

Risk Management Strategy and QRA

Introduction

The effective management of risk and uncertainty through accurate evaluation and proactive mitigation of risks is critical to the success of the project. A key aspect of our service delivery is minimising any risks to our client. To achieve this, the risk management team and other project stakeholders will be provided with a clear understanding of how risk management is performed across the project. The following guiding principles will be adhered to:

- Risk management is part of all project management activities and decision-making
- Risk management will be proactively and consistently applied throughout the project lifecycle
- The management of risks is to ensure their reduction to a level as low as 'reasonably practical' or adopt appropriate mitigation strategy
- A risk management plan will be initiated at the beginning of the project
- Risk communication will be open and transparent to all stakeholders

Our risk management commences at the initial stage of the project with the identification and assessment of risks in terms of their likelihood and associated cost outcomes, and follows a cyclic process as shown below.



The Risk Cycle

We will identify risks and measure their impacts on the programme. All risks will be documented in a register with the impact on programme clearly defined and the mitigation set out. Our programme will take account of the 'most likely' scenario after mitigation.

The top risks and our measures to mitigate them are included below/elsewhere following a Quantified Risk Assessment (QRA).

Robust risk management will be undertaken by balancing performance and cost, taking account of changing objectives and aims.

A high-level risk register has been prepared and appended, and this will be developed and will form a major component of our risk management process. The risk register will show each of the risks, together with the likelihood/probability, consequence/impact, possible outcomes and mitigation of the impacts. We will involve our technical experts to identify risk management measures. Risk ranking will be established in the form of a decision matrix based on the specified level likelihood and consequence. The Risk Register will be regularly reviewed and revised as required. This review includes all current risks, reviewing the relevance of strategies against current risks, identifying new risks identified following previous reviews.

The Project Manager will be responsible for the management of risks associated with the commission and will ensure that they are identified at regular risk workshops and recorded in the project risk register for inclusion in the QRA. We believe the risk management process improves when responsibility for individual risks are delegated to team members, where necessary. The Project Manager will re-issue the Risk Register as and when it is revised based on regular internal risk workshops. The Risk Register will be made available for the client to review as required.

A QRA has been undertaken for the project initially and results presented at this stage. Further reviews of QRA will be undertaken as required for this project. QRA is undertaken in line with the WebTAG guidance on Scheme Costs (DfT TAG Unit A1.2, November 2014).

The main purpose of a QRA is to support the scheme costing to cover the construction of the scheme, by predicting the level of risk contribution, having a defined level of confidence. QRA allows for uncertainty in unplanned and unforeseen additional cost items that cannot be included in the project costs. It helps focus attention on priority areas. Consideration will be given to both cost risks (financial) and schedule risks (delay).

QRA Process

The QRA process involves four steps.



Figure – Steps in QRA

Step 1 is identification of all risks affecting the project through risk workshops and risk reviews, resulting in a risk register. Risk workshops typically include a mixture of expertise such as engineers, designers, cost consultants, procurement specialists, and environmentalists.

Typically, the risk register is instigated with a list of project risks with qualitative information, then through various workshops and iterations, it will be developed to a comprehensive risk register to log the full spectrum of potential risks (also opportunities if necessary). Appropriate risk owners will be allocated for each risk, and progress on the management of the key risks will be discussed at each Project Board meeting. Periodic risk workshops will review all risks, add new risks, and close expired risks as the project progresses.

Step 2 of the QRA process is analysis of the various risks by defining their distributions in terms of probabilities, impacts and knock-on effects. This information is gathered through risk workshops and other interactions. A qualitative risk ranking will be undertaken in the form of a standard decision matrix using the concept shown below. Each risk will be assessed using a score; High, Medium, Low, etc., for Cost, Time, Performance, and Probability to calculate an overall risk scoring and to categorise into Red, Amber, or Green. This process may be developed and tailored for better fit for this type of project.

| | | | | |
|--------------------------|-----------------|-----------|-------------|----------|
| Likelihood / Probability | High 3 | 3 | 6 | 9 |
| | Medium 2 | 2 | 4 | 6 |
| | Low 1 | 1 | 2 | 3 |
| | | High 1 | Medium 2 | Low 3 |
| | Severity | | | |

In addition to the above, for the QRA process, monetised risk quantities will be agreed through group consensus for each individual risk for the minimum impact, maximum impact, likely impact, and likelihood/probability of occurring.

An indicative likelihood/probability scale that will be used is shown below.

| Probability | | Likelihood | Scale |
|-------------|----------------|--|-------|
| 1 | Almost Certain | Confident that risk is very likely to occur. | 95% |
| 2 | Likely | Almost certain that risk will occur. | 50% |
| 3 | Possible | Probable chance that risk will occur. | 25% |
| 4 | Unlikely | Remote chance that risk will occur | 12.5% |
| 5 | Rare | Very unlikely to happen, rare or exceptional occurrence. | 5% |

Step 3 is undertaking the risk modelling using Monte Carlo simulation (CH2M will use @Risk® software). A risk model will be constructed by CH2M using the Microsoft Excel and @Risk® software packages. The model will use the Monte-Carlo simulation theory by replicating a large number of iterations (10,000) of likely project risk scenarios. Confidence levels relating to the cost of the scheme are obtained from the distribution of the averaged results produced by the simulations.

Step 4 is analysing the results against required contingency needs for the project. The 50% percentile value P(50) is reported in line with WebTAG guidance. The Project Board will use other results of the QRA, including other percentile values, to monitor and manage risks at overall project level.

The management strategy will enforce a systematic approach to responding to the various risks during the project lifecycle, and will continuously look to avoid, mitigate, transfer, or accept risks. In many cases, additional technical work or surveys, or early discussions with partners will reduce or mitigate risks. Risk control measures such as preventive, corrective, directive, or detective measures will be in place to treat risks. Delivery and contractor teams will be responsible for managing their risks and reporting any newly identified risks to the Project Manager. Risks escalated to Medium or High which could impact on the progress or financial position of the project will be referred by the Project Manager and escalated if necessary to the Project Board.

The results of the QRA are shown below, with the key output of P(50) value shown. The QRA outputs were also used to determine the top ten risks listed below.

Worcester QRA Results

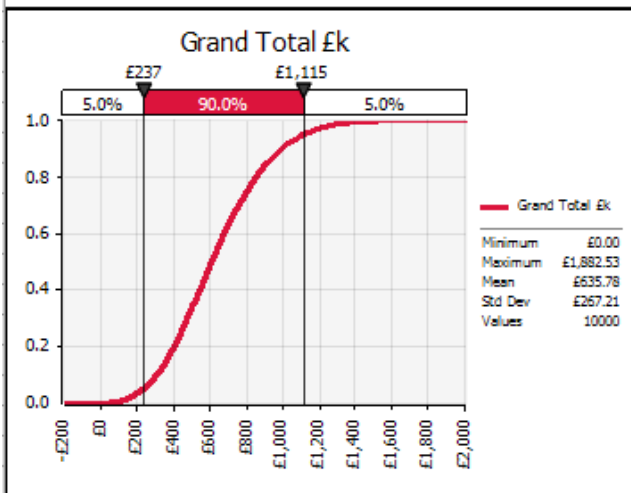
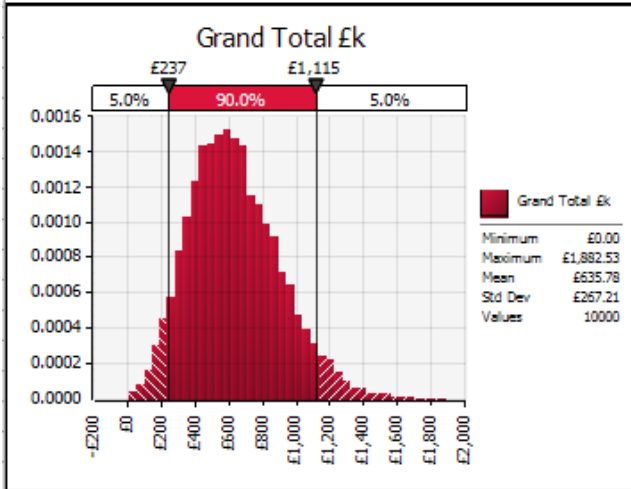
The P(50) value for the Worcester bid is **£612,000**. A total of 27 risks could be quantified, and the following risks were found to be the top ten. A screenshot of the results of the QRA is also shown below.

| | | |
|----|---------|--|
| 1 | Risk 8 | Tender price exceeds programme/budget |
| 2 | Risk 1 | Potential shortfall in WCC contributions |
| 3 | Risk 17 | Statutory Undertakers diversions C3 estimates exceed budget |
| 4 | Risk 16 | Statutory Undertakers information missing or inaccurate |
| 5 | Risk 24 | Part 1 Claims |
| 6 | Risk 2 | Insufficient design detail for accurate costing |
| 7 | Risk 13 | Extent of Archaeology |
| 8 | Risk 14 | Extent of Site Investigation: geotech/contaminated land |
| 9 | Risk 28 | Scheme location requires substantial streetworks input and co-ordination |
| 10 | Risk 6 | Time limited grant, could affect delivery through any delays in programme. Delivery expectation 2018/19 |

@RISK Output Report for Grand Total £k T53

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Simulation Summary Information

| | |
|-----------------------|------------------------|
| Workbook Name | WCC NPIF Worcester QRA |
| Number of Simulations | 1 |
| Number of Iterations | 10000 |
| Number of Inputs | 54 |
| Number of Outputs | 4 |
| Sampling Type | Monte Carlo |
| Simulation Start Time | 22/06/2017 11:06 |
| Simulation Duration | 00:00:08 |
| Random # Generator | Mersenne Twister |
| Random Seed | 1842143411 |

Summary Statistics for Grand Total £k

| Statistics | Percentile | |
|------------|-------------|-------------|
| Minimum | £ - | 5% £ 237 |
| Maximum | £ 1,883 | 10% £ 310 |
| Mean | £ 636 | 15% £ 364 |
| Std Dev | £ 267 | 20% £ 405 |
| Variance | 71400.44103 | 25% £ 444 |
| Skewness | 0.500668547 | 30% £ 477 |
| Kurtosis | 3.223779781 | 35% £ 510 |
| Median | £ 612 | 40% £ 547 |
| Mode | £ 648 | 45% £ 579 |
| Left X | £ 237 | 50% £ 612 |
| Left P | 5% | 55% £ 646 |
| Right X | £ 1,115 | 60% £ 679 |
| Right P | 95% | 65% £ 714 |
| Diff X | £ 878 | 70% £ 759 |
| Diff P | 90% | 75% £ 806 |
| #Errors | 0 | 80% £ 857 |
| Filter Min | Off | 85% £ 914 |
| Filter Max | Off | 90% £ 991 |
| #Filtered | 0 | 95% £ 1,115 |