the risks are not addressed in an organized way, some important risks may be overlooked
- The risks that have been identified may not be the root causes of schedule variability
- This level lacks an organized way of calculating how individual risks affect the schedule including the complex logical relationships that cause the risk to affect the risk-critical paths
- At Level 1 addressing risks is *ad hoc* and therefore may be quite inefficient

Level 2: Qualitative Risk Analysis

- This level of maturity represents examining project risk to schedule using qualitative methods that lead to developing a Project Risk Register.
- This method recognizes the need to identify risks and prioritize them by probability and impact
- Often used for smaller projects

Level 2: Characteristics

- Examining project risk to schedule (and to other objectives such as cost, quality and scope) using qualitative methods that lead to developing a Project Risk Register
- Often viewed as a low-cost and easily-understood but organized method of addressing project risks
- Maturity at Level 2 may be sufficient for some projects or some organizations.

Level 2: Capabilities Needed

- Ability to identify and name project risks by the risk sentence structure
- Ability to understand the probability that a risk will happen affecting the project finish date - “uncertainty that matters”
- Ability to estimate, within a range, the probability and effects of a risk’s occurring projected on the project finish date
- Participate in or lead a risk workshop

Level 2: Impact Definitions

Defined Conditions for Impact Scales of a Risk on Major Project Objectives Examples for Negative Impacts Only					
Project Objective	Very Low 1	Low 2	Moderate 4	High 8	Very High 16
Cost	Insignificant Cost Increase	<$.5 million Increase	$.5 – $5 million Increase	$5 - $20 million Increase	>$20 million Increase
Time	Insignificant Time Increase	<2 weeks Increase	2 – 5 weeks Increase	6 to 10 weeks Increase	> 10 weeks Increase
Scope	Scope Decreases Are barely Noticeable	Minor Areas of Scope Affected	Major Areas of Scope Affected	Scope Reduction Unacceptable to Sponsor	Project End Item is Effectively Useless
Quality	Quality Degradation Barely Noticeable	Only Very Demanding Applications are Affected	Quality Reduction Requires Sponsor Approval	Quality Reduction Unacceptable to Sponsor	Project End Item is Effectively Useless

Definitions are necessary to put all risks on the same scale. Some qualitative risk analyses do not create / use these definitions and are useless

Level 2: Risk Prioritization Scheme

Probability and Impact Risk Scores: Time Objective											
Risk = P x I											
Probability	Threats					Opportunities					Probability
Very High											Very High
High											High
Moderate											Moderate
Low											Low
Very Low											Very Low
	VL	L	M	H	VH	VH	H	M	L	VL	
	Threat Impact					Opportunity Impact					

Level 2: Strengths

- Handling risk at maturity level 2 may be enough for many projects
- The smaller, shorter-duration, lower-cost projects that do not affect the commitments or reputation of the organization might be handled with the development and maintenance of a risk register
- Record the mitigation of risks and their assessed improvement in lowering the probability, reducing the impact, or both

Level 2: Weaknesses

- Can not provide an estimate of the probability that the scheduled finish date will be overrun or the amount of contingency needed to provide a desired level of certainty
- Gauging the impact of a risk on the finish date is difficult without a schedule
- Risk workshops, often used to collect these data, can ignore risks that are difficult to discuss in a group

Level 3: Basic Quantitative Analysis

- Recognizes that project schedule success is affected by uncertainty of the estimated durations of the activities in the project schedule
- Can be analyzed statistically by applying Monte Carlo simulation (MCS) with specialized but available software

Level 3: Characteristics

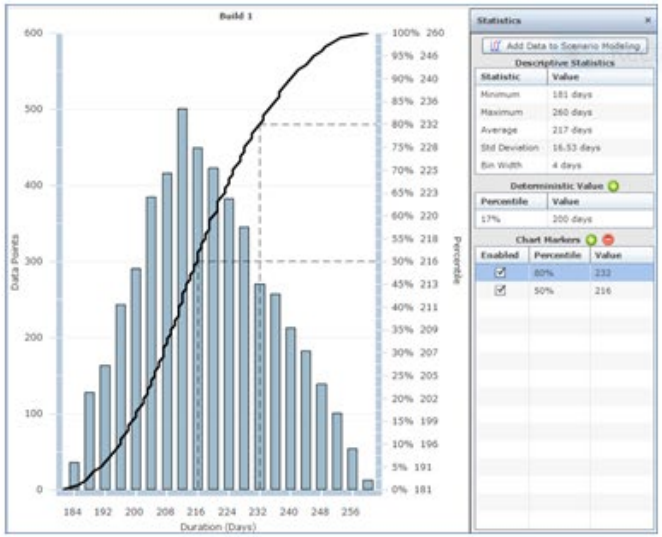
- Variability of activity durations is represented by applying probability distributions, typically 3-point estimate of Low, Most Likely and High days of impact *directly to the activity durations*
- Monte Carlo simulation produces histograms and cumulative distributions giving probability of finishing on time and estimates a contingency of schedule and cost

Level 3: Capabilities Needed

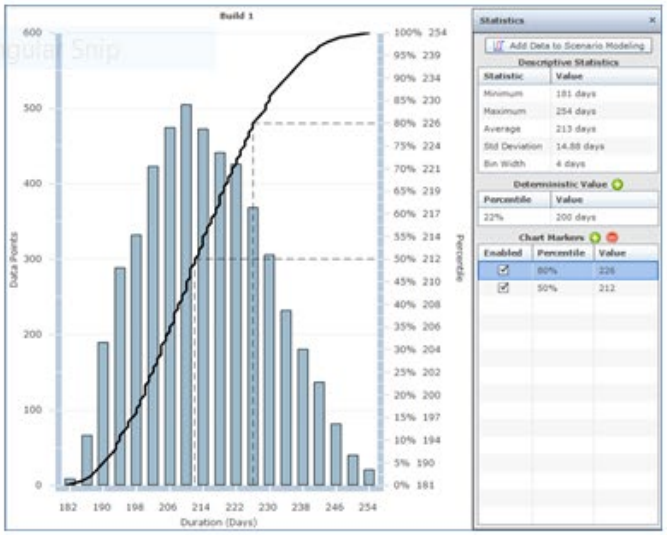
- An ability to understand and assess a schedule against schedule best practices (e.g., GAO Schedule Assessment Guide)
- Using Monte Carlo simulation (MCS) software that simulates schedules using 3-point estimates on durations

Level 3: Distributions Used

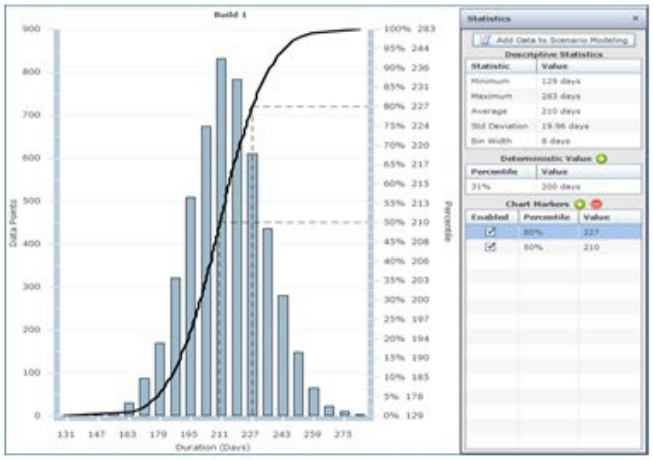
Triangular



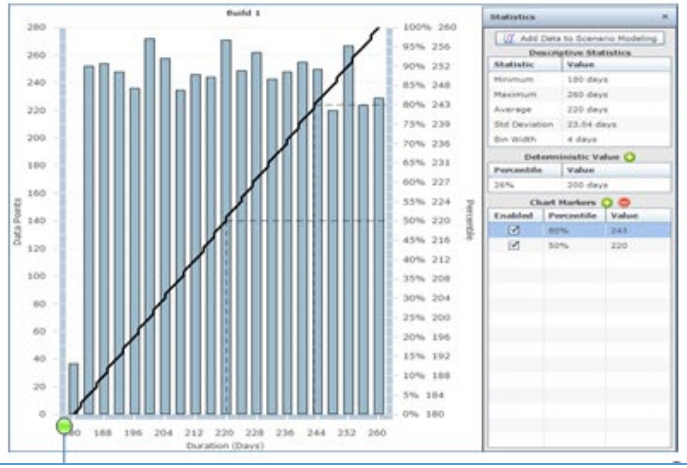
Beta PERT



Normal



Uni-form

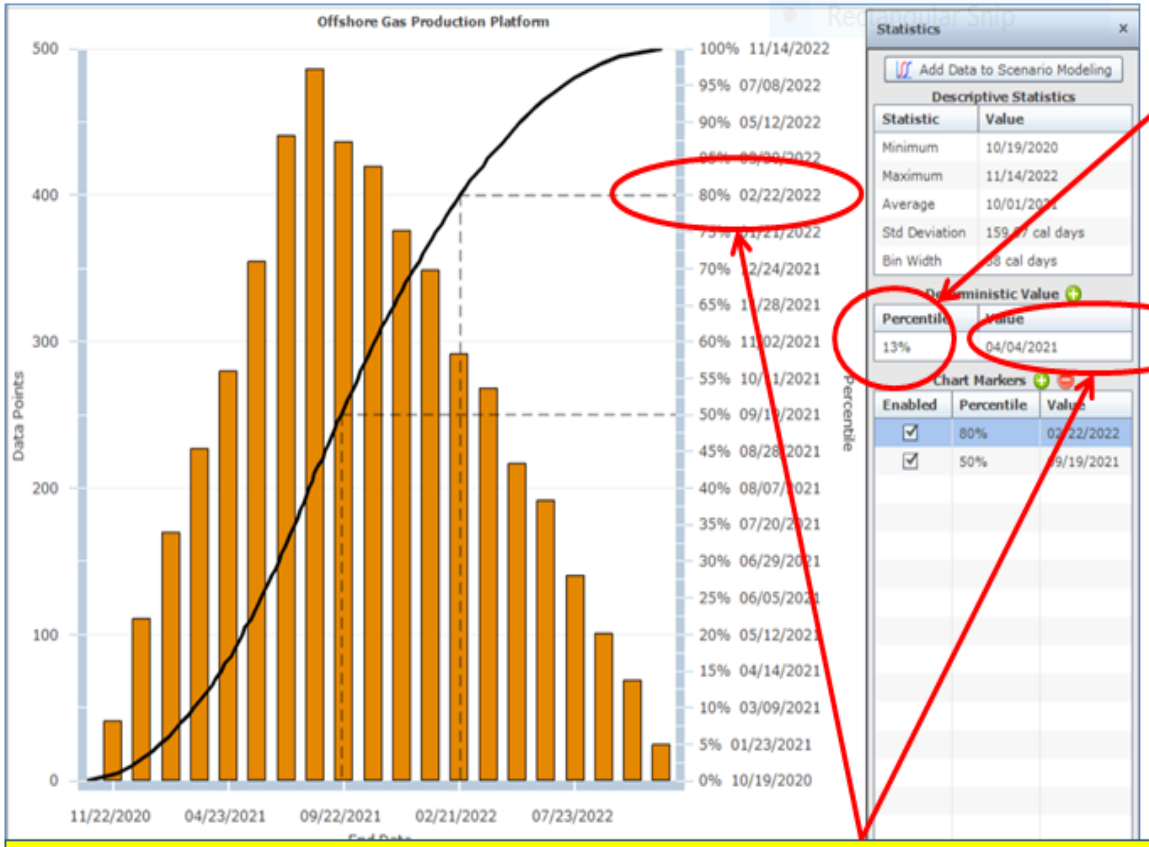


These reflect the “image” of, perhaps, several risks on activity durations – not the risks themselves

Level 3: Benefits

- The use of the schedule avoids having to guess at the impact on the finish date
  - Uses schedule logic and Monte Carlo simulation software for complex calculations
- Provides results such as total project contingency estimates that are not available from the qualitative Risk Register methods

Level 3: Benefits - Example



Question # 1: Probability of finishing on schedule= 13%

Question #2: Contingency for an 80% likelihood of finishing on time or earlier
Subtract scheduled finish of 4-4-21 from the P-80 date of 2-22-22 for 10.5 months

Simulation software shown here is Polaris® from Booz Allen Hamilton

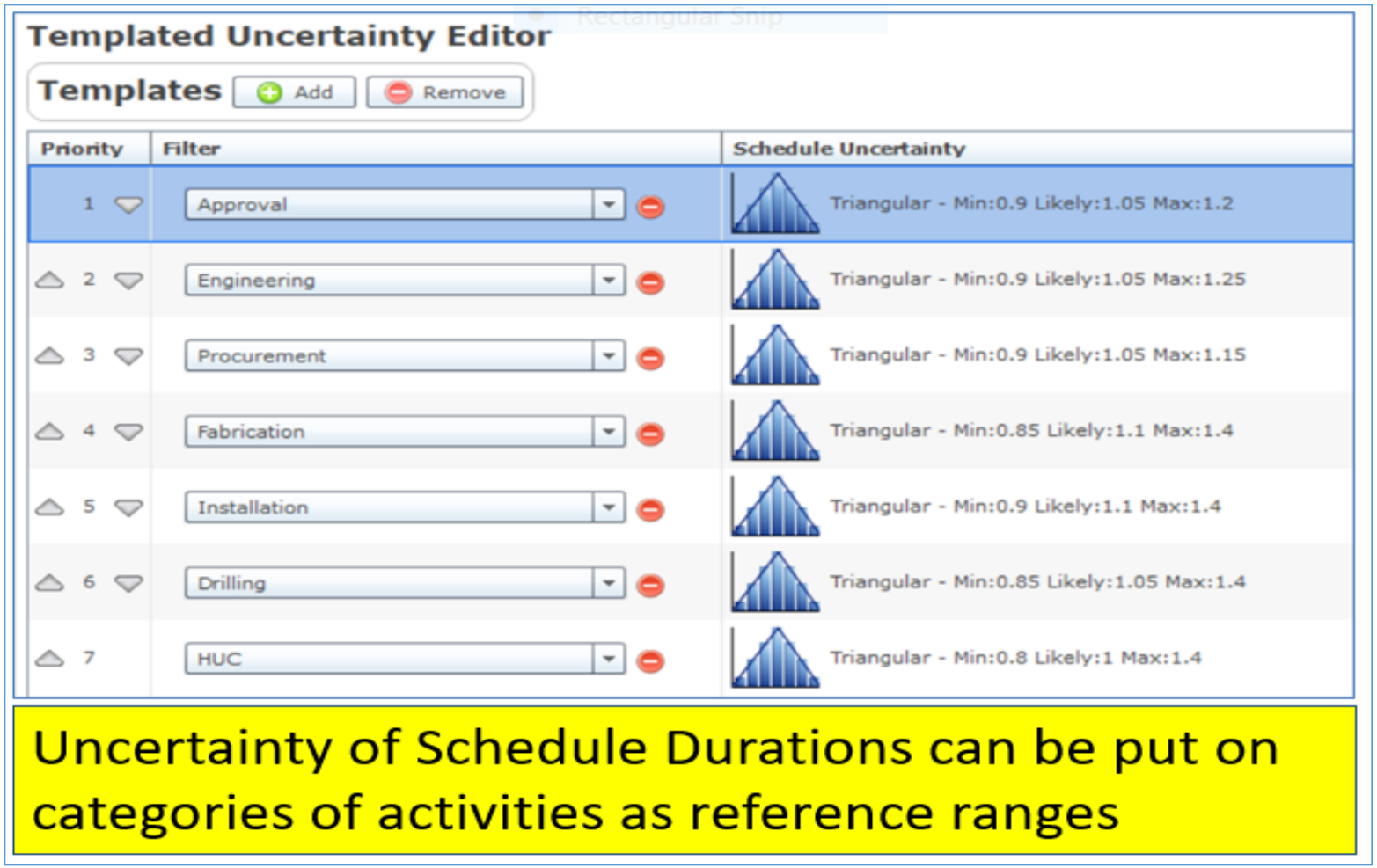
Level 3: Weaknesses

- Since does not use the individual risk, does not identify which risks caused the fluctuations in the MCS
- Does not handle the probability that the risk will / will not occur
- Range estimating cannot capture the effect of individual risks if:
  - An activity if affected by several risks
  - A risk affects multiple activities – chained together
- Require specifying correlation coefficients, about which we are particularly imprecise

Level 4: Modern Quantitative Risk Analysis

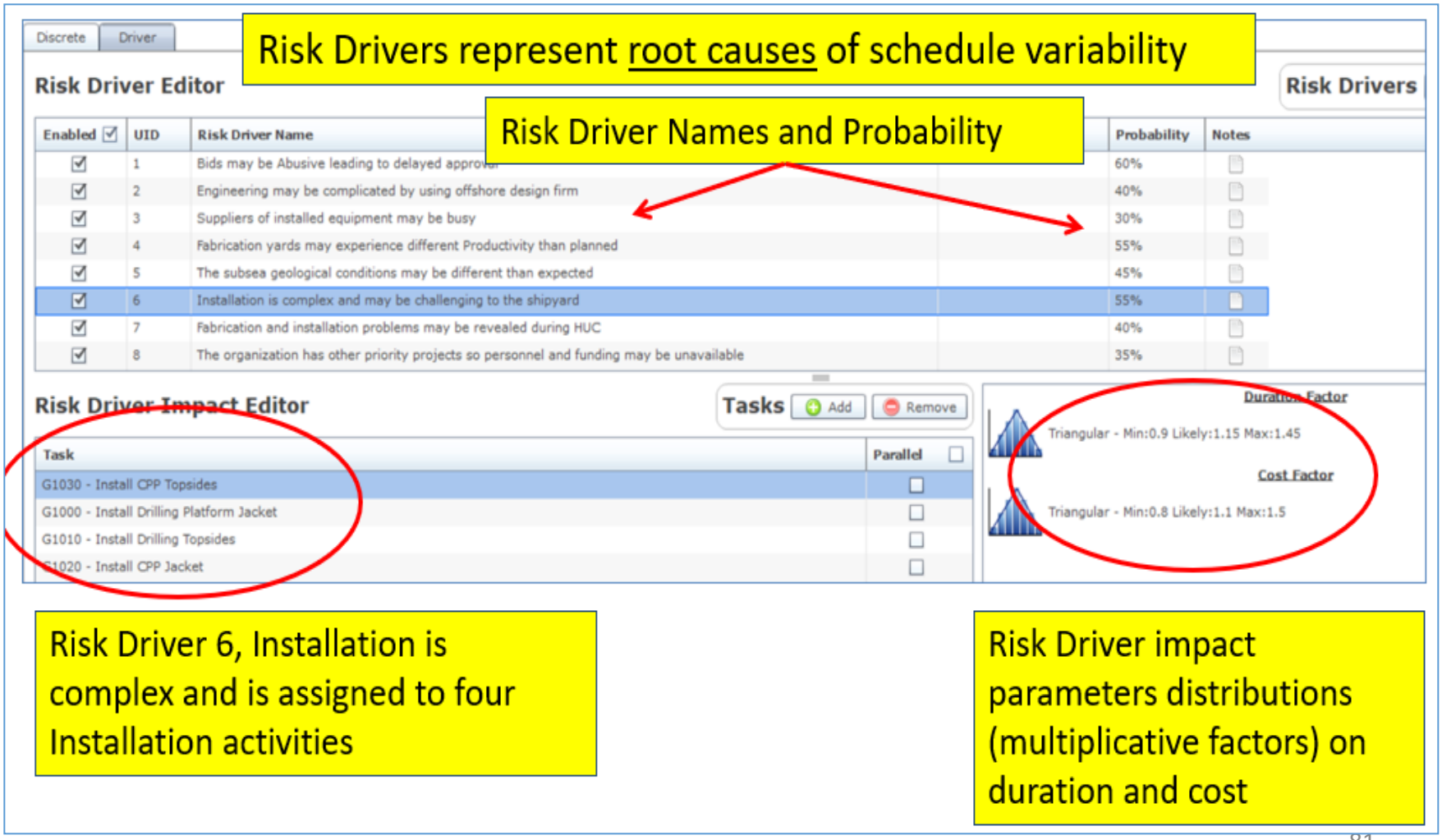
- Builds up risk to the model to simulate the schedule.
- Distinguishes between:
  - *Uncertainty* – background variability, estimating error and bias, if present
  - *Identifiable project-specific risks*, starting from the Level 2 risk register, augmenting it by:
- Collecting quantitative data in confidential risk interviews, identifies “Known-Unknowns” and gets better quality data
- Apply risks to activities they affect
- The risk analyst will often decide to develop a summary schedule for the risk analysis
- Best to compare MCS results to history of schedule overruns of similar projects for “outside view”

Level 4: Applying Uncertainty



Uncertainty of Schedule Durations can be put on categories of activities as reference ranges

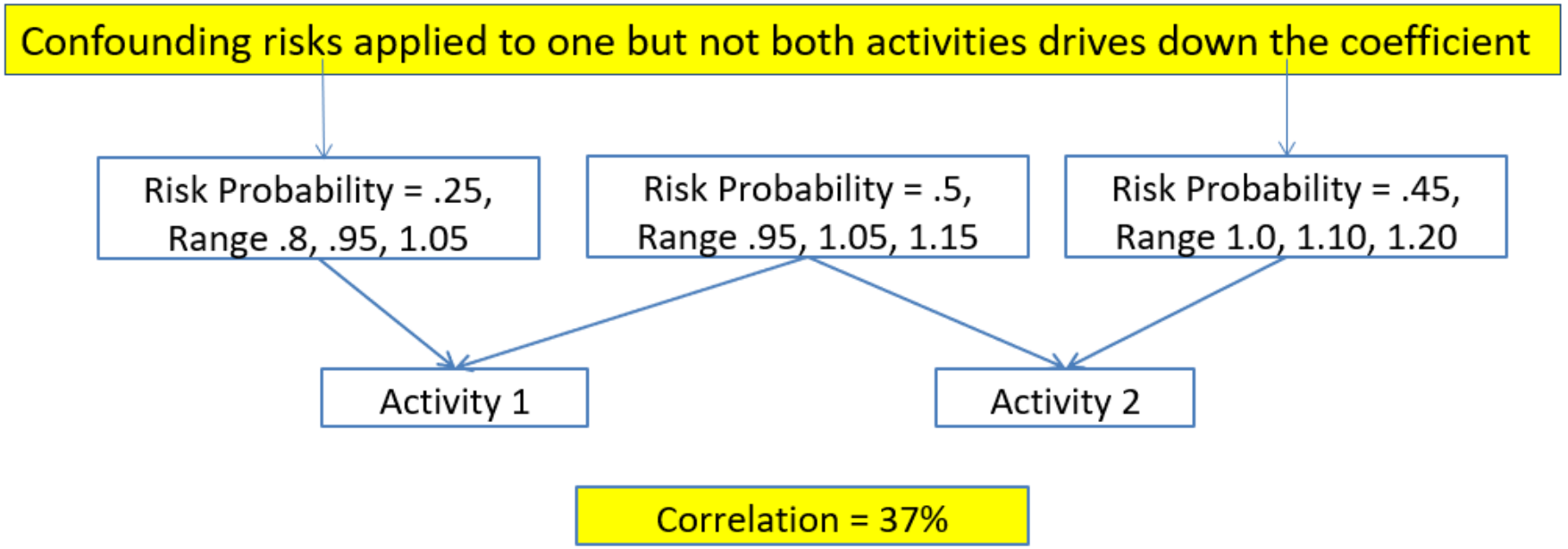
Level 4: Applying Risk Drivers



Level 4: Strengths

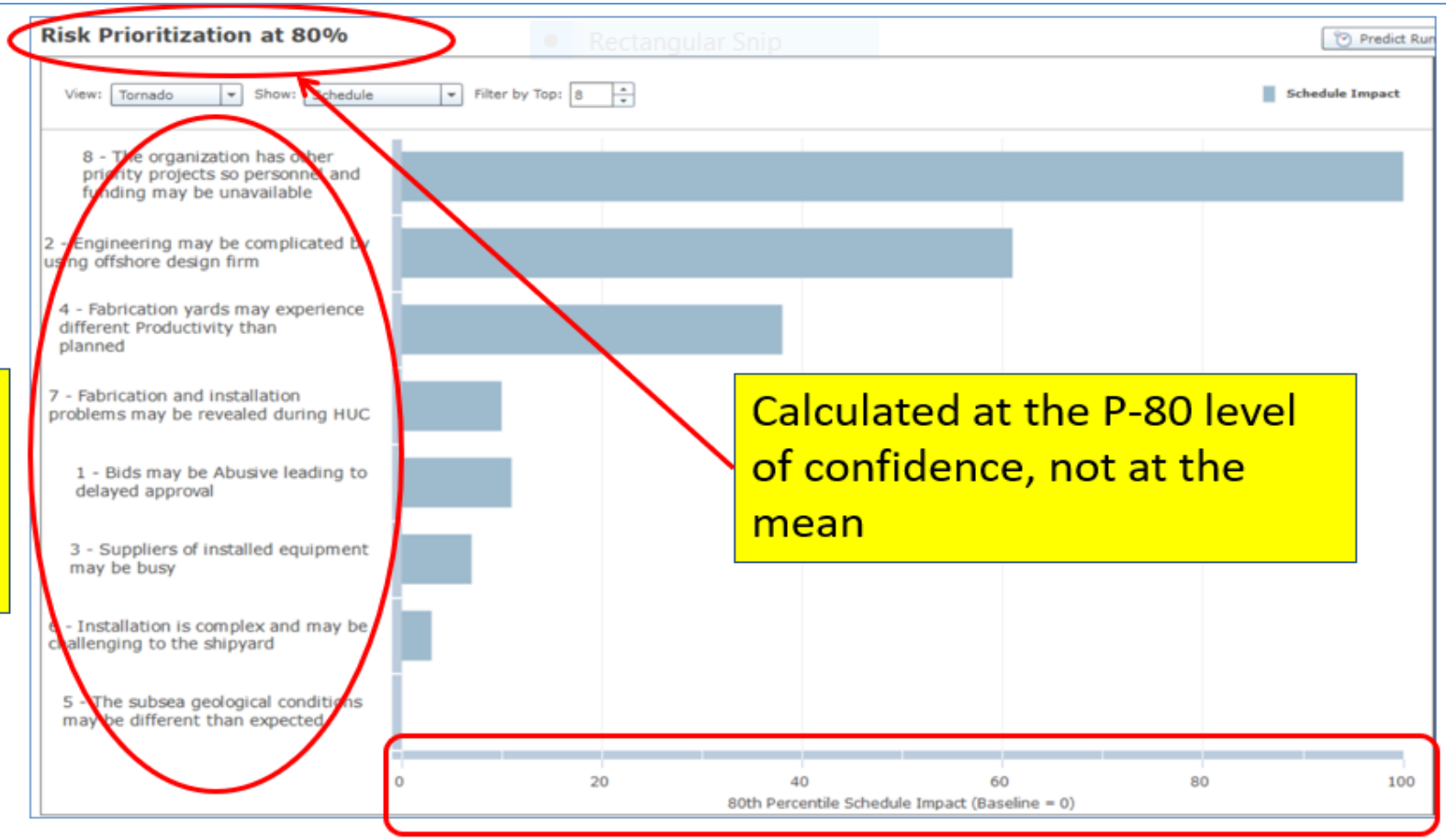
- Applying Risk Drivers *to activities' durations* is easier than estimating the impact on the *project finish date* – Let MCS of the schedule do that part
- Using identified risks to drive the MCS allows us to prioritize individual risks for mitigation
- Collecting risk data using confidential interviews always uncovers risks not in the standard Risk Register at Level 2
- Risk Drivers model how correlation occurs, developing correlation coefficients during MCS

Level 4:Risk Drivers Model Correlation



- Correlation is modeled as it is caused in the project
- Correlation coefficients are generated, not guessed
- Correlation drives the results correctly
- By modeling correlation we never get an inconsistent correlation coefficient matrix (Steve Book)

Level 4: Prioritizing Risks Tornado



Risks, not Activities or paths

Calculated at the P-80 level of confidence, not at the mean

Days saved if mitigated, not correlation coefficients

Level 4: Weaknesses

- Individuals may incorporate their biases when discussing uncertainty concepts about possible future events
- MCS build-up data is developed based on SME's expert judgment
  - We need to check the results from Monte Carlo simulation against historical experience
  - Some suggest that using risk / uncertainty build-up from experts is not able to handle Systemic Risks – a debate.
- Best to compare MCS results to history of schedule overruns of similar projects for "outside view"

Level 5: Integrated Cost-Schedule Risk Analysis

- Recognizes the important fact that activity durations and costs are related when labor-type resources are applied
- Starts with resources costed without contingency being applied to activities
- The resources are distinguished by being time-dependent and time-dependent – handled differently in integrated cost-schedule risk analysis (ICSRA)

- Risk drivers themselves are correlated

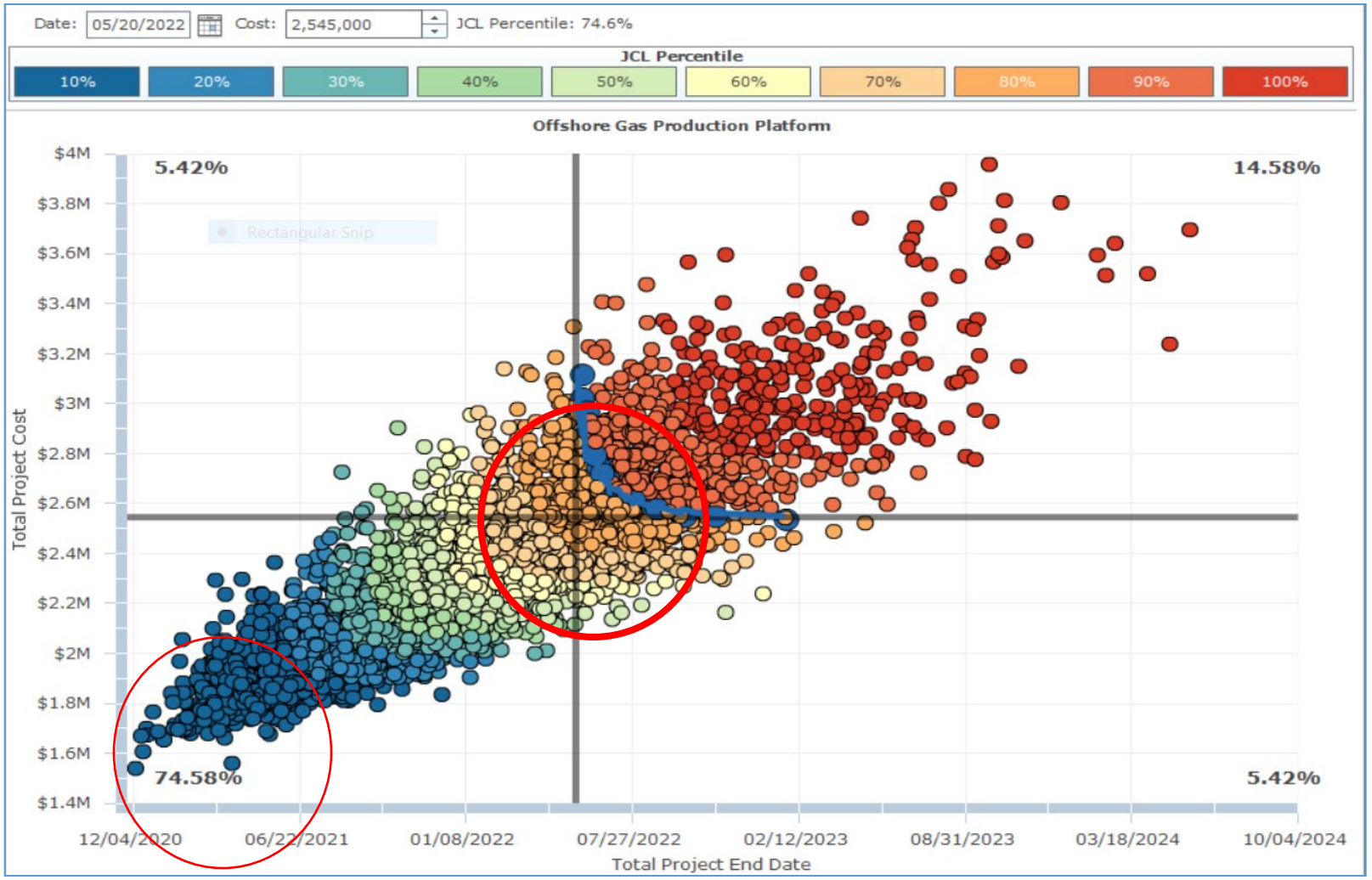
Level 5: Capabilities Needed

- Estimators and schedulers need to communicate activities' costs in a WBS that both can understand and apply
- Be alert to traditional cost risks that could increase or decrease (a) the daily expenditure rate on labor and (b) total cost of time-independent materials, even if schedule is perfect

Level 5: Strengths

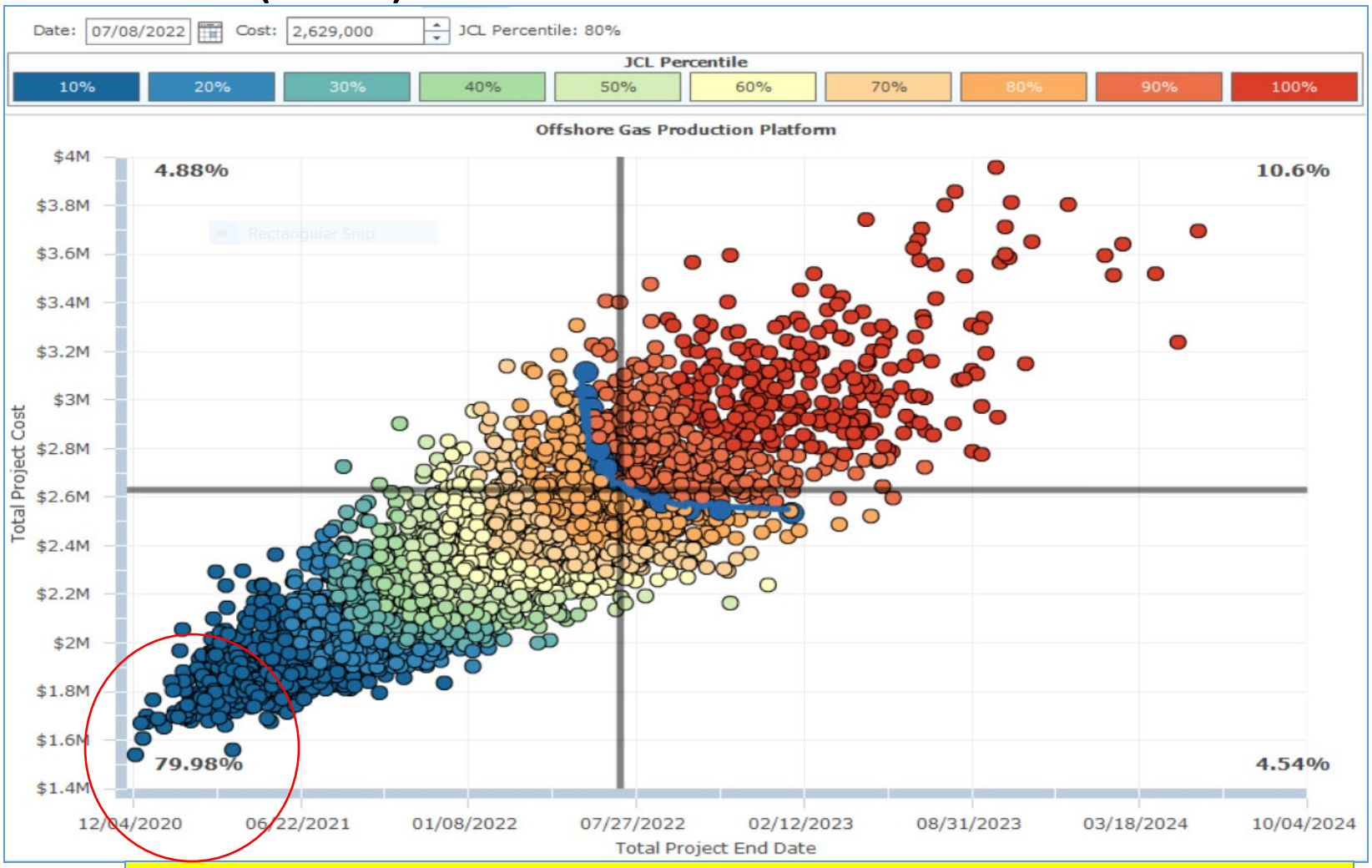
- Histograms, risk prioritization are the same as at Level 4. Risk Drivers can be used in both
- Histograms for cost reflect both:
  - Indirect effect of activity durations on costs
  - Cost-risks applied to labor's burn rate and total time-independent resource's costs
- New concept available, the *Joint Confidence Level* of estimating a finish date and cost that are both likely to be met with some target probability

Level 5: Joint Confidence Level (JCL)



The P-80 for time and cost individually produces only a 74.6% probability of both being met. Influenced by time-cost correlation

Level 5: Joint Confidence Level (JCL)



Adding 6+ weeks to the finish date and $84 million brings the probability of meeting both up to 80%

Level 5: Weaknesses

- The weaknesses at Level 4 are present at Level 5, namely that the MCS build-up rests on the expert judgment of project team members and should be bolstered by reviewing historical data.
  - Best to compare MCS results to history of schedule overruns of similar projects for “outside view”
- There is no good way implemented yet to identify *the most likely JCL-80 combination of cost and schedule*
  - Try to approximate the most likely (top of the 3-D probability “ridge”) from the scatter diagram that is also JCL-80

Project Controls EXPO
Melbourne, Australia

Project Controls Expo – 22nd November 2018 Melbourne Cricket Ground

Quantitative Risk Analysis Demonstration using Safran Risk

About the Speaker

- Civil Engineer and certified AACE Planning and Scheduling Professional
- 18+ years' experience in project planning and controls in the infrastructure and construction industry
- Now an independent consultant offering specialist planning and scheduling services such as
  - Time Location Reporting and
  - Schedule Risk Analysis
  - Graphical Path Planning
- Co-founder of Linear Project Software, producing tools to visualise linear project schedules

AUSTRALASIAN PROJECT PLANNING
www.austprojplan.com.au

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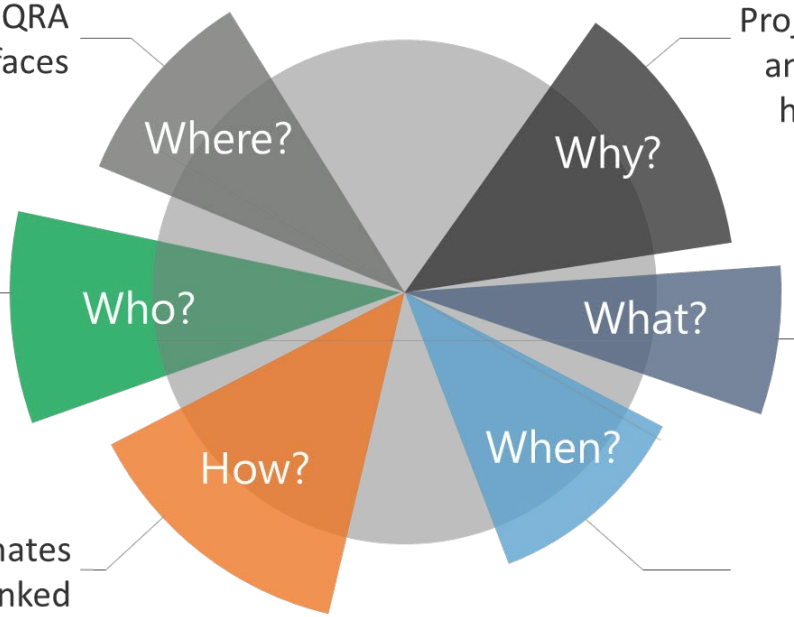
Context for Schedule Risk Analysis

Planning Tools, Risk data, QRA Tool, Interfaces

Projects are probabilistic in nature and risk analysis information can help set realistic timescales and cost



Project Controls Teams (Cost/Schedule/Risk), Operations & Delivery, Project & Senior Management

Realistic information on project durations and cost taking into account risk

Monte Carlo sampling on estimates with risks and their impacts linked to estimate/schedule

As required through the project lifecycle, for setting timescales, budgets and contingency before execution and to aid project controls forecasting during execution

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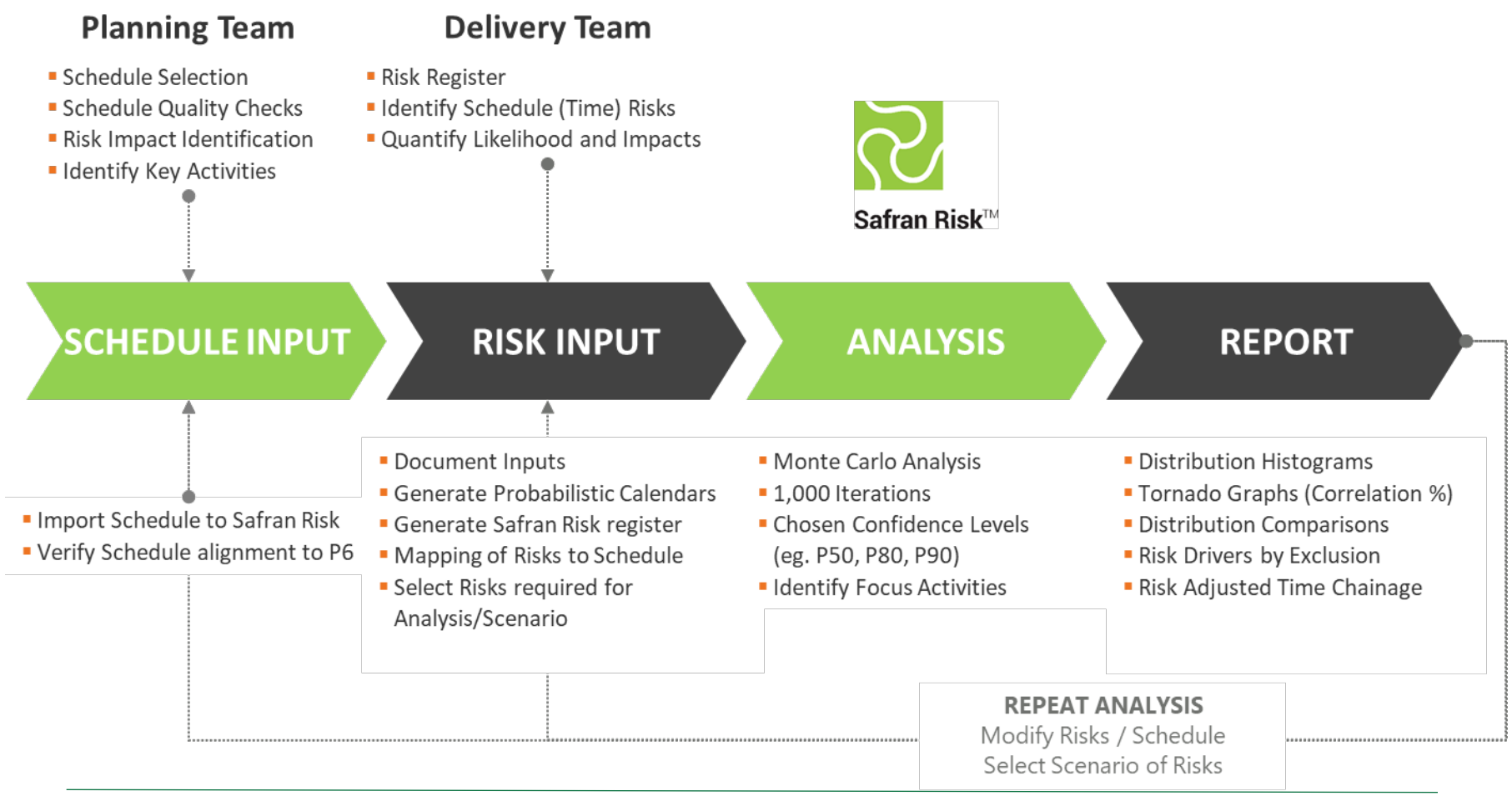
Preparing the Risk Model

Tools Used

- ❑Planning/Scheduling tools
- ❑Cost estimating & control Tools
- ❑Risk management tools
- ❑QRA tools
- ❑Import/export interfaces

Safran Risk
https://www.safran.com/risk

Analysis Process



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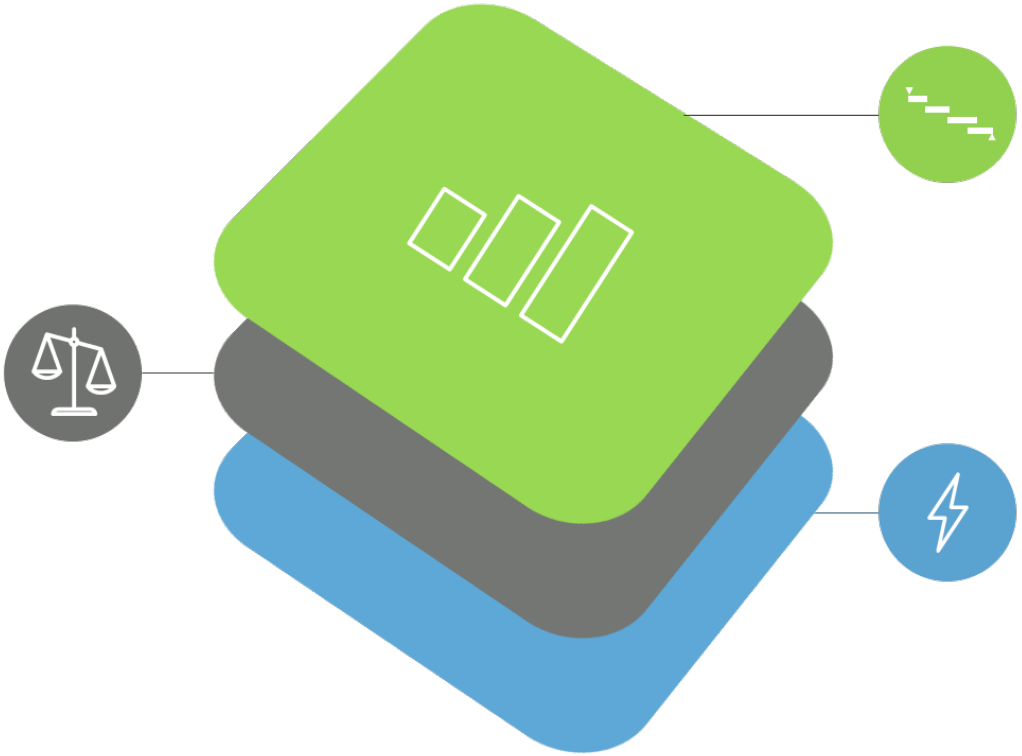
The Risk Model

Inputs to the Analysis are



Schedule

Model representing project methodologies and outcomes

Risks

Quantified time related uncertainties that will affect the project schedule

Risk Impacts

The distribution of risks across the project schedule

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Importing and Checking Schedule

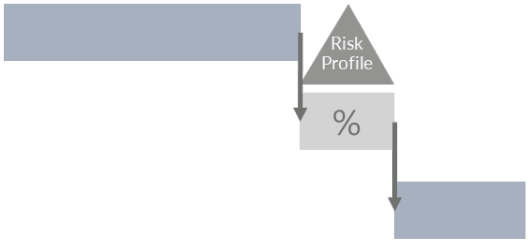
Key Schedule Quality Issues

- **Open Ends** and **High Floats**: risk impacts will have no effect
- **Constraints**: Hard Constraints (Mandatory or Must Start/Finish on) ignore activity relationships and hold dates. As Late As Possible activities may simply start earlier rather than delaying finish
- **Negative or Excessive Lags**: Lags may not represent realistic behaviour of relationships
- **Out of Sequence Activities**: may effect activity behaviour by retaining logic
- **Calendar changes**: Multiple calendars can cause unrealistic results on activities

Time Related Risks

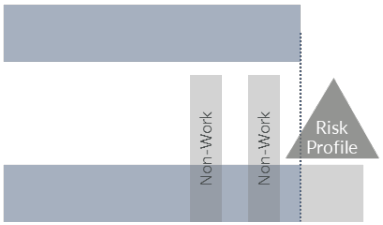
Duration Uncertainty

Uncertainty in the scope of work or variance in the delivery method from the base schedule. The likelihood of occurrence of is 100%.



Contingent Risks

Unforeseen events that are not included in, but may impact the base schedule. The likelihood of occurrence is under 100%. Also known as discrete risks



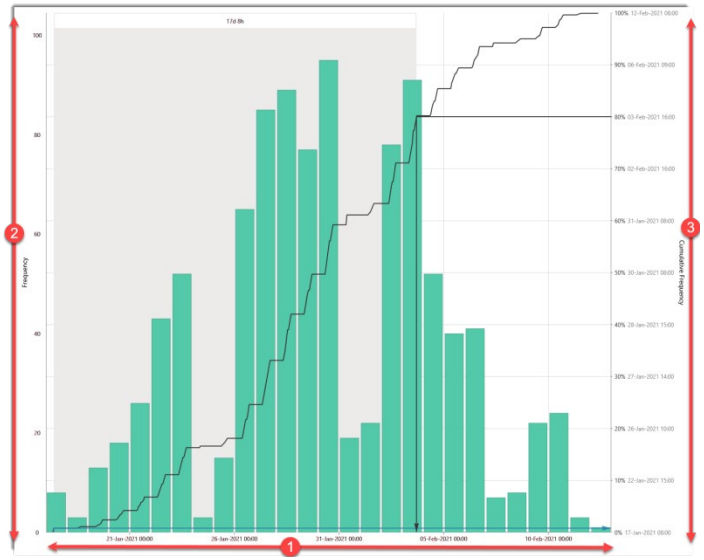
Calendar Uncertainty

Uncertainty in the available work periods of the base schedule. Also known as probabilistic calendars

Distribution Outputs

Distribution Graphs present the results of the Monte-Carlo analysis for a chosen activity (or summary)

1. Horizontal axis is the range of resultant analysis dates for the selected activity, from minimum (earliest) to the maximum (latest).
2. Left hand axis represents the **Frequency** of each result, as shown by the vertical bars
3. Right hand axis represents the **Cumulative Frequency** of results expressed as percentage of total results, as shown by the distribution curve.



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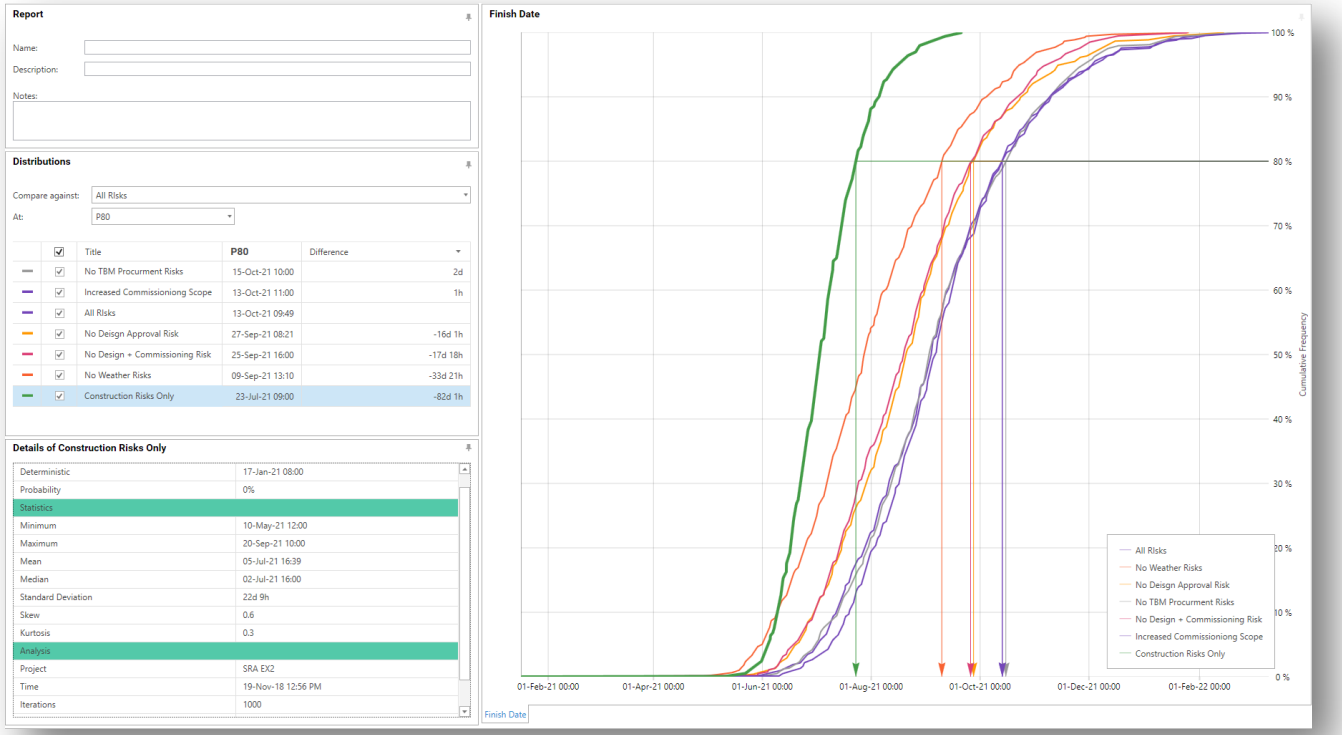
Output Comparisons

Compare Results Across key items in model, or against scenarios of models



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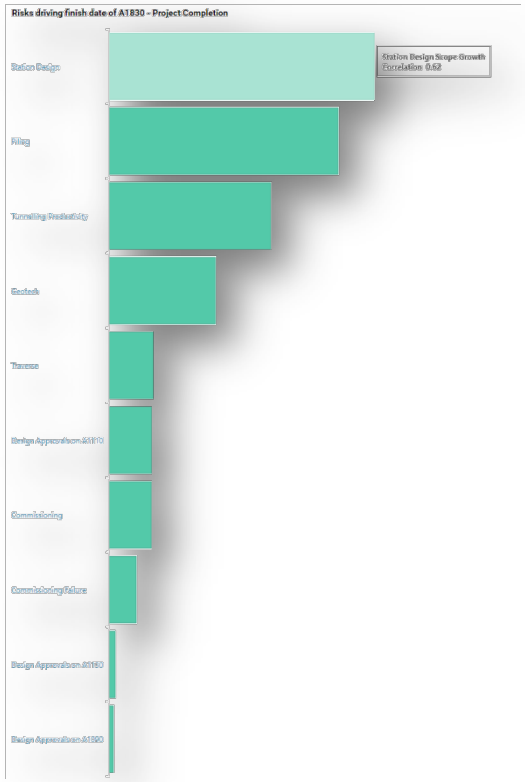
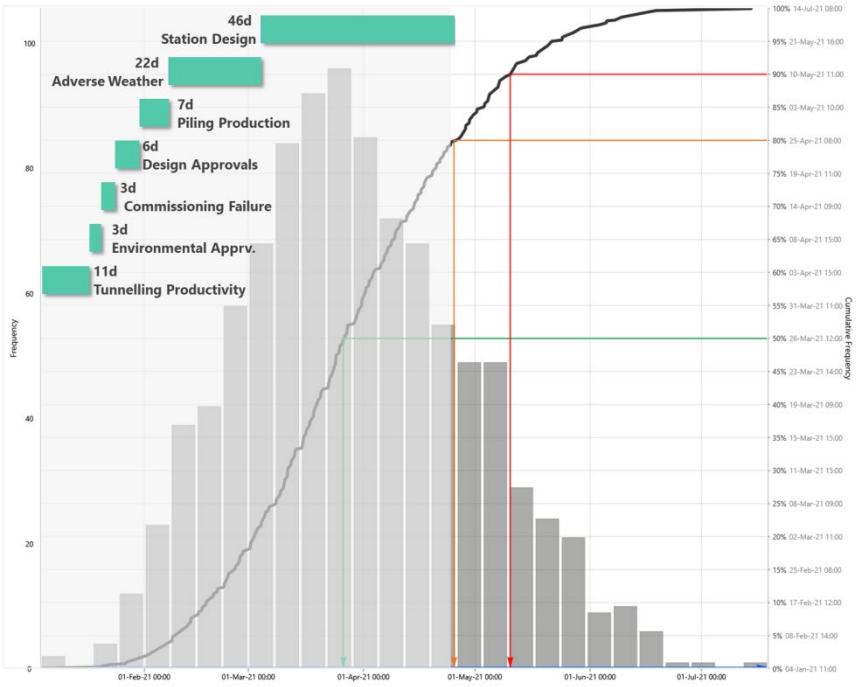
Sensitivity Outputs

Tornado Driver chart vs **Risk Prioritisation**





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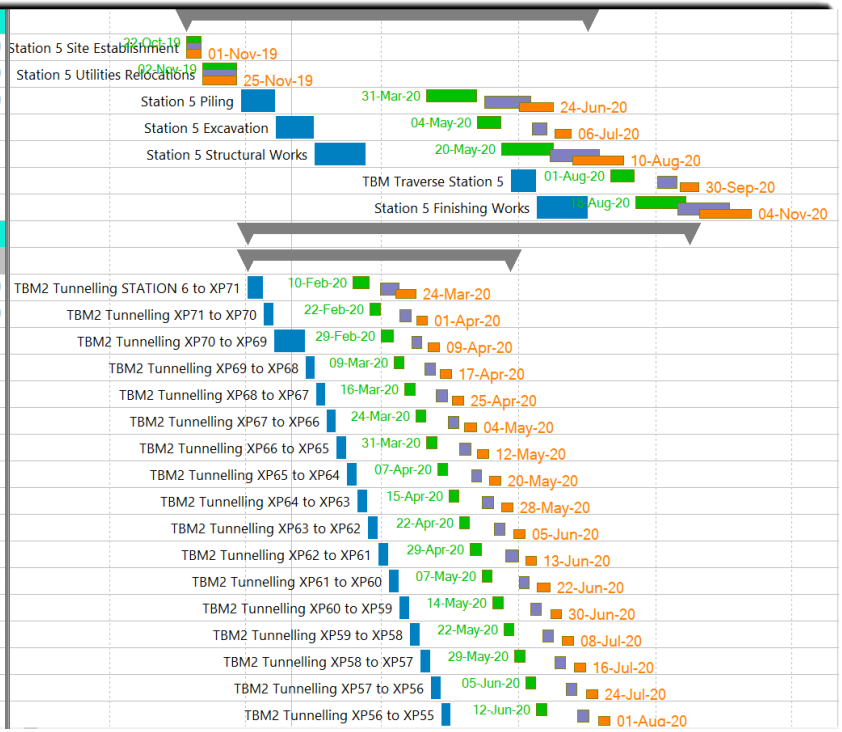
Risk Adjusted Schedules

Presenting a Schedule at Pxx Dates

TCHART_	CONSTRUCTION - STATION 5				
2170	Station 5 Site Establishment	10 d	22-Oct-19	01-Nov-19	
2180	Station 5 Utilities Relocations	20 d	02-Nov-19	25-Nov-19	
2190	Station 5 Piling	20 d	28-Nov-19	20-Dec-19	
2200	Station 5 Excavation	10 d	21-Dec-19	15-Jan-20	
2210	Station 5 Structural Works	30 d	16-Jan-20	19-Feb-20	
2220	TBM Traverse Station 5	15 d	27-May-20	12-Jun-20	
3170	Station 5 Finishing Works	30 d	13-Jun-20	17-Jul-20	
TCHART_	TUNNEL STATION 6 to STATION 5				
TCHART	TUNNELLING				
2820	TBM2 Tunnelling STATION 6 to XP71	10 d	02-Dec-19	12-Dec-19	
2810	TBM2 Tunnelling XP71 to XP70	6 d	13-Dec-19	19-Dec-19	
2800	TBM2 Tunnelling XP70 to XP69	6 d	20-Dec-19	09-Jan-20	
2790	TBM2 Tunnelling XP69 to XP68	6 d	10-Jan-20	16-Jan-20	
2780	TBM2 Tunnelling XP68 to XP67	6 d	17-Jan-20	23-Jan-20	
2770	TBM2 Tunnelling XP67 to XP66	6 d	24-Jan-20	30-Jan-20	
2760	TBM2 Tunnelling XP66 to XP65	6 d	31-Jan-20	06-Feb-20	
2750	TBM2 Tunnelling XP65 to XP64	6 d	07-Feb-20	13-Feb-20	
2740	TBM2 Tunnelling XP64 to XP63	6 d	14-Feb-20	20-Feb-20	
2730	TBM2 Tunnelling XP63 to XP62	6 d	21-Feb-20	27-Feb-20	
2720	TBM2 Tunnelling XP62 to XP61	6 d	28-Feb-20	05-Mar-20	
2710	TBM2 Tunnelling XP61 to XP60	6 d	06-Mar-20	12-Mar-20	
2700	TBM2 Tunnelling XP60 to XP59	6 d	13-Mar-20	19-Mar-20	
2690	TBM2 Tunnelling XP59 to XP58	6 d	20-Mar-20	26-Mar-20	
2680	TBM2 Tunnelling XP58 to XP57	6 d	27-Mar-20	02-Apr-20	
2670	TBM2 Tunnelling XP57 to XP56	6 d	03-Apr-20	09-Apr-20	
2660	TBM2 Tunnelling XP56 to XP55	6 d	10-Apr-20	16-Apr-20	



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Outputs

Contents of a Schedule Risk Analysis Report

1. **Overview/Background**: the purpose for the analysis
2. **Schedule**: Identify the schedule, key details (e.g. Id, data date, No. of Activities etc). Any modifications made to the schedule for SRA requirements
3. **Key Activities**: Identify the key milestones or activities that the analysis will monitor and their corresponding deterministic date
4. **Risks**: clearly document the risks being analysed, with key details (e.g. name, description, probability, impact values, impacted activities)
5. **Results**: Selected confidence levels, distribution graphs, comparisons, sensitivities, risk adjusted schedules
6. **Commentary**: Conclusions, key driving risks, further actions

The Future – Smart cities

SYNCHRONY

The future – access and airspace

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Autonomous Vehicles – Infrastructure, Energy Sources

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Artificial Intelligence

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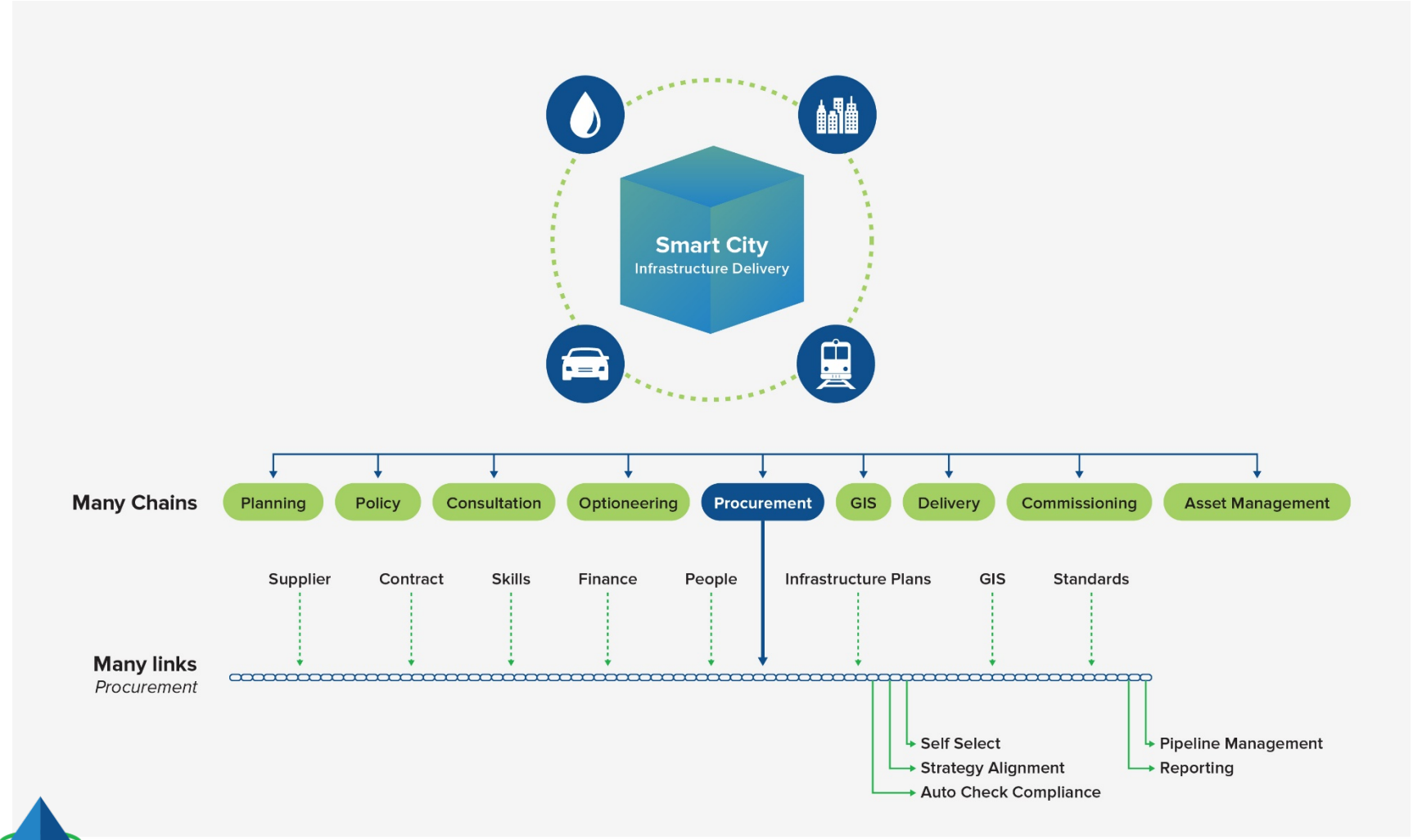
Blockchain



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The Future - Key Points

- Projects are becoming more integrated and complex systems engineering and asset management problems.
- Larger opportunities for benefits (e.g. automation and AI) and greater vulnerabilities (e.g. Cyber risks and AI).
- The rate of change will keep increasing
- Culture and change management issues for organizations and government departments.

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THANKYOU

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