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Creating value from uncertainty

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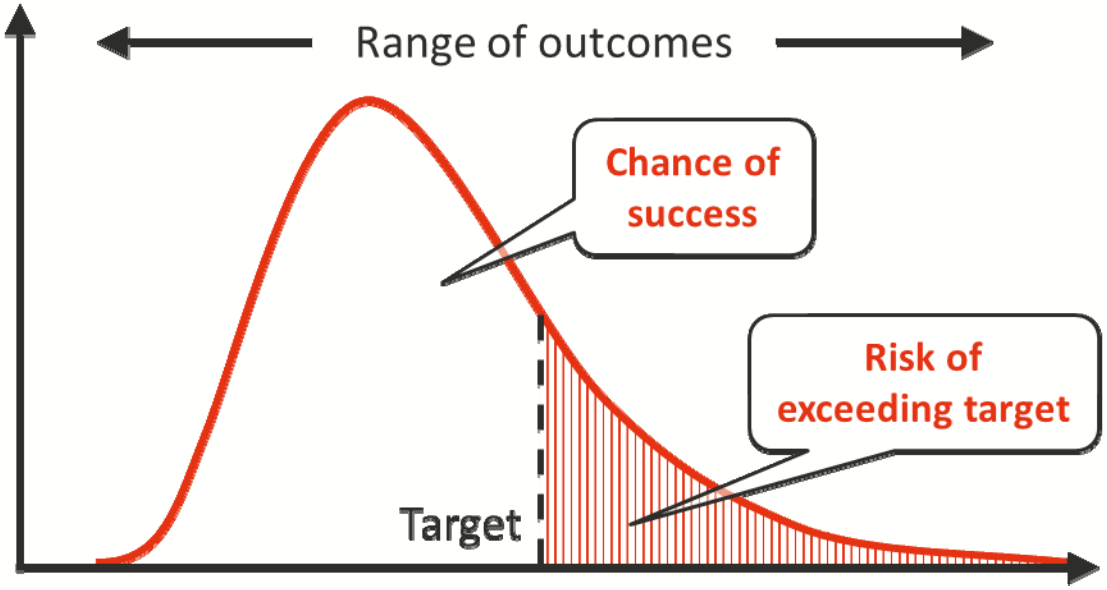
Cost and schedule risk assessment



PMI Australia Conference 2014

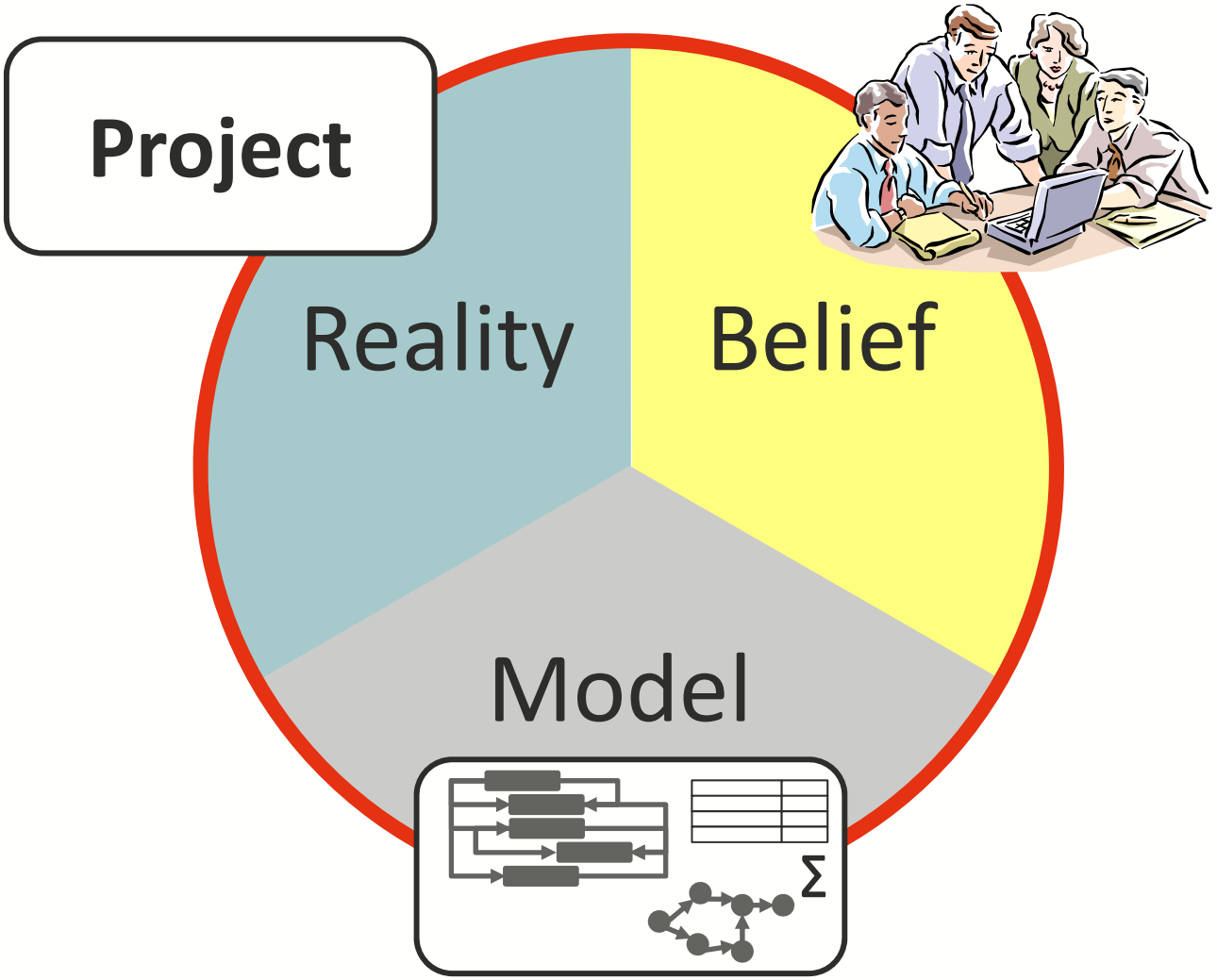
Presented by Dr Stephen Grey

Theme

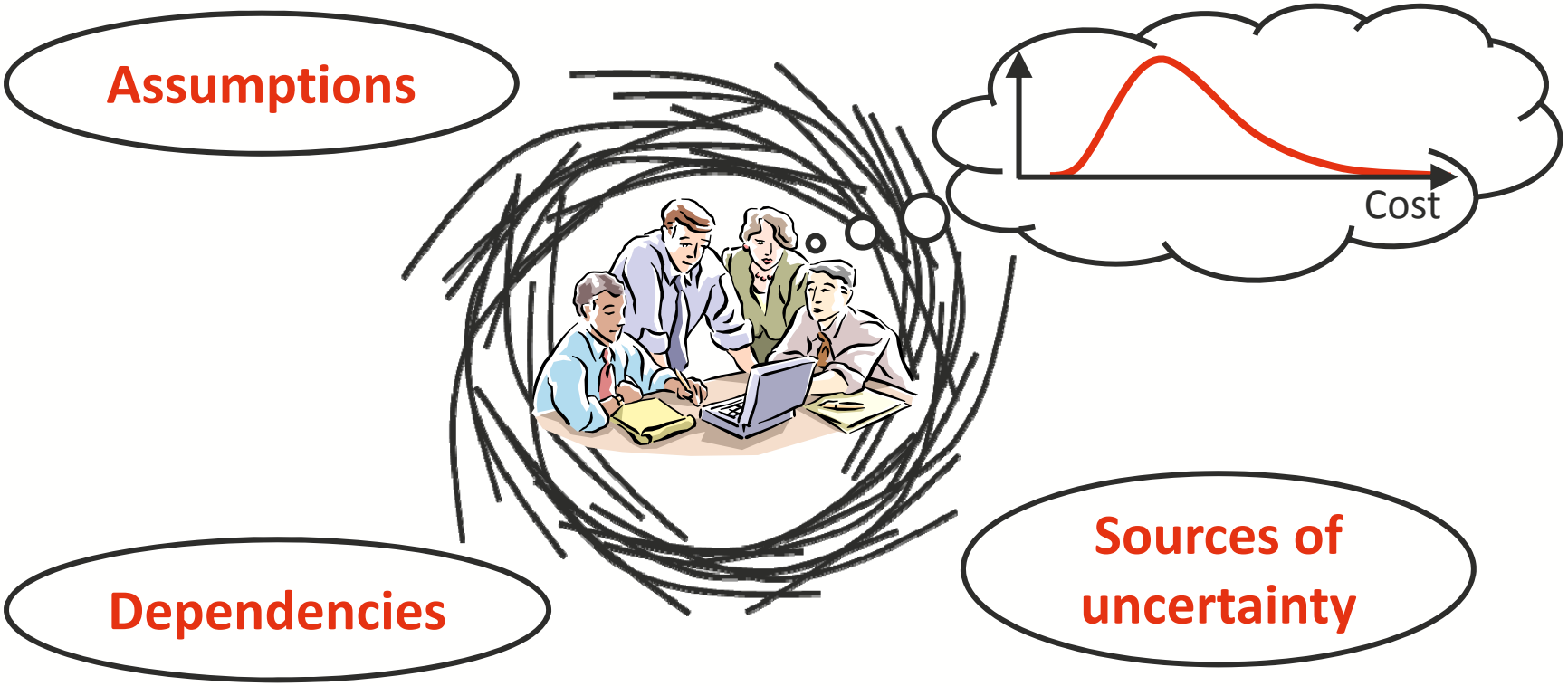
A lot of quantitative risk assessment is unnecessarily cumbersome and soaks up effort without adding value to a project.

The approaches used often make it very hard to think clearly and realistically about a project.

Modelling

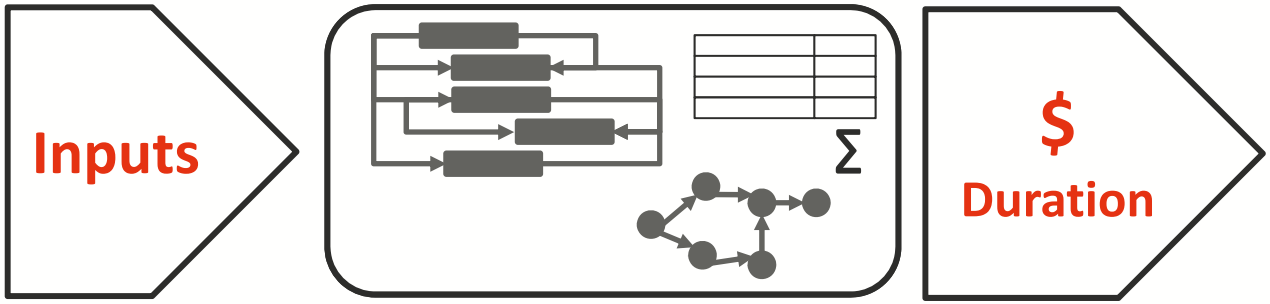


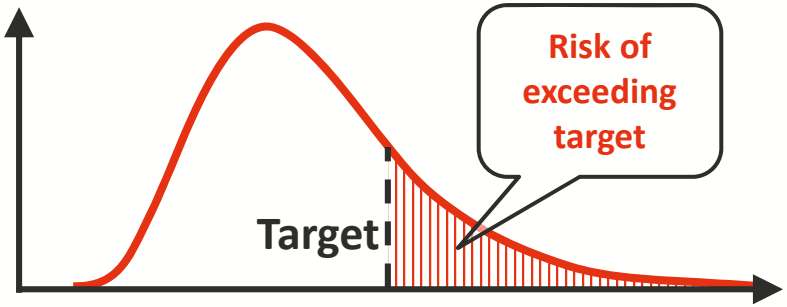
Describing a model



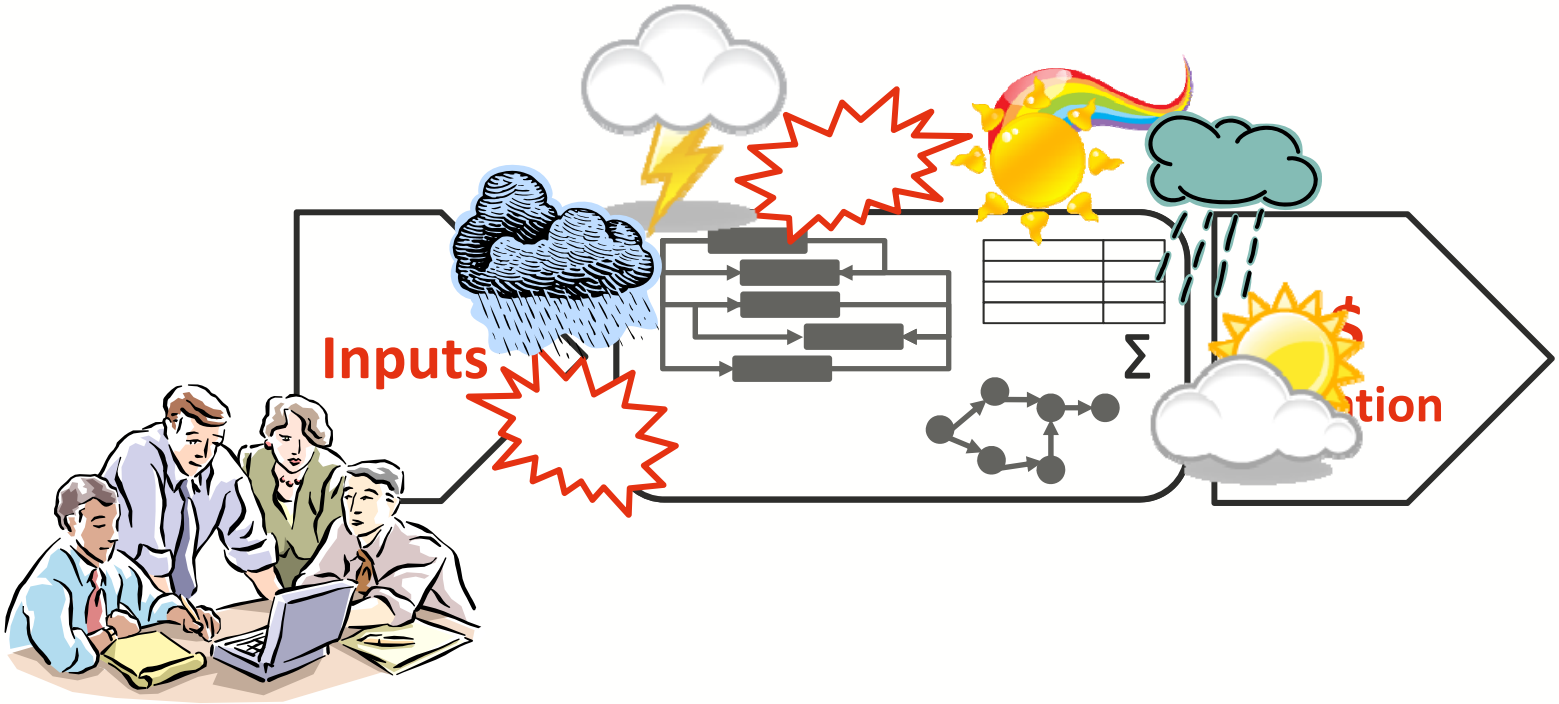
The requirement

Requirement

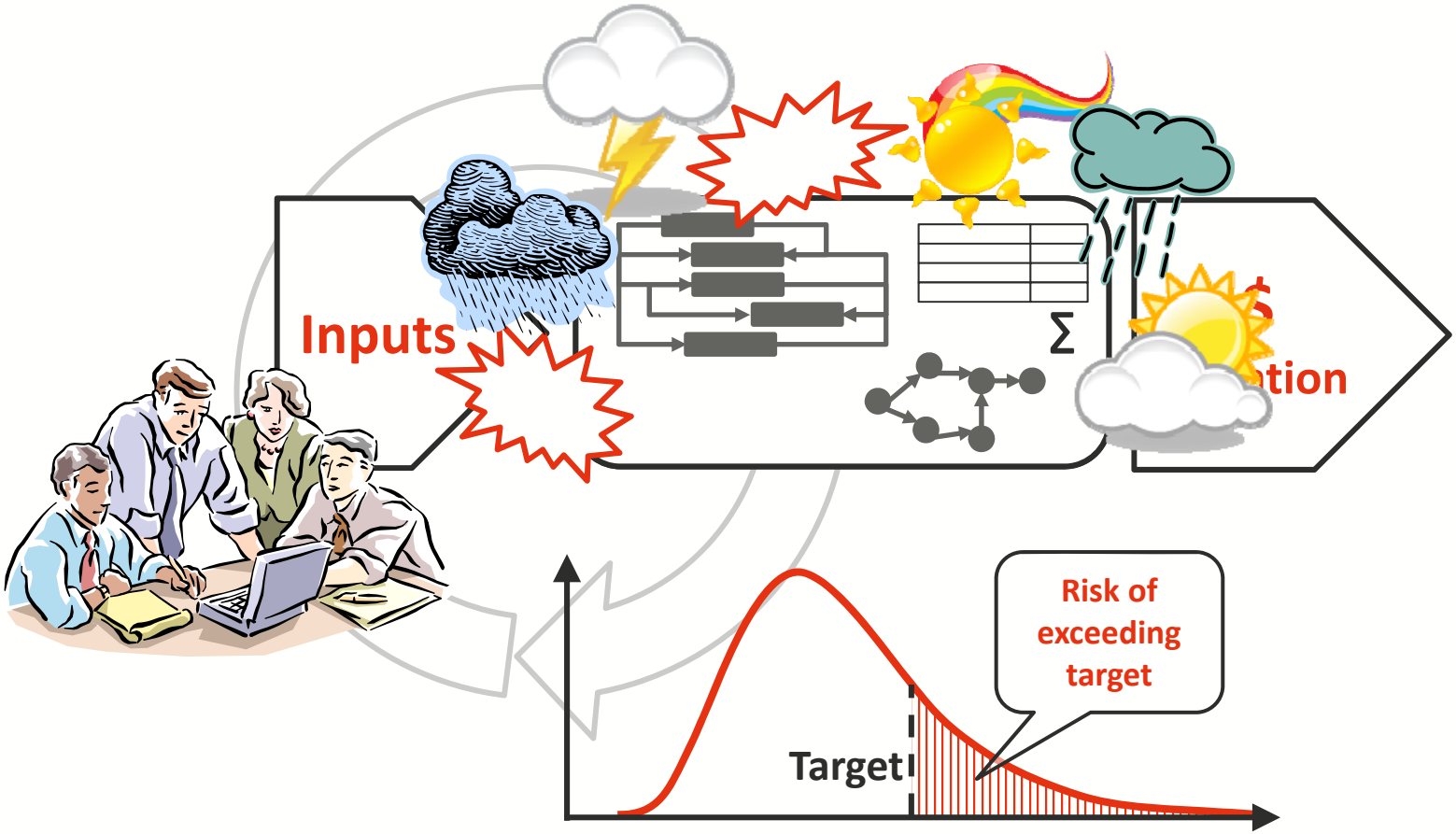




Requirement



Requirement



The candidates

Three methods

Risk events

- List risks
- Probability and impact (range of variation)
- Add them up

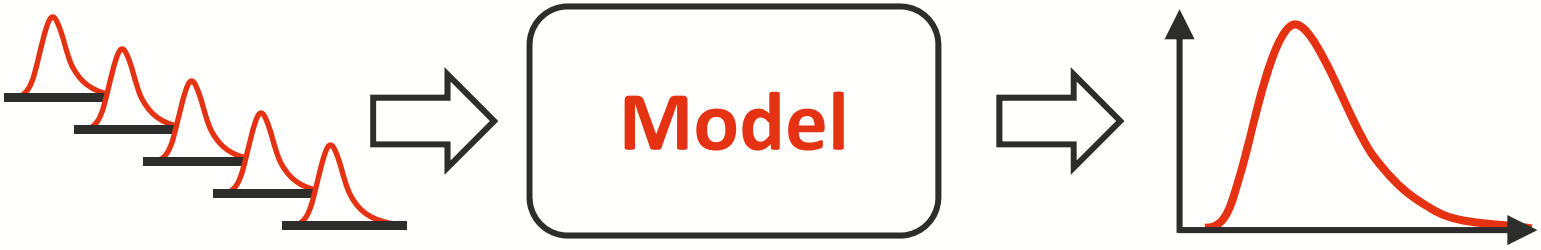
Line items

- Line items from estimate (summary)
- Range of variation in line item
- Add them up

Risk factors

- Cost or duration estimating relationships
- Uncertainty in inputs to relationships (ranges)
- Simulate the effect on the base case

Similarities



Relationships in the model ≡ Relationship in reality?

Is the link between inputs and reality easily understood?

Almost any attention to project risk will be beneficial

Some are more cost-effective than others

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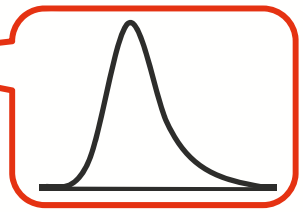
Risk event model

Risk	Probability	Impact	P x I
Risk 1	P_1		$P_1 \times I_1$
Risk 2	P_2		$P_2 \times I_2$
Risk 3	P_3		$P_3 \times I_3$
Risk 4	P_4		$P_4 \times I_4$
…	…	…	
Risk n	P_n		$P_n \times I_n$
Total			$\Sigma P_i \times I_i$

Monte Carlo simulation



Modelling based on risk events

Risk	Probability	Impact	P x I
Risk 1	P_1		$P_1 \times I_1$
Risk 2	P_2		$P_2 \times I_2$
Risk 3	P_3		$P_3 \times I_3$
Risk 4	P_4		$P_4 \times I_4$
…	…	…	
Risk n	P_n		$P_n \times I_n$
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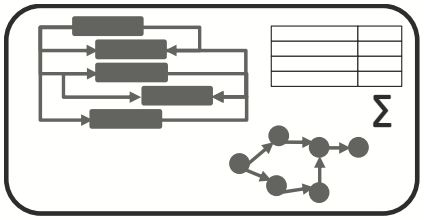
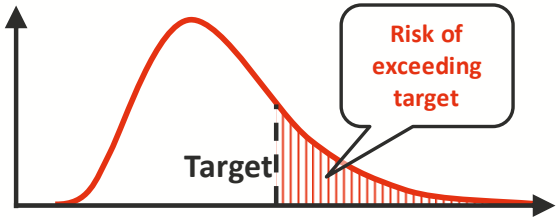
Monte Carlo simulation



Indirect inclusion of original cost and schedule relationships



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Line item modelling

WBS Item	Labour	Materials	Total	Contingency
Annnn	$	$	$	
Bnnnn	$	$	$	
Cnnnn	$	$	$	
Dnnnn	$	$	$	
…	…	…	…	…
Znnnn	$	$	$	
Total			**Σ$**	**Σ$**

Monte Carlo simulation

Line item modelling

WBS Item	Labour	Materials	Total	Contingency
Annnn	$	$	$	
Bnnnn	$	$	$	
Cnnnn	$	$	$	
Dnnnn	$	$	$	
…	…	…	…	…
Znnnn	$	$	$	
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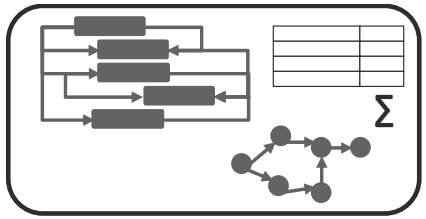
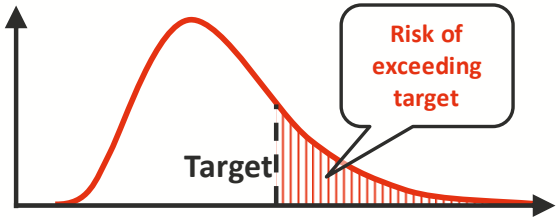
Monte Carlo simulation



Indirect inclusion of original cost and schedule relationships



Risk factors model

Cost estimating relationships (e.g. Cost = Quantity x Unit rate)

Simulated cost = Base estimate x (1 + ΔQuantity) x (1 + ΔRate)

Uncertainty about quantities of concrete (m^3)

Project estimate summary								
	Labour	Facilities	Super-vision	Materials	Sub-contracts	Services	Expenses	Total
Earthworks	1234567	1234567	1234567	1234567	1234567	1234567	1234567	?
Concrete	1234567	1234567	1234567		1234567	1234567	1234567	?
…	1234567	1234567	1234567	1234567	1234567	1234567	1234567	?
Overheads	1234567	1234567	1234567	1234567	1234567	1234567	1234567	?
Project Total	?	?	?	?	?	?	?	

Uncertainty about rates for cost of concrete ($/$m^3$)

Risk factor modelling

Simulated cost = Base estimate x (1 + ΔQuantity) x (1 + ΔRate)

Uncertainty about quantities of concrete (m^3)

Project estimate summary	Labour	Facilities	Super-vision	Materials	Sub-contracts	Services	Expenses	Total
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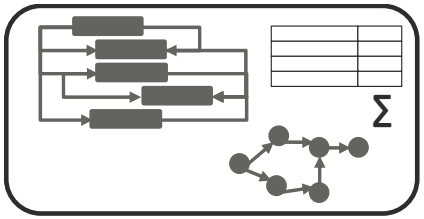
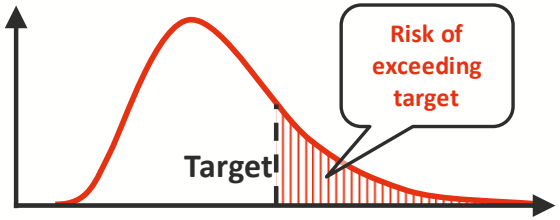
...	1234567	1234567	1234567	1234567	1234567	1234567	1234567	?
Overheads	1234567	1234567	1234567	1234567	1234567	1234567	1234567	?
Project Total	?	?	?	?	?	?	?	

Uncertainty about rates for cost of concrete ($/$m^3$)

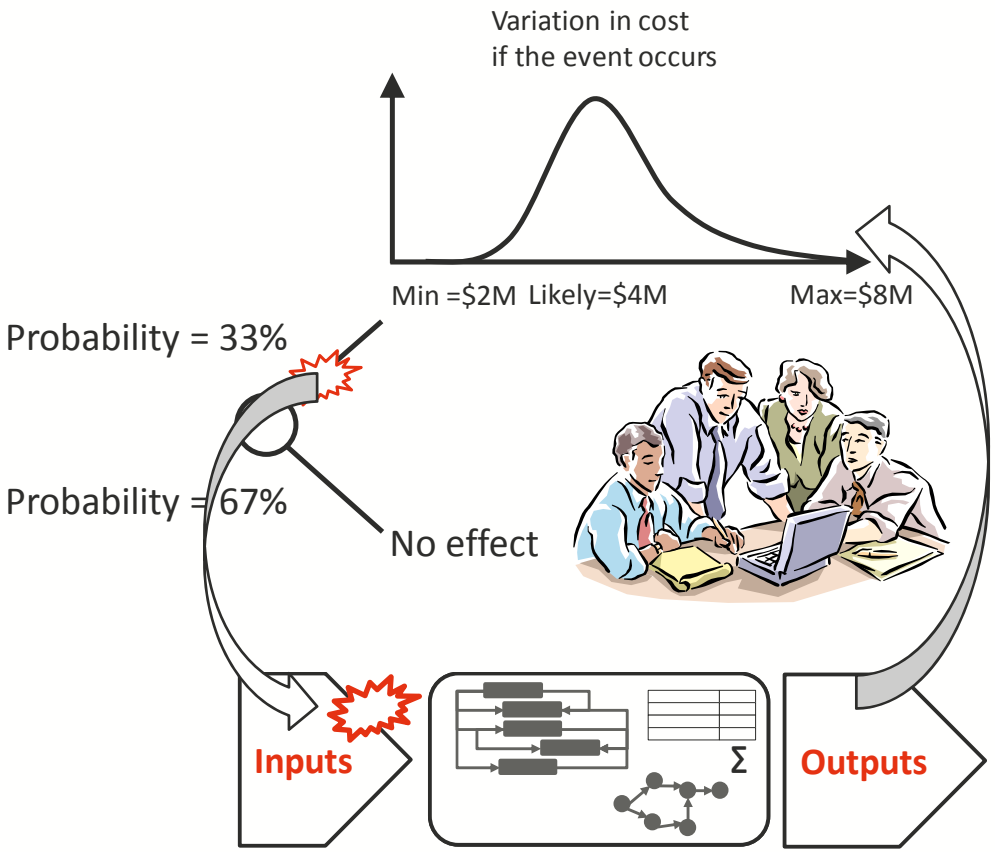


Direct inclusion of original cost and schedule relationships

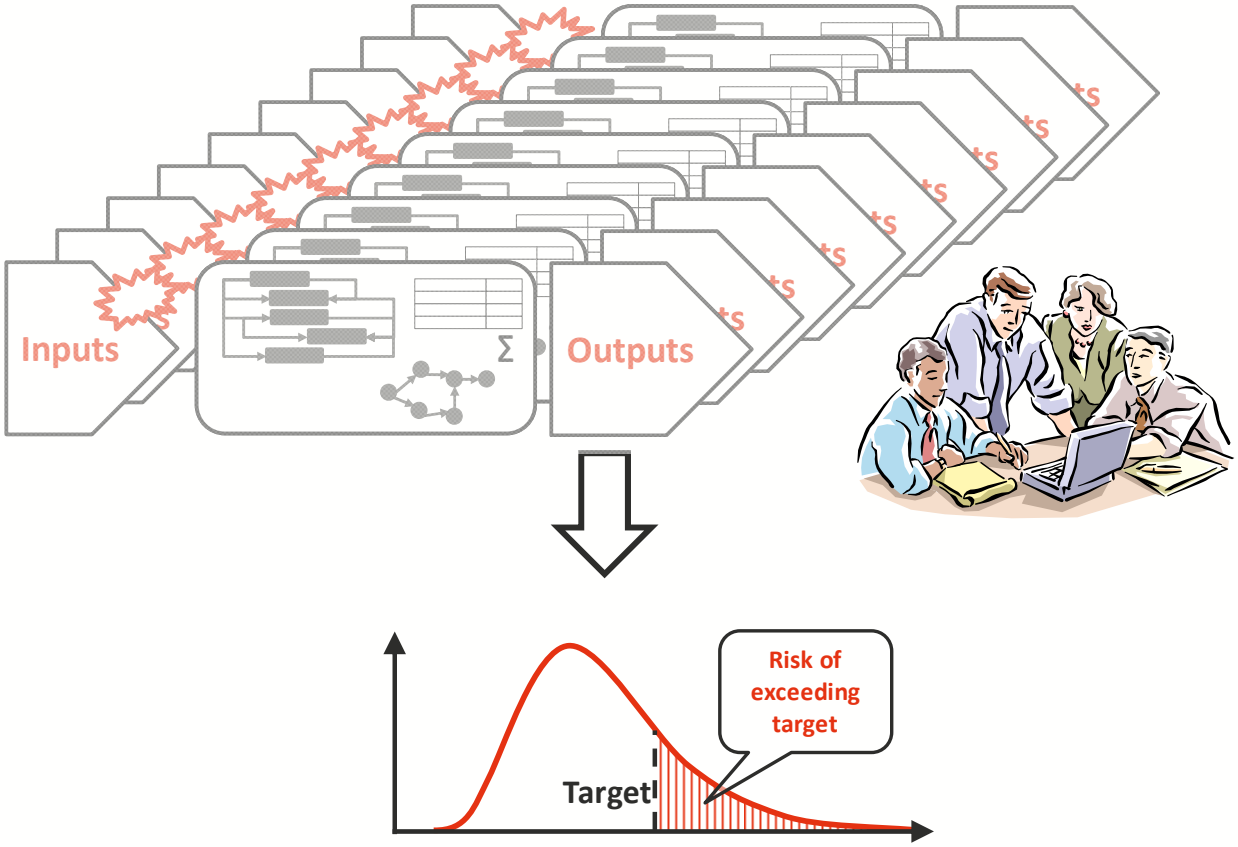


Making it work

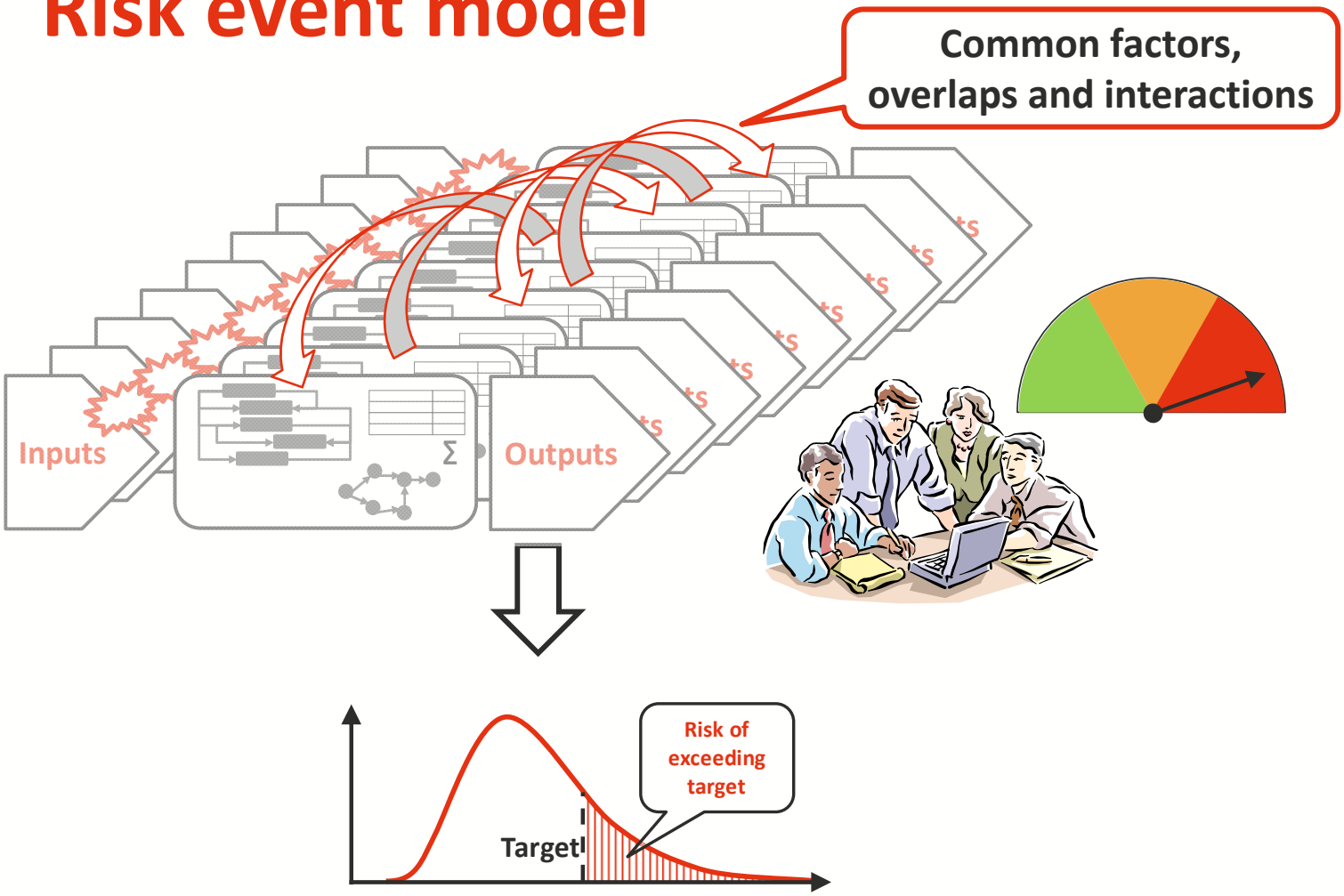
Risk event


Variation in cost
if the event occurs
Min =$2M
Likely=$4M
Max=$8M
Probability = 33%
Probability = 67%
No effect
Inputs
Σ
Outputs

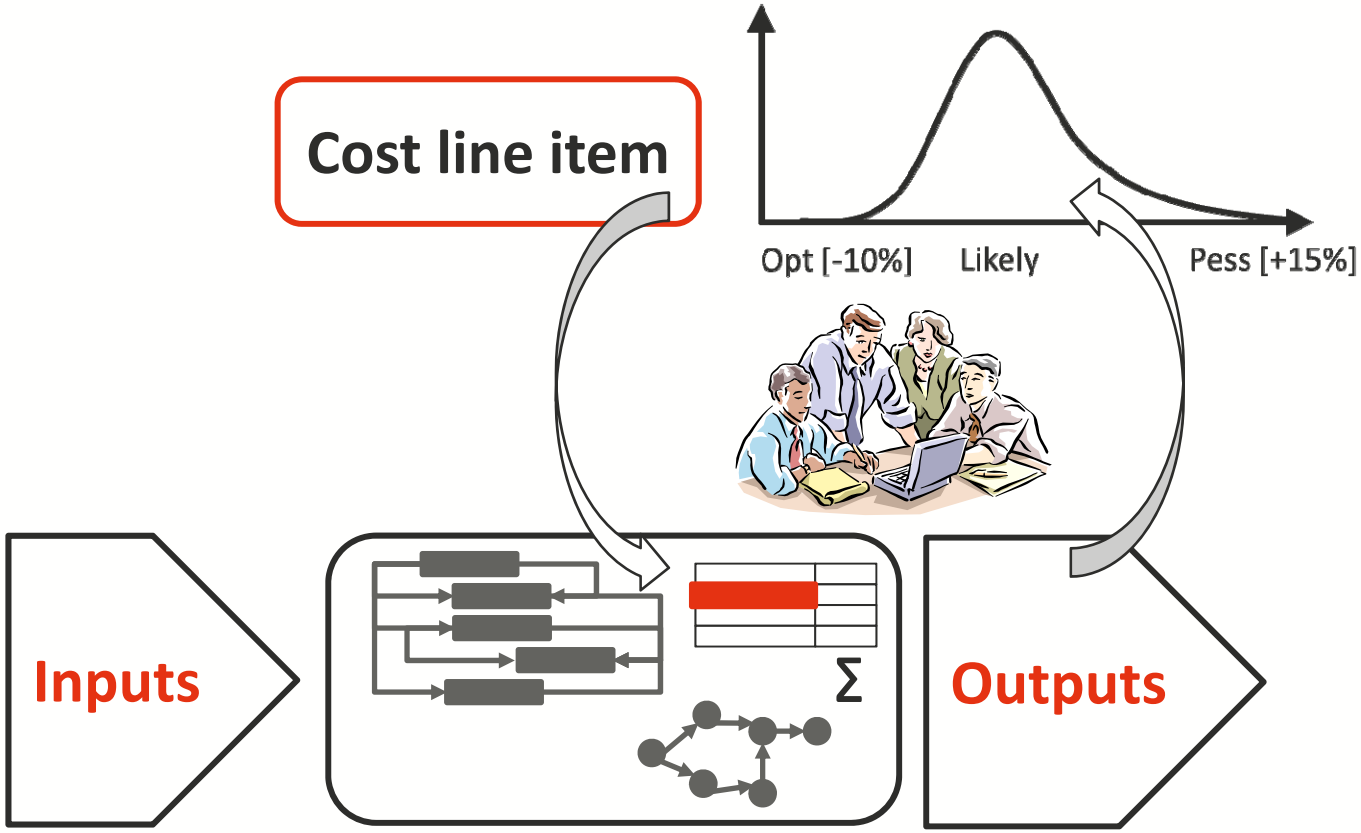
Risk event model



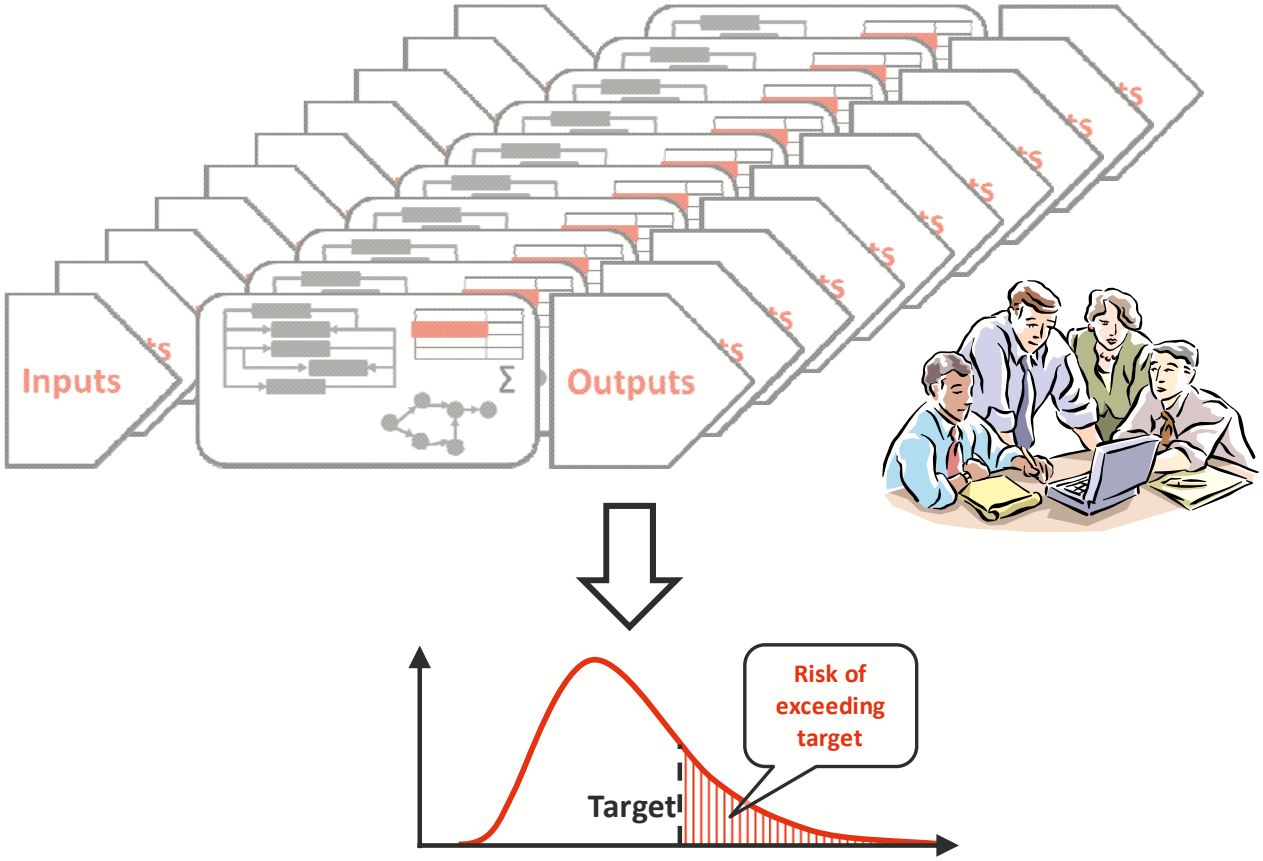
Risk event model



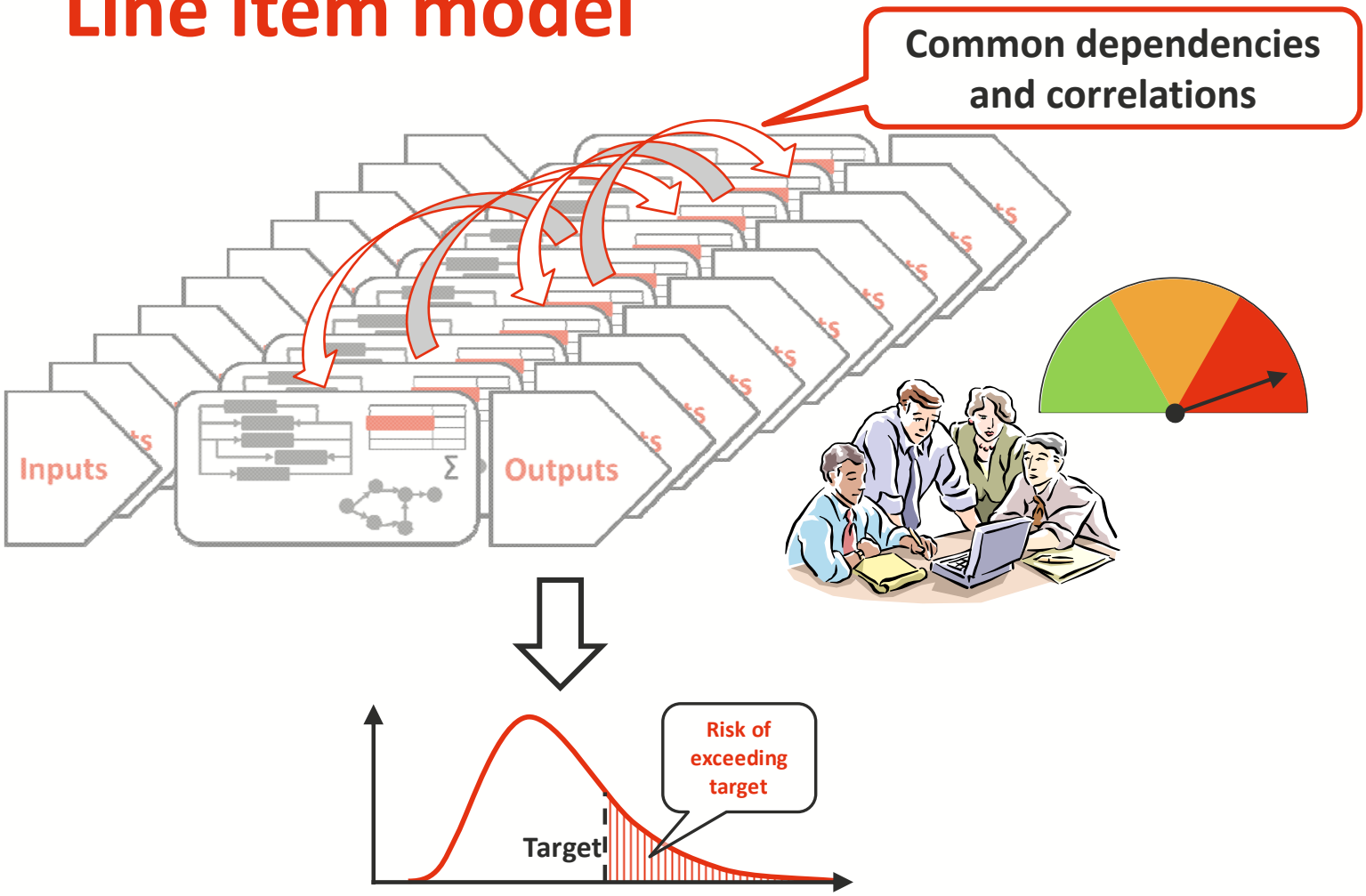
Line item range



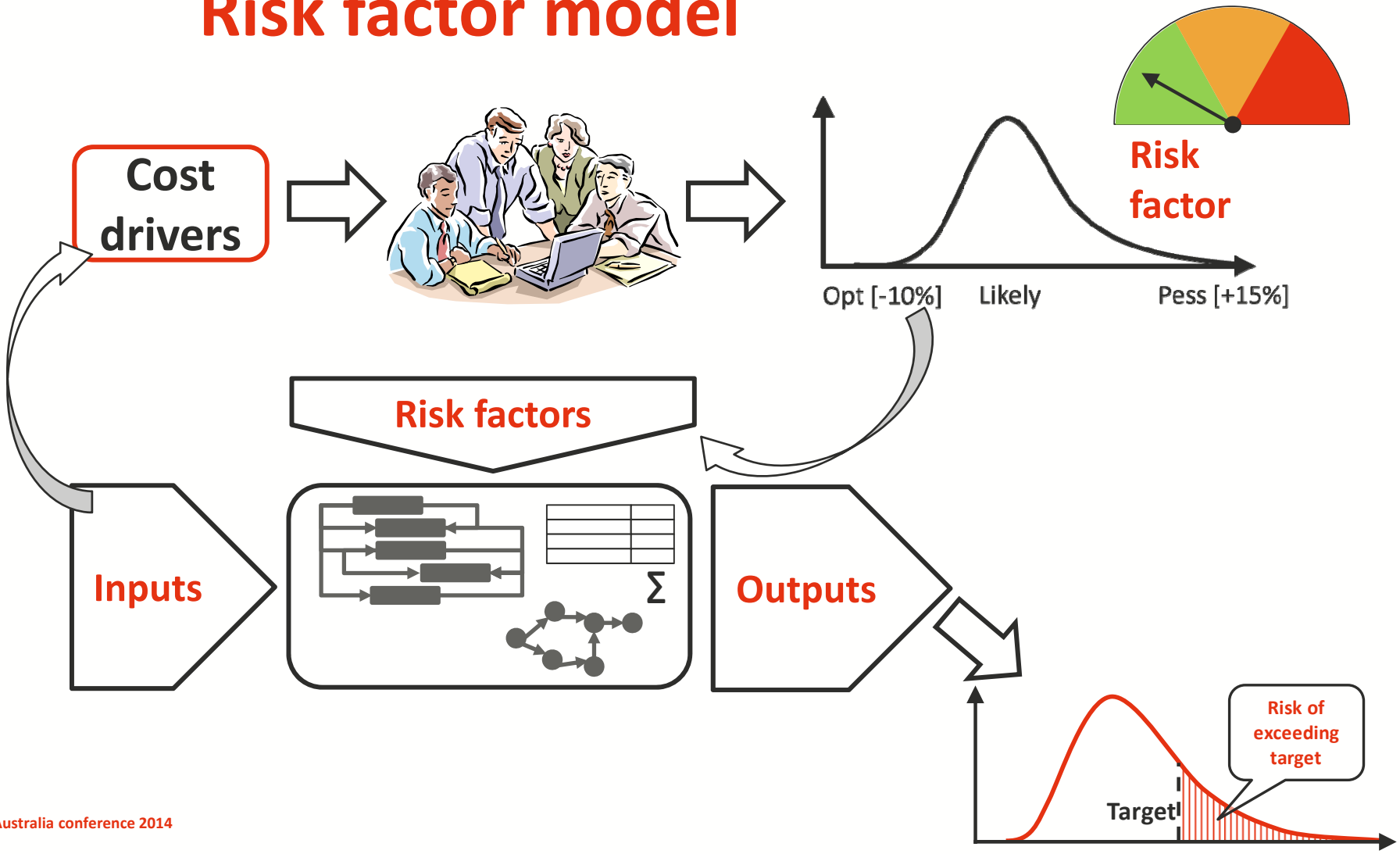
Line item model



Line item model

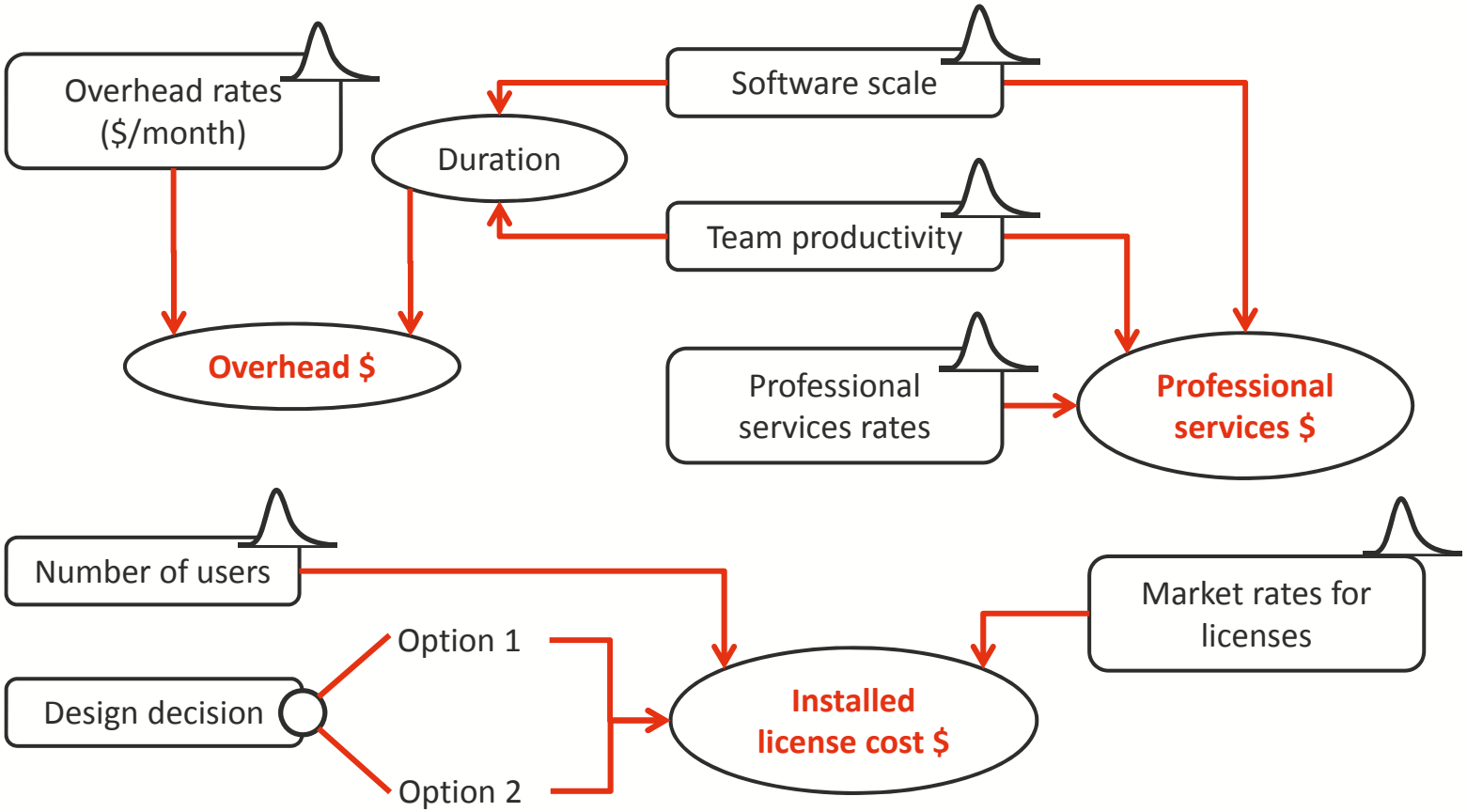


Risk factor model



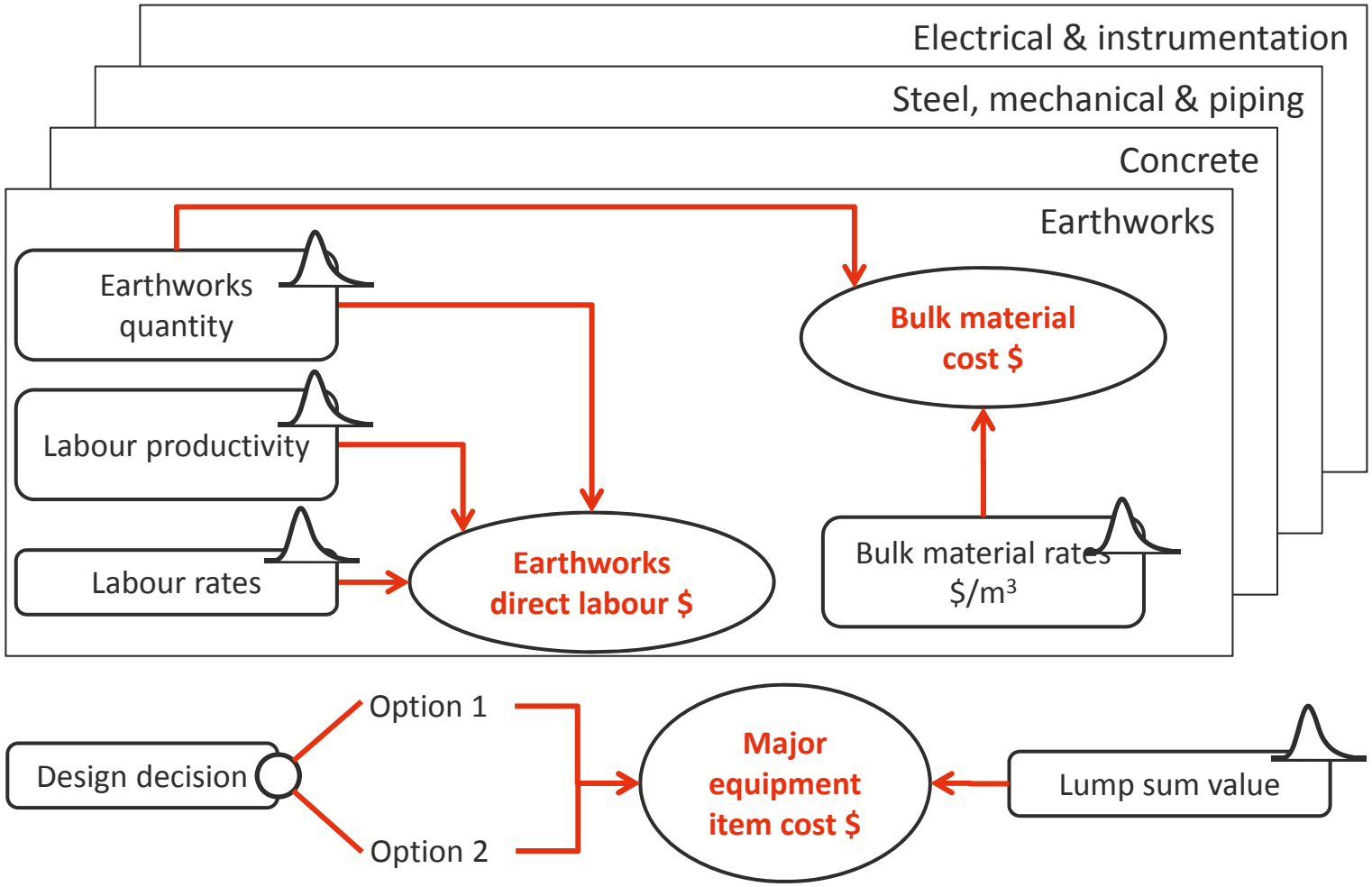
Risk factor example (partial)

Small IT development project



Risk factor example (partial)

Mineral processing plant construction

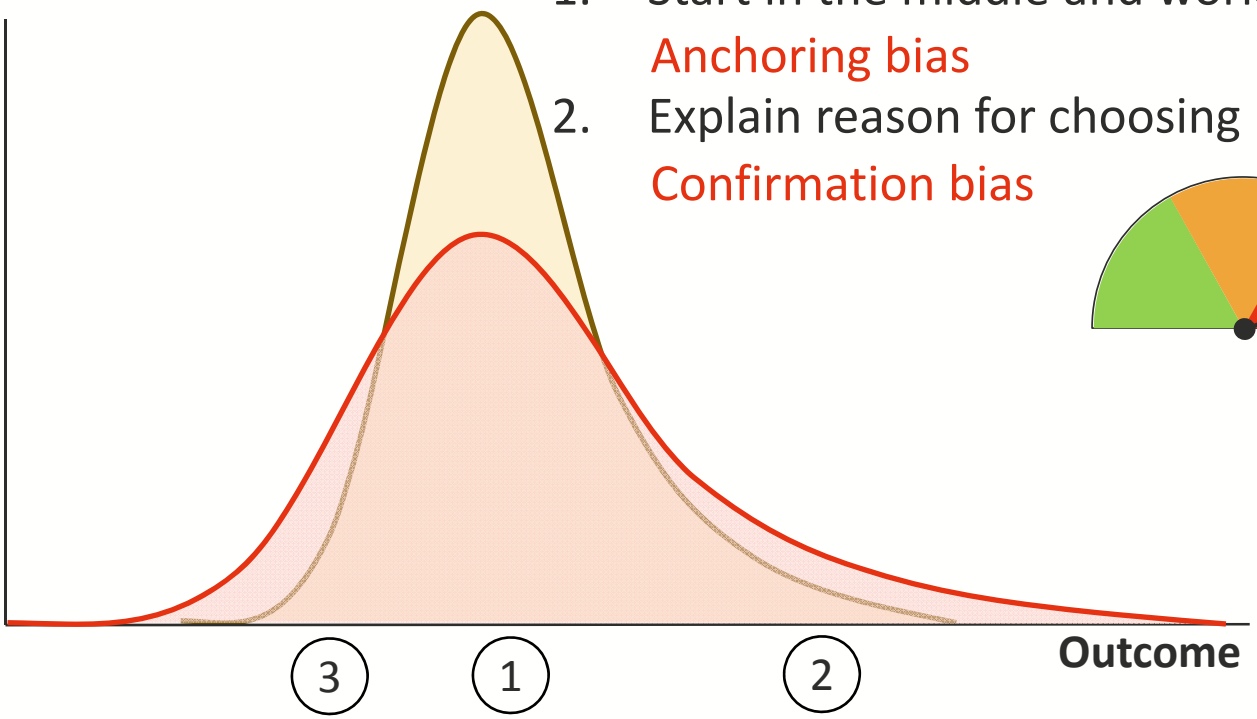


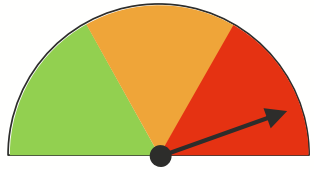
Assessing input parameters

Describing a range

Common practice

1. Start in the middle and work out
   Anchoring bias
2. Explain reason for choosing numbers
   Confirmation bias





Describing a range

Good practice

1. Establish context
   - Assumptions
   - Sources of uncertainty
   - Pessimistic and optimistic scenarios

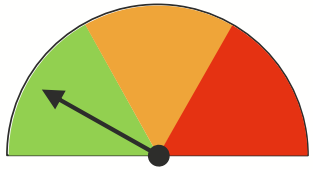
   Pre-empt confirmation

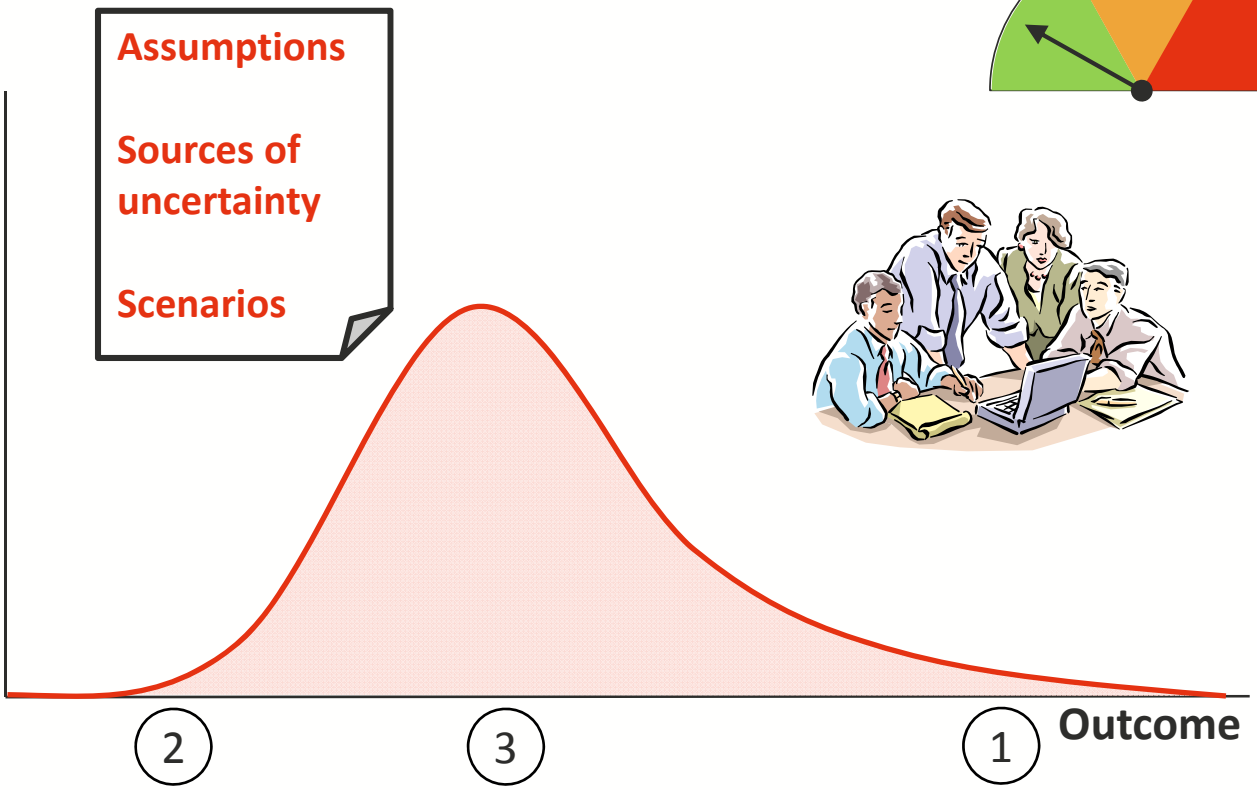
2. Start with the extremes and work in

   Break anchoring

Describing a range

Common practice





Summary

Modelling using risk factors is generally simpler and more realistic than using structures based on risk events or line item ranging

Context setting and methods to limit anchoring are required to get realistic assessments of uncertain values' ranges

It need not be hard work!

Contact

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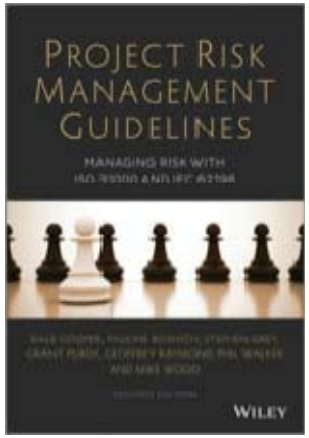

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