15 - 16 November, Wembley Stadium, UK

Project Controls EXPO
London, UK

"Project controls are all about collaboration and teamwork"

(W) www.projectcontrolexpo.com/uk (M) +44 (0) 203 883 1386 (E) info@projectcontrolexpo.com

2022

Understanding a Quantitative Risk Analysis (QRA)

Simon White – Trigo White Ltd

simon@trigowhite.com

Introduction

- QRA
  - How much contingency do we need, to cover risk? – e.g. at P10, P50, P90
  - Which risks should we mitigate? – is it worth it?
  - How much risk is there? – is it realistic?

- We can quantify risk – risk workshops, etc.

- But do we trust the QRA?
  - Trust the inputs – who contributed, where assessments came from
  - Trust the logic of a schedule – need realistic forward-driven schedule logic
  - Trust our understanding of probabilities – not since school!

Introduction

- We want to:
  - See the link between the inputs and outputs
  - Explain the overall contingency, in terms of individual risks

- So that we can:
  - Understand which risks the QRA most sensitive to
  - Trust that the QRA represents reality

Case study

- Major oil operator use QRA to approve and manage all upstream projects
  - Integrated **cost and schedule** analysis (CSRA)
  - Risk workshops to **assess and quantify all risk to project execution**
  - **Evaluate contingency** – more efficient use of capital

- They require breakdowns of contingency into **individual exposures of risks**
  - Understand risk, **validate risk assessments**
  - **Evaluate mitigation** / responses
  - **Compare** with other projects

- They use **White Box for PRA** – a tool to calculate individual exposures of risks

Terminology

- **Probability distribution** – the range of likely outcomes
- **P10, P50, P90 etc.** – the outcome which has a 10%, 50% and 90% chance (respectively) of being met
- **Probability** – how likely to happen
- **Impact** – how much, if it happens
- **Exposure** – ????
- **Two- and three-point estimates** – "between x and y", "… most likely z"

- **QRA** – Quantitative Risk Analysis
- **SRA** – Quantitative Schedule Risk Analysis
- **CRA** – Quantitative Cost Risk Analysis
- **CSRA** – Quantitative Cost and Schedule Risk Analysis

How do we know the results of a QRA are reasonable?

- Many hindrances:
  - missing risks
  - risks on a non-critical activity
  - probability too low (or too high)
  - underestimated worst case impact
  - unrealistic schedule logic (e.g. constraints instead of finish-to-start logic links)

- Comparing to our expectations can be circular
  - We expect results X
  - Model gives Y => model is wrong => we adjust the model, until ….
  - Model gives X => model is right!

- Need a way to understand our QRA

Measuring exposure helps understand the QRA

- Need to see how the QRA has arrived at the results

- Need to see the **exposure** of each individual risk, on overall project
  - We assess the risk against a specific activity
  - How does it affect the overall project?

- Better understanding of a QRA
  - The exposure of each risk is realistic
    => the overall output is realistic

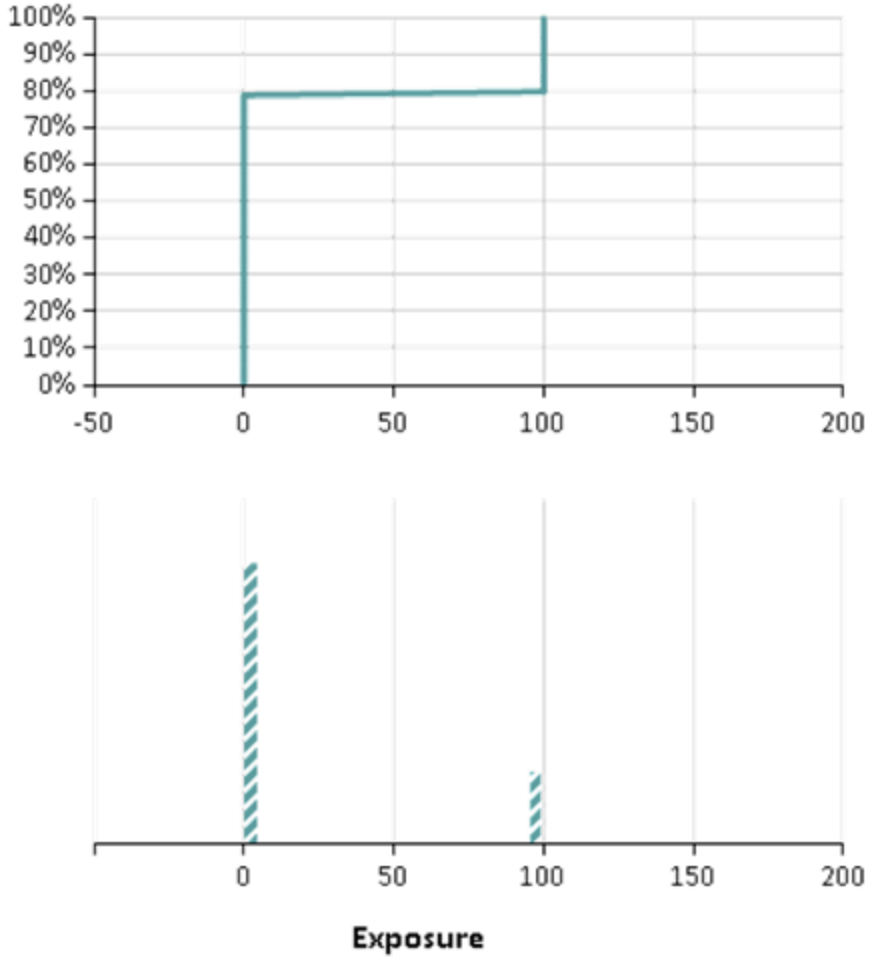
Defining the exposure of a risk

- For example, a 20% chance of losing £100
- **"*How much richer would I be, without that risk?*"**
- Not P x I (probability times impact)!
  - 20% x £100 = £20

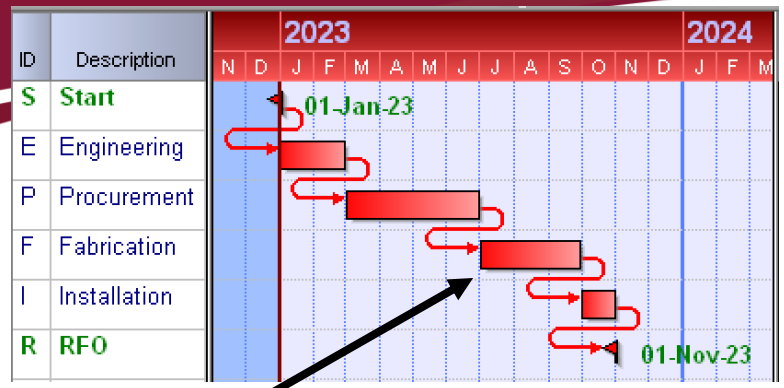
Defining the exposure of a risk

- For example, a 20% chance of losing £100
- **"*How much richer would I be, without that risk?*"**
- Imagine looking back:

  "*What was our exposure to that risk, in the end?*"
  - Could be either zero or £100
  - Won't ever be the average of £20!

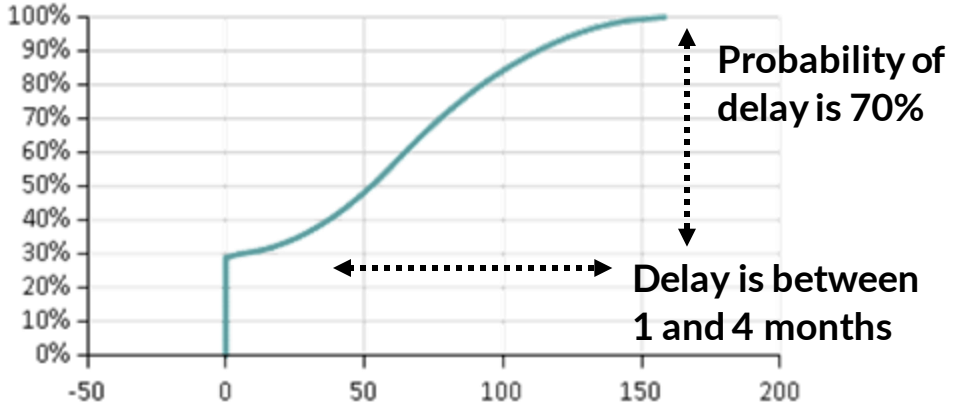


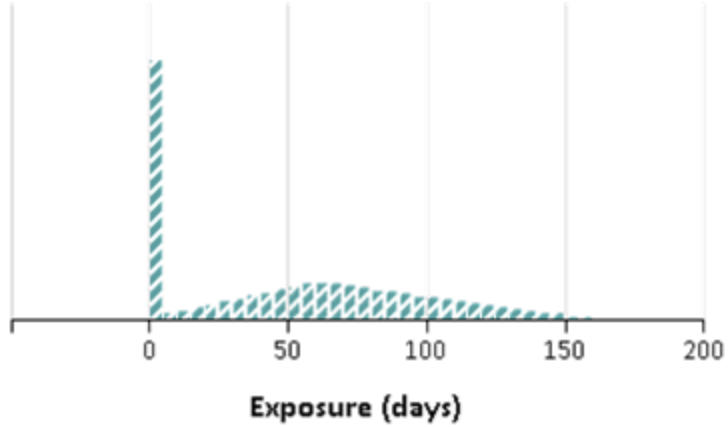
Example 1



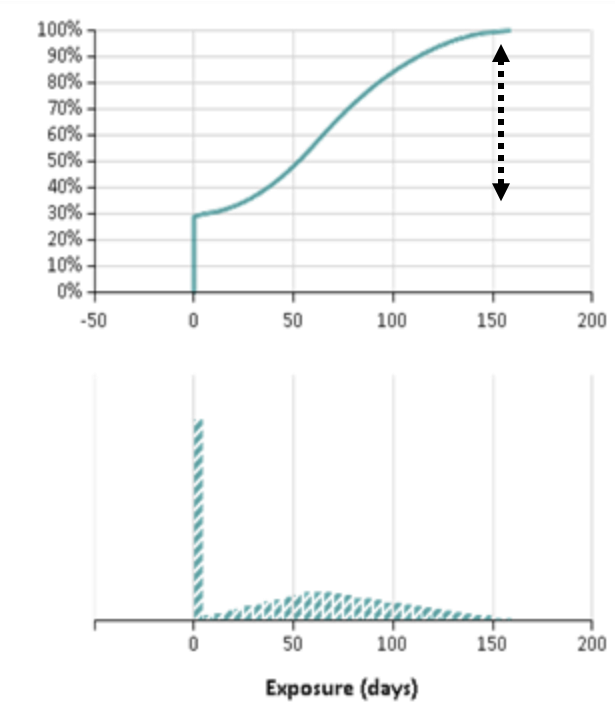
- Fabrication risk:
  - Probability 70%
  - Impact P10: +1 month; P50: +2 months; P90: +4 months

- What is the exposure of the **fabrication risk**?

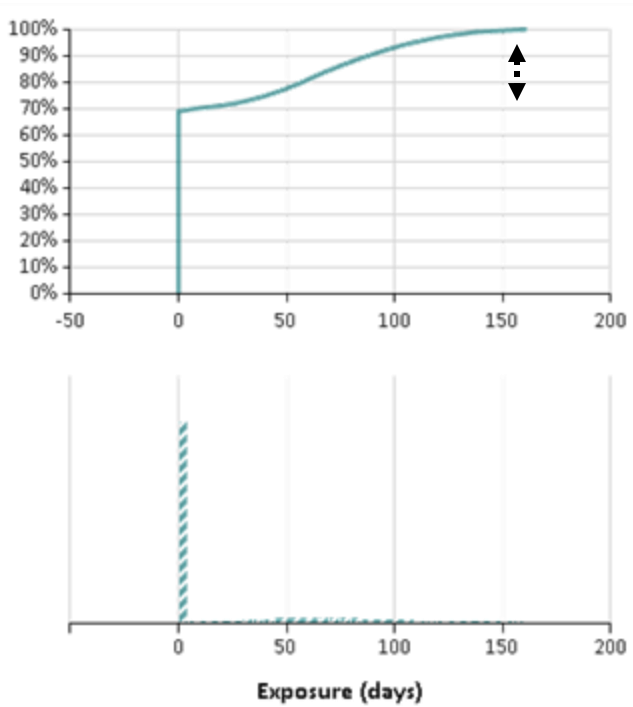




Exposure indicates probability

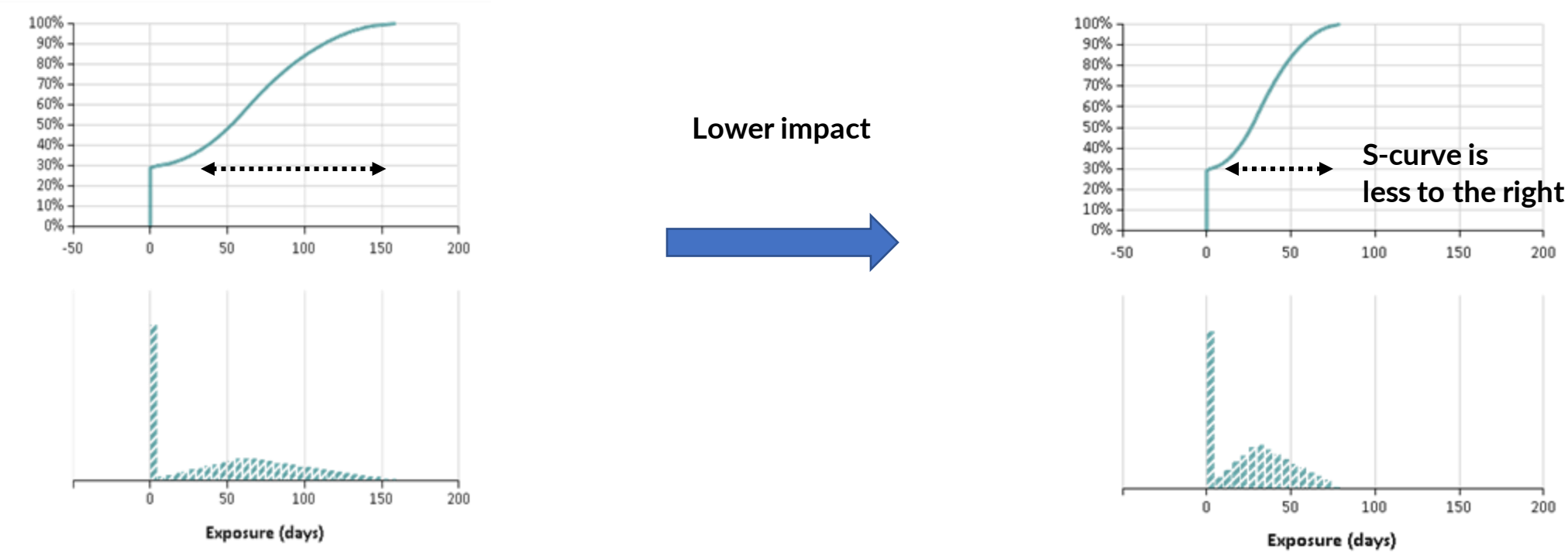


Lower probability

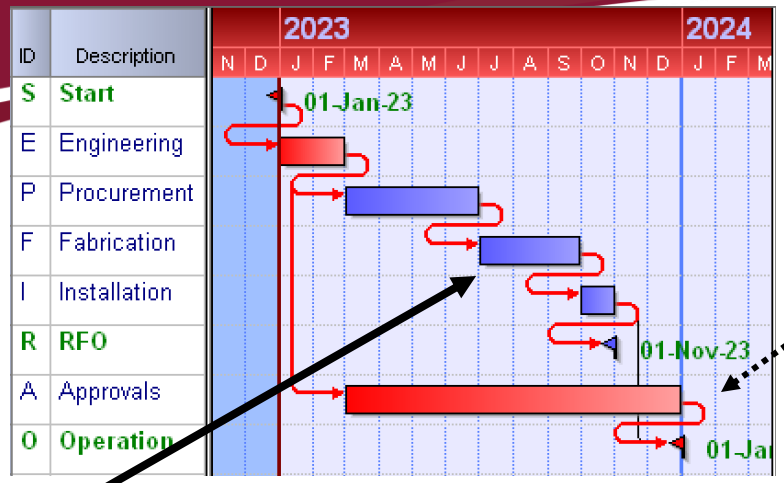


S-curve is less tall

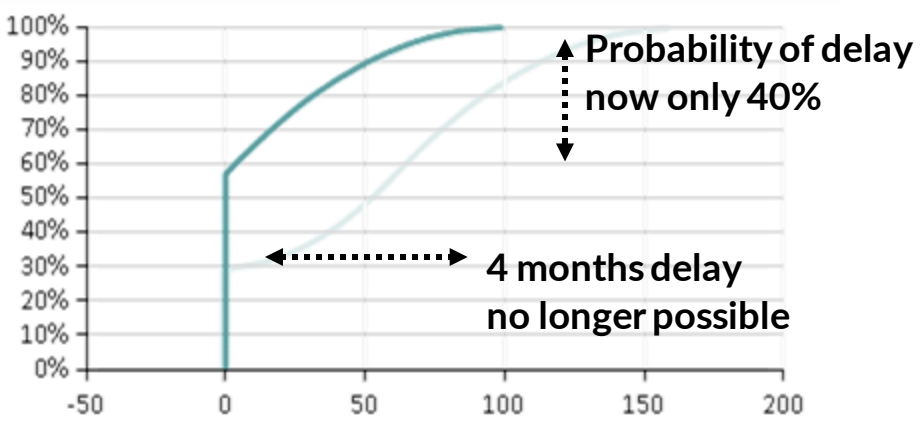
Exposure indicates range of impacts



Example 2

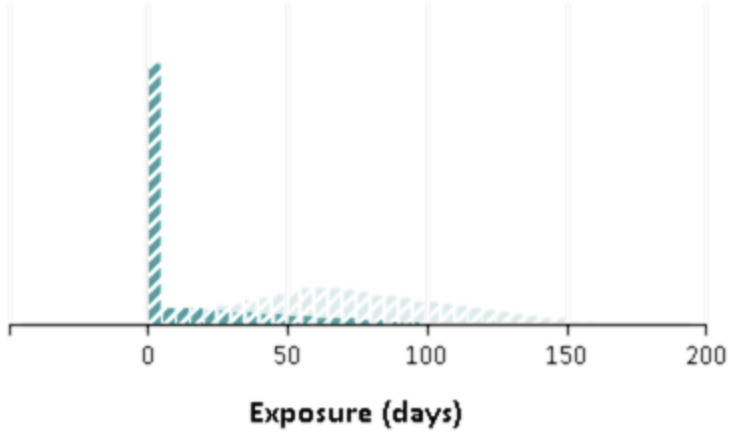


Approvals is on the critical path, with 2 months' float

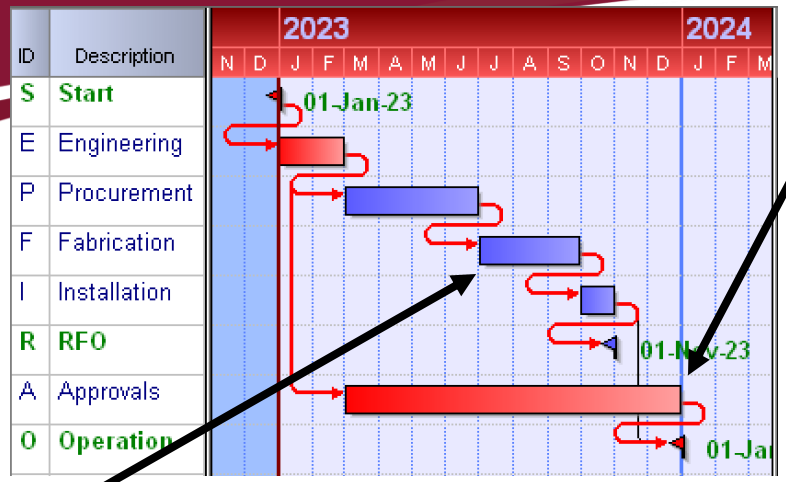


- Fabrication risk:
  - Probability 70%
  - Impact P10: +1 month; P50: +2 months; P90: +4 months

- Now what is the exposure of the **fabrication risk**?

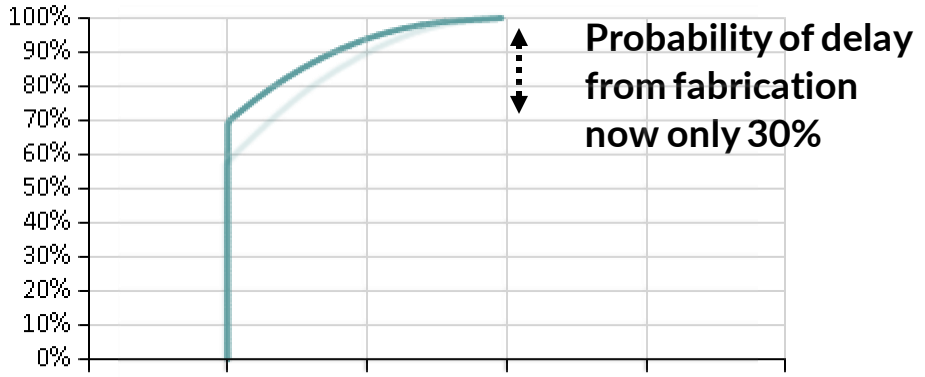


Example 3

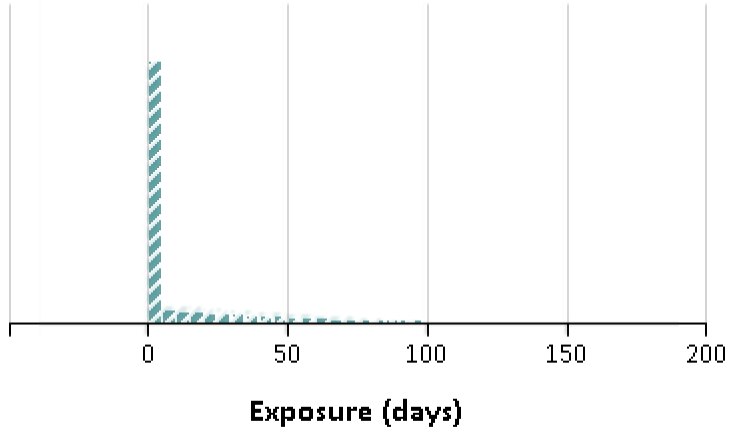


- Approvals risk:
  - Probability 50%
  - Impact P10: +2 weeks; P50: +1 month; P90: +2 months

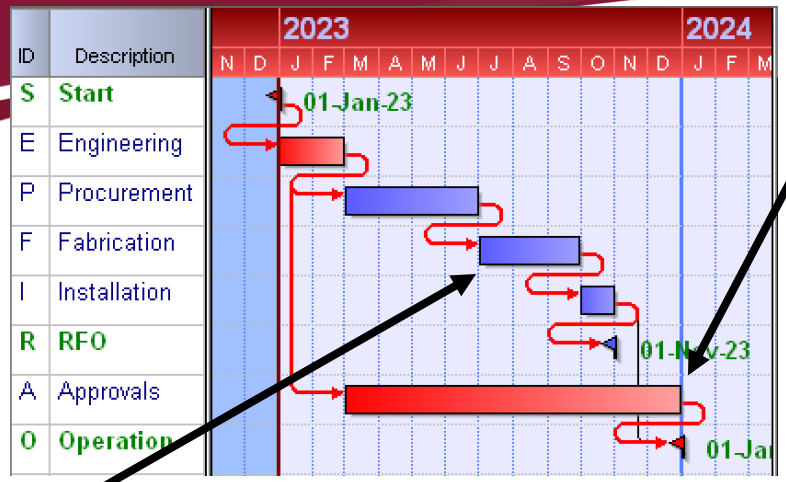
- Fabrication risk:
  - Probability 70%
  - Impact P10: +1 month; P50: +2 months; P90: +4 months



- Now what is the exposure of the **fabrication risk**?



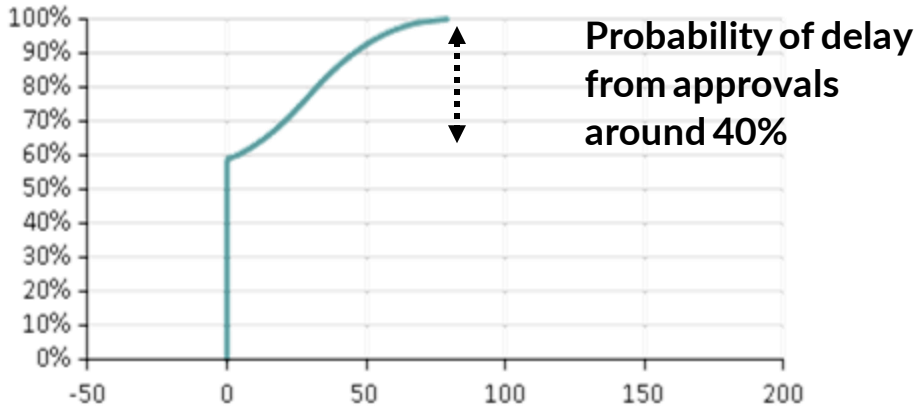
Example 3



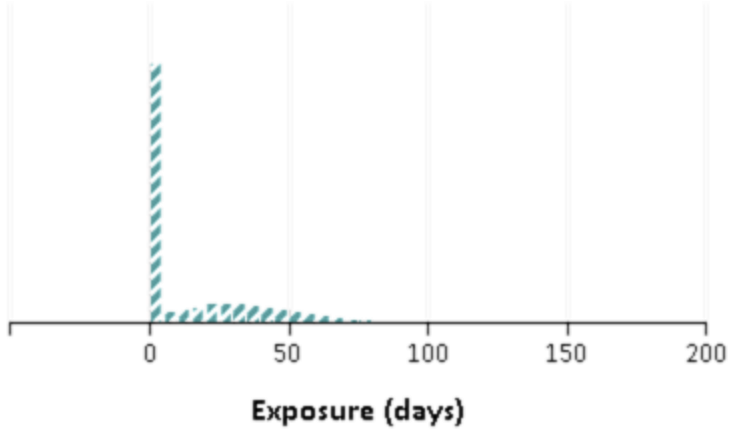
- Approvals risk:
  - Probability 50%
  - Impact P10: +2 weeks; P50: +1 month; P90: +2 months

- Fabrication risk:
  - Probability 70%
  - Impact P10: +1 month; P50: +2 months; P90: +4 months

- What is the exposure of the **approvals risk**?



Probability of delay from approvals around 40%



What does exposure reveal?

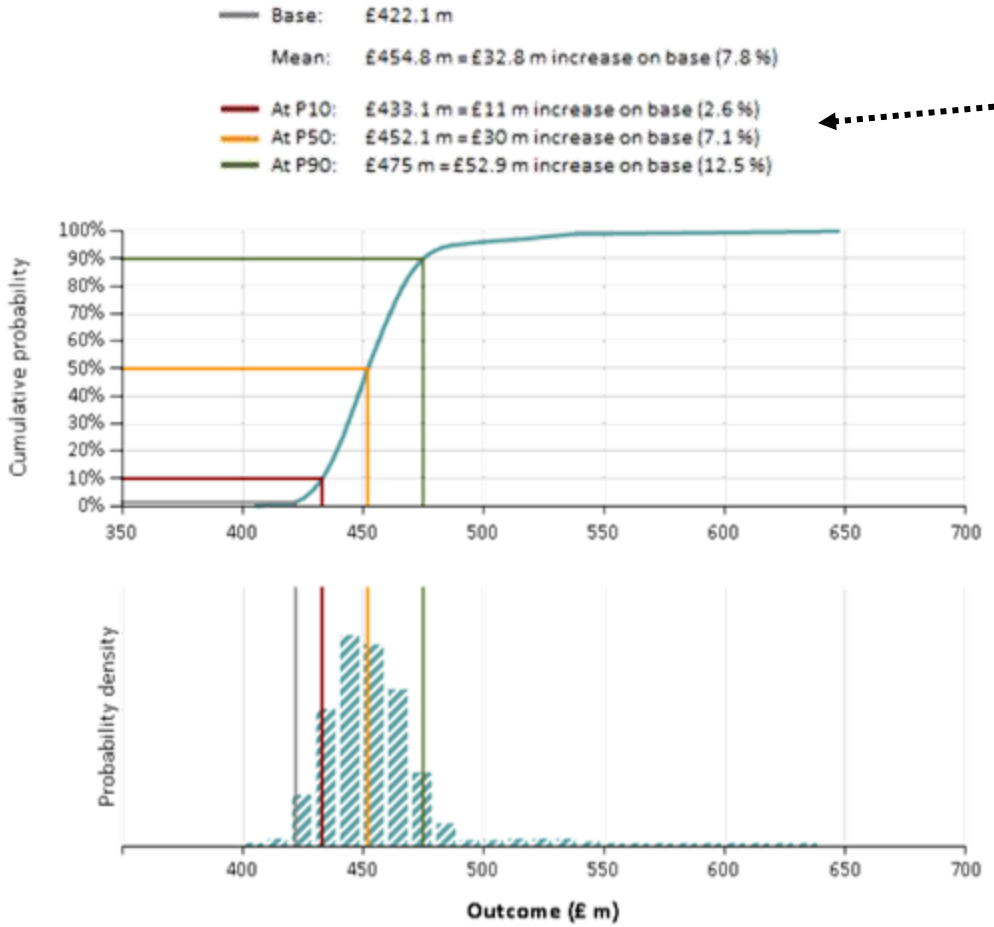
- The exposure is not always obvious, particularly in an SRA
- Ignoring them would mean less understanding, less confidence in any QRA

- We can see how the QRA has arrived at the results

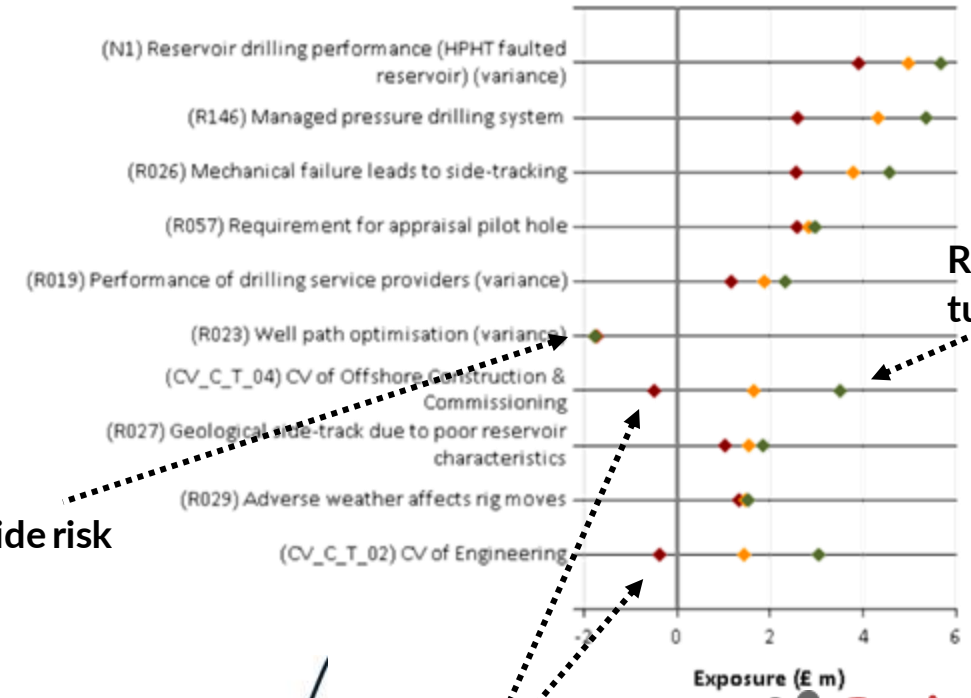
- The **exposure** of each individual risk, on overall project
  - We assess the risk against a specific activity
  - Reveals **how it affects the overall project**

- Better understanding of a QRA
  - The exposure of each risk is realistic
    => the overall output is realistic

What does exposure reveal?



Tornado explains the contingency



Reason for project turning out badly

Upside risk

Variances

Conclusion

- Calculating exposure:
  - Shows how much effect each risk is really having on the overall project
  - Gives insight into the logic of the model
  - Gives us a breakdown that explains the overall contingency (e.g. at P10, P50, P90)

- Explain contingency
  - "*Of the 3 months' contingency at P50, 1 month is caused by risk X alone*"

- Validate the QRA
  - "*Why is that the top risk in the P50 case?*"
  - "*Why is this risk bigger in the P90 case?*"
  - Reveal logic errors, assessment errors, tool errors

- "*If you disagree with the outputs, which individual risk's assessment do you disagree with?*"

Summary

- Exposure of a risk = ***"How much better would the project be, without that risk?"***
- Exposure is a probability distribution (the risk might not happen)
- Exposure is not probability times impact (P x I)
  - P x I doesn't represent any possible outcome
  - P x I doesn't reflect the critical path
- Overall risk exposure = sum of individual exposures

THANK YOU

Understanding a Quantitative Risk Analysis (QRA)

Simon White – Trigo White Ltd

simon@trigowhite.com