RICS PRACTICE INFORMATION

# Management of risk

UK

1st edition, June 2015

RICS®

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# RICS standards framework

RICS' standards setting is governed and overseen by the Standards and Regulation Board (SRB). The SRB's aims are to operate in the public interest, and to develop the technical and ethical competence of the profession and its ability to deliver ethical practice to high standards globally.

The RICS Rules of Conduct set high-level professional requirements for the global chartered surveying profession. These are supported by more detailed standards and information relating to professional conduct and technical competency.

The SRB focuses on the conduct and competence of RICS members, to set standards that are proportionate, in the public interest and based on risk. Its approach is to foster a supportive atmosphere that encourages a strong, diverse, inclusive, effective and sustainable surveying profession.

As well as developing its own standards, RICS works collaboratively with other bodies at a national and international level to develop documents relevant to professional practice, such as cross-sector guidance, codes and standards. The application of these collaborative documents by RICS members will be defined either within the document itself or in associated RICS-published documents.

## Document definitions

| Document type | Definition |
|---|---|
| **RICS professional standards** | **Set requirements or expectations for RICS members and regulated firms about how they provide services or the outcomes of their actions.**<br><br>RICS professional standards are principles-based and focused on outcomes and good practice. Any requirements included set a baseline expectation for competent delivery or ethical behaviour.<br><br>They include practices and behaviours intended to protect clients and other stakeholders, as well as ensuring their reasonable expectations of ethics, integrity, technical competence and diligence are met. Members must comply with an RICS professional standard. They may include:<br><br>∫ mandatory requirements, which use the word 'must' and must be complied with, and/or<br><br>∫ recommended best practice, which uses the word 'should'. It is recognised that there may be acceptable alternatives to best practice that achieve the same or a better outcome.<br><br>In regulatory or disciplinary proceedings, RICS will take into account relevant professional standards when deciding whether an RICS member or regulated firm acted appropriately and with reasonable competence. It is also likely that during any legal proceedings a judge, adjudicator or equivalent will take RICS professional standards into account. |
| **RICS practice information** | **Information to support the practice, knowledge and performance of RICS members and regulated firms, and the demand for professional services.**<br><br>Practice information includes definitions, processes, toolkits, checklists, insights, research and technical information or advice. It also includes documents that aim to provide common benchmarks or approaches across a sector to help build efficient and consistent practice.<br><br>This information is not mandatory and does not set requirements for RICS members or make explicit recommendations. |

# 1 Introduction

The aim of this practice information is to provide a reference point for professionals on the discipline of risk management.

The success of construction projects arguably can be gauged on the ability of the professional team to mitigate threats and maximise opportunities in relation to the overall objectives of the project. A risk register is a risk management tool generally adopted as a central repository for all risks and threats identified (see appendix B for example risk registers). For each threat or risk identified, information in relation to each risk is included, such as a description of the risk, risk consequences, impact rating, risk owner and so on.

Risk management as a discipline is becoming far more prevalent for the success of projects, programmes and indeed the construction industry. This practice information provides details of the general principles of risk management and provides practical applications and considerations for successful implementation.

This practice information supersedes the RICS information paper *The management of risk* (2000).

# 2 General principles (Level 1 – Knowing)

## 2.1 Key principles of risk management

### 2.1.1 Definition of risk

A risk can be defined as an uncertain event or circumstance that, if it occurs, will affect the outcome of a programme/project (note that where this practice information refers to a project it could also refer to a programme).

Risk management is now widely recognised as being concerned with both threat and opportunity. For the purposes of this practice information, 'risk' refers to both positive and negative uncertainties.

Some alternative risk definitions:

| Risk definitions |
| --- |
| 'The likelihood of an event or failure occurring and its consequences or impact' (*NRM1*, RICS, 2012) |
| 'Risk is a possible future event combining the probability or frequency of occurrence of a defined threat or opportunity and the magnitude of the consequences of that occurrence' (*IEC Guide 73:2002*, British Standard, 2002). |
| 'An uncertain event or set of circumstances that should it or they occur would have an effect on the achievement of one or more of the project objectives' (*APM Body of Knowledge*, APM, 2006). |
| 'Uncertainty of outcome (whether positive opportunity or negative threat). It is the combination of the chance of an event and its consequences' (*Management of Risk: Guidance for Practitioners*, OGC, 2002). |
| 'Uncertainty of outcome (whether positive opportunity or negative threat)' (*The Orange Book Management of Risk – Principles and Concepts*, HM Treasury 2004). |

### 2.1.2 Definition of issue

Unlike risks, which are uncertain events, issues (sometimes known as trends) are usually classified as events, that are happening now or will almost certainly happen in the future. Therefore, issues require more immediate action than risks. Typically, issues can arise from

sources such as unmediated disputes, unaddressed concerns, unresolved decision-making or risks that have occurred (thus becoming an issue). Issues should be managed in similar terms as risks, with response plans, accountability and agreed action dates. While almost certain to occur, it may not be possible to precisely define issues in cost terms and they may have a range of costs.

| Issue definitions |
| --- |
| 'A relevant event that has happened, was not planned and requires management action. It could be a problem, query, concern, change request or risk that has occurred' (*Management of Risk: Guidance for Practitioners*, OGC, 2002). |
| 'It can be any concern, query, request for change, suggestion or off-specification raised during the project. [They] can be about anything to do with the project' (*Prince2: Glossary of terms*, AXELOS, 2009; © AXELOS Limited 2011). |

### 2.1.3 Types of risk

A construction project, no matter what its size, involves risks. As mentioned within RICS *New rules of measurement* (NRM 1), at the stage of putting in order a bill of quantities, a quantified schedule of works, or other quantity documents, the management of risk will still be required by the employer and the project team. This is referred to as the employer's residual risk exposure. From the initial stages, adopting a risk register can aid the contract process, showing how risks are deemed to be allocated between the client and the contractor (see appendix B for example risk registers). The NRM clarifies that the risks to be apportioned will take the form of one or more of the following:

**Risk avoidance:** Where risks have such serious consequences on the project outcome that they are totally unacceptable. Risk avoidance measures might include a review of the employer's brief and a reappraisal of the project, perhaps leading to an alternative design solution that eliminates the risk or even project cancellation.

**Risk reduction:** Where the level of risk is unacceptable and actions are taken to reduce either the chance of the risk occurring or the impact of the risk should it occur. Typical actions to reduce the risk can include: further site investigation to improve information, using different materials/suppliers to avoid long lead times or using different construction methods.

**Risk transfer to the contractor:** Risks that may impact the building programme are transferred to another party able to control it more effectively, usually involving a premium to be paid. If the risk materialises, the impacts are carried by the other party.

**Risk sharing by both employer and contractor:** This is when a risk is not wholly transferred to one party and some elements of the risk are retained by the employer. In accordance with NRM, the approach for dealing with risks that are apportioned between the client and the employer will normally be dealt with using provisional quantities, with the pricing risk being delegated by the contractor and the quantification risk being allocated to the employer.

**Risk retention by the employer:** In the event where risks are to be retained by the employer, the appropriate risk allowance identified in the cost plan will be reserved and managed by the employer.

All projects contain an element of risk. These generally fall into five categories, as detailed below. Risks should also be categorised in accordance with the RICS NRM 1, also detailed below.

| General risk categories | |
|---|---|
| Political and business risks | The occurrence of one of the project, programme, consequential or benefit risks that breaks out into the public domain and has an adverse effect on the business as an ongoing concern; for example, the client's share price reduces due to the severe delay of moving into new premises and the associated negative effect on organisational efficiency. The client's management board should have appropriate measures in place to minimise such impacts. |
| Benefit risks | The failure of the project to deliver the performance expected, leading to an undermining of the long-term business case. For example, compliance with planning requirements may limit the size of the scheme and hence revenues through reduced net-lettable space. The project team does not have the power to eliminate this risk; however, the client should be able to safeguard the business case by undertaking sensitivity analysis, modelling any potential loss in revenue and building in allowances to enhance robustness. |
| Consequential risks | Risks that may occur as a result of other risks; that is, there is a knock-on effect. Consequential risks may occur within the project: they affect other project-related activities or outside the project; that is, the occurrence of a risk may affect the client's operations/business (e.g. disruption to activities due to interruption of power supplies). In the case of the former the project team should analyse the risk to find the root cause and interdependencies and develop suitable management actions. However, in the case of the latter the consequences cannot be managed by the project team as they have no jurisdiction or authority outside the project; therefore, appropriately senior client staff should put contingency measures in place. |

| General risk categories | |
|---|---|
| Project risks | The possibility that something may go wrong during the execution of the project; that is, risks that could affect the successful delivery of the project. Project risks are commonly considered in terms of time, cost and quality. |
| Programme risks | Risks that impact on the programme as a whole, rather than individual projects. These risks concern decisions that transform strategy into action. Typical risk areas would include funding, organisational/cultural issues, quality, business continuity and so on. Also, when project risks exceed set criteria and affect programme objectives, then they would be escalated to the programme level. |

| NRM1 risk categories (NRM 1: Order of cost estimating and cost planning for capital building works, 2nd edition) | |
|---|---|
| Design development risks | An allowance for use during the design process to provide for the risks associated with design development, changes in estimating data, third-party risks (e.g. planning requirements, legal agreements, covenants, environmental issues and pressure groups), statutory requirements, procurement methodology and delays in tendering. |
| Construction risks | An allowance for use during the construction process to provide for the risks associated with site conditions (e.g. access restrictions/limitations, existing buildings, boundaries, and existing occupants and users), ground conditions, existing services and delays by statutory undertakers. |
| Employer change risk | An allowance for use during both the design process and the construction process to provide for the risks of employer-driven changes (e.g. changes in scope of works or brief, changes in quality and changes in time). |
| Employer other risks | An allowance for other employer risks (e.g. early handover, postponement, acceleration, availability of funds, liquidated damages or premiums on other contracts due to late provision of accommodation, unconventional tender action and special contract arrangements). |

The client and project team's risk viewpoint varies markedly.

Normally the project team can only manage the project risks and some of the consequential risks directly, but it should be ensured that the client is informed of other risks to enable

development of their contingency plans. The client is most concerned with business and benefit risks.

## 2.2 Response/mitigation strategies

Risk exposure (i.e. the potential effect of risk) changes as the building project progresses: continually managing the risks is therefore essential. As the design evolves, more of the project requirements are defined, and a risk response can be decided.

### 2.2.1 Risk avoidance

Risk avoidance occurs where risks have such serious consequences on the project outcome that they are totally unacceptable. Risk avoidance measures might include a review of the employer's brief and a reappraisal of the project, perhaps leading to an alternative development mix, alternative design solution or cancellation of the project.

### 2.2.2 Risk reduction

Risk reduction occurs where the level of risk is unacceptable.

### 2.2.3 Risk transfer

Risk transfer occurs where accepting the risk would not give the employer best value for money. The object of transferring risk is to pass the responsibility to another party better able to control the risk. Whenever risk is transferred there is usually a premium to be paid (i.e. the receiving party's valuation of the cost of the risk). To be worthwhile, risk transfer should give better overall value for money to the employer (the total cost of the risk to the employer is reduced by more than the cost of the risk premium). Risk transfer measures include taking out insurance cover where appropriate.

### 2.2.4 Risk sharing

Risk sharing occurs when risk is not entirely transferred and the employer retains some element of risk.

### 2.2.5 Risk retention

Risk retention occurs when the employer retains risks that are not necessarily controllable. This remaining risk is called the residual risk exposure.

Considering the limited information about the building project and site conditions, the risk allowance at the RIBA Plan of Work (preparation stages) (i.e. 0: Strategic definition and 1: Preparation and brief) and the OGC gateways (0 Strategic assessment and business justification and 2 Delivery/procurement strategy) can be a significant percentage of the total estimated cost whereas, after completion (when all accounts are settled) the requirement for a risk allowance will be zero.

Proper risk identification, assessment, monitoring and control are therefore a prerequisite of realistic cost estimates and of minimising the consequential costs arising from the employer's residual risk exposure.

It is recommended that risk allowances are not a standard percentage, but a properly considered assessment of the risk through quantification.

The success of the project's risk-management efforts depends on the effective implementation of the risk responses. The risk monitoring and control process is designed to provide oversight of the implementation of the responses, identify the requirement for additional responses, and determine impacts of any changes in the project's risk profile. The objectives of the risk monitoring and control process are to:

- review (monthly) the current risk profile and identify changes in risk probabilities and impacts
- monitor (monthly) the implementation of risk responses and implement any necessary changes
- update (quarterly) the risk register with any new risks and associated responses based on changes in project scope, project progress and changing risk generators (see appendix B); and
- review (quarterly) the level of project risk management maturity of each project in the programme.

### 2.2.6 Interrelationship of risks

There are often interrelationships between risks (known as consequential risks) that increase the complexity of assessing them. It is not uncommon for one risk to trigger or increase the impact and/or likelihood of another. Such knock-on effects can turn a relatively minor event, such as the redecoration of a single room, into a major event; i.e. the facility cannot be handed over until the room is complete and the client is not able to receive a rental income. Interrelationships of risks often cross boundaries in the project plan (i.e. ownership, funding, decision-making and organisational/geographical structures). The risk manager should be able to communicate and liaise across these boundaries. Identifying, assessing and tracking down interrelationships of risks are essential parts of the riskmanagement process.

Care must be taken with overarching risks and double counting within the risk register. Classification of risks in strategic and project operation and regular reviews of the register, led by an experienced facilitator who is familiar with the project, will help mitigate problems in this regard.

## 2.3 Procurement routes and risk

This section outlines the foundations of procurement strategy and procurement routes, their characteristics and the risks associated with each route.

### 2.3.1 Procurement strategy

The procurement process tends to commence with the client developing a procurement strategy. The strategy entails measuring the risks, benefits and cost, time and quality constraints to conclude and establish the most suitable procurement route and what contractual factors should be considered.

The procurement strategy identifies the most effective approaches in successfully delivering a construction project. The procurement strategy that is developed should reflect the client's objectives, which would include but are not limited to cost, time and quality risks from an early stage.

Below is a brief description of each of the key criteria:

- **Funding (cost):** the total costs for the delivery of the construction project and the client's availability and accessibility of finance throughout the project life cycle.
- **Time:** certainty of completion date and any flexibility in delivery date.
- **Performance (quality):** the desired performance functionality and standards of quality.

The amount of emphasis on a particular key criterion will certainly impact other criteria. For example, increasing the weight of project performance (quality) may have an effect on the cost and time of the project delivery. Essential to the selection process is defining the project requirements of the client: how much are they willing to spend, what standard of quality do they desire and what delivery date do they want?

The procurement strategy implemented will affect the recruitment route selected and in particular will define how applicants in the initiation, design and construction of the project are selected and the level of responsibility their role will possess.

### 2.3.2 Procurement route

There are numerous procurement routes that can be adopted for construction.

It is recommended that each option is sufficiently evaluated. An in-depth understanding of the characteristics, advantages and disadvantages and the weight of risk associated with each procurement route is essential, as the various routes differ strategically and can impact the delivery of a project to a different extent.

Understanding the risk associated with each procurement route is essential. Each procurement route has various different risks, therefore, it is important that a risk register is prepared at the initial stage which reflects all the risks associated with the project. When identifying risks it is vital to consider the likelihood of a risk occurring and the impact on the project should it occur. Depending on the nature and contract route, mitigation activities should be identified for each risk, and management practices should be put into place to avoid or reduce the likelihood or severity of the key risks.

In developing the risk register it is also beneficial to consider and identify risk ownership. Various procurement routes permit the design and production processes to be tightly integrated and allow close collaboration. Other routes follow a methodology where the design and construction teams are selected separately and there is minimal collaboration between parties during the design process.

### 2.3.3 Procurement factors

Construction procurement is concerned with how a building project or programme is acquired. A suitable construction procurement strategy is fundamental to the success of a project or programme as it defines the interfaces and relationships between the stakeholders, the allocation of risk and the responsibility for design. Determining a suitable construction procurement strategy will depend on a number of factors, such as:

- client type
- risk allocation
- time available
- cost certainty
- design development
- design responsibility
- specialist input
- BIM
- complexity of project
- change accommodation and
- contract administration.

These factors are often interrelated and in tension, i.e. emphasis on one factor often has a negative effect on another. Finding the most suitable construction procurement strategy will therefore represent a balance between these factors.

## 2.4 Risk quantification techniques

### 2.4.1 The process and requirements

In some circumstances it is desirable or necessary to quantify the risks to a project in terms of cost and/or time. Reasons for quantification could include:

- to build a risk allowance that could be part of a project contingency
- where clients need to report upwards in their organisation or to a third party
- where the project forms part of a larger programme of projects
- to motivate people into following through management actions

- where clients insist on it as part of their procedures or have capped funds
- where it is desirable to link risk to contingency and
- where it is required or provides comfort to funders or other third parties.

### 2.4.2 Probability trees

Most of the risks faced on a project are independent of other risks. These types of risks are easier to identify and easier to manage. However, there are times when risks are connected; that is, certain risks may only appear as a result of actions taken to manage another risk. This is where the probability tree is used. A probability tree is a technique for determining the overall risk associated with a series of related risks.

Example

A project needs to place a large equipment order. The risk manager thinks there is a 20% risk that the primary hardware supplier may not be able to provide all the equipment needed for a large order in a timely manner. This is risk A. As a part of the risk response plan, the risk manager decides to talk to a second vendor to see if they can help fulfil the equipment order on short notice. They normally have the equipment in stock. However, the risk manager also discovers that there is a 25% possibility that there may be disruption in their plant because of a potential strike. This is risk B.

Risk A is the primary project risk. If the risk manager can successfully manage risk A, there will be no reason to work with the second vendor and therefore risk B will never enter into the project. However, if risk A comes true, then the risk plan will also need to deal with the second risk, risk B.

### 2.4.3 Central limit theorem

This is a mathematical technique used to provide a 90% confidence level for a project contingency fund. See subsection 3.4 Contributing data for quantification for further details.

### 2.4.4 Monte Carlo

This is a computer-generated simulation used to model outcomes. See subsection 3.4 Contributing data for quantification for further details.

### 2.4.5 Fault tree analysis

Fault trees represent a deductive approach to determining the causes contributing to a designated negative outcome, beginning with the definition of a top (undesired) event, and branching backwards through intermediate events until the top event is defined in terms of basic events.

### 2.4.6 Event tree analysis

The purpose of an event tree analysis is to find possible outcomes from an initial event, and in this way is the opposite of a fault tree analysis.

### 2.4.7 Percentage addition

Percentage addition is based on a percentage of the cost plan and should only be used for preparing rough and initial order cost estimates. A percentage risk for all elements of the project where risk is expected is derived,multiplied by the cost of that element and then totalled to give an overall risk allowance. For example, 5% x £100,000 construction costs (£5,000) + 10% x £10,000 design team cost (£1,000) gives a risk allowance of £6,000.

### 2.4.8 Simple method of assessment

The simple method is the most basic quantitative method for calculating a risk allowance on a project. A likely cost is assigned to all risks in the register along with a, usually subjective, probability or occurrence. The cost is then multiplied by the probability to give an expected value. The expected value for each risk is then totalled for an overall risk allowance.

### 2.4.9 Probabilistic method

The probabilistic method is a more in-depth version of the simple method and sometimes called '3-point estimating'. It applies a meaningful, yet subjective, probability to each risk in the register over a range of assumptions, usually best, likely and worst case. The probabilities for all 3 should total 1 (100%). This generates an expected value per assumption that can be totalled to apply an expected value to each risk. All risks can then be totalled to give an overall risk allowance for a cost plan.

### 2.4.10 Sensitivity analysis

A sensitivity analysis (sometimes called 'what-if' analysis) is a practical method of investigating risks on a building project by varying the values of key factors and measuring the outcome. This does not give a mathematical result but highlights the key factors that may affect the project outturn, should they be varied.

## 2.5 Effect of risk on programme and cost

Schedule quantitative risk analysis is an integral part of project planning and is a powerful forecasting technique. It uses a quality programme and accurate risks to reduce project uncertainty and therefore add value. The process should not be seen as a one-off intervention but as a regular part of the project review and management process that can be used on individual projects or within a programme management environment.

A schedule quantitative risk analysis builds upon the traditional critical path method (CPM) of scheduling. It takes into account estimates for durations and simulates possible outcomes to provide a confidence level surrounding possible project completion dates.

The outcome is a more realistic programme that provides the client with the confidence of delivering a successful project on time, while allowing them to identify potential areas where risk mitigation may prove necessary.

# 3 Practical application (Level 2: doing)

## 3.1 Risk identification techniques

### 3.1.1 Risk-management strategy

Risk management should not be viewed as an add-on to the project management process but should be embedded into it.

Risk management is more effective when it is used to identify and manage risks from the earliest project stages in order to minimise likelihoods and impacts or to maximise benefits. It should be applied throughout the project cycle – that is, from inception to use.

Opportunities for making changes reduce as the project develops. As decisions are made and signed off, the more constrained the project is against change. Likewise, the costs of making change will increase as the project progresses; the more advanced the design, the more complex it is to incorporate changes. Moreover, the longer people have been working on a particular project, the more attached they become to existing plans.

Where appropriate, a risk-management strategy should be developed and included as part of a risk execution plan. A typical risk-management strategy would cover:

details of the client's risk appetite

- a definition of who is responsible for risk management
- a description of how risks will be identified, analysed (qualitatively/quantitatively), managed and reviewed
- the frequency of risk review meetings
- the software tools and techniques that will be used
- reporting forms and structures and
- if required, identification and reporting of trends, providing appropriate mitigation actions and advising on the decisions.

In embedding a risk-management approach the following areas are likely to be considered:

an understanding of the link between corporate and project requirements

- • the identification of current maturity level and any gaps
- • a development of the risk approach that may include training and specific tools
- • the implementation of the risk-management process and

- • how to improve the process and monitor its effectiveness.

The level of detail at which risk management is applied should vary depending on the size and complexity of the project.

### 3.1.2 Risk breakdown structure

Project risks are typically identified by the project team members with the aid of a risk breakdown structure (RBS). The RBS identifies potential risk generators in seven risk environments:

- natural
- economic
- government
- societal
- client
- construction and
- project.

3.1.3 Risk categories

Each of the risk events identified in the risk identification process is allocated to one of the following risk categories:

- external – uncontrollable
- external – influenceable
- internal – client operations (controllable)
- internal – user requirements (controllable) or
- internal – project processes (controllable).

The significance of each of these categories in terms of the risk response planning process is described in table 1.

### 3.1.4 Other risk-identification techniques

The project team can use a variety of techniques to identify:

- brainstorming
- cause and effect diagrams
- checklists
- delphi technique (anonymous polling)
- force-field analysis

- historical information
- industry knowledge base
- influence
- interviews
- lessons learned
- list of assumptions and constraints
- project document review
- questionnaire
- root-cause analysis
- strengths, weaknesses, opportunities and threats analysis
- team workshops and
- value improvement processes.

| Risk category | Risk source | Source characteristics | Response characteristics |
|---|---|---|---|
| External – uncontrollable | The event occurs due to circumstances outside of the project's control. | The client and project team have no control over the event occurring or its impact. | Provide contingencies to cater for the impact of the event should it occur. |
| External – influenceable | The event occurs due to circumstances outside of the project's control. | The client and/ or project team have a degree of influence over the probability of the event occurring and its impact. | Plan actions to influence the probability of the event occurring. Provide contingencies to cater for the residual impact of the event should it occur. |

| Risk category | Risk source | Source characteristics | Response characteristics |
|---|---|---|---|
| Internal – client operations | The event occurs due to action(s) taken by the client organisation. | The client has control over the probability of the event occurring. The project team has no influence over the probability of the event occurring or its impact. | The project team draws the client's attention to the ramifications of planned or implemented actions. The project team plans actions to reduce the impact of the event. The project team defines contingencies to cater for the residual impact of the event should it occur. |
| Internal – user requirements | The event occurs due to action(s) taken by the client and the project team. | The client and the project team have joint control over the probability of the event occurring. The client has control over the impact of the event. | Plan actions for the client and project team to implement that reduce the probability of the event occurring and its impact. Provide contingencies to cater for the residual impact of the event should it occur. |
| Internal – project processes | The event occurs due to action(s) taken by the project team. | The project team has control over the probability of the event occurring. The project team has control over the impact of the event. | Plan actions for the project team to implement that reduce the probability of the event occurring and its impact. Provide contingencies to cater for the residual impact of the event should it occur. |

Table 1: Risk categories

## 3.2 Qualitative risk assessment and management

### 3.2.1 Risk and opportunity analysis

The risk and opportunity analysis stage seeks to explore the likelihood of the occurrence of specific risks/ opportunities, the consequence of the occurrence and the magnitude of the potential impact.

### 3.2.2 Qualitative analysis

The purpose of qualitative analysis is to prioritise the risks in terms of importance, without quantifying (costing) them. This should be carried out during the first phases of the risk-management process.

An assessment is made (either by an individual or a group) of the likelihood that the risk will occur and the magnitude of its potential impact. The qualitative severity rating is reached by multiplying the likelihood of occurrence by the qualitative impact.

Likelihoods and impacts are typically categorised using scales such as:

- very high (VH)
- high (H)
- medium (M)
- low (L) or
- very low (VL).

This is based on a five-point scale, however, scales vary depending on the desirable level of categorisation.

Tables 1 and 2 are examples of possible scales that could be used for likelihood and impact assessment.

| Description | Scenario | Guide probability (%) |
|---|---|---|
| Very high | Almost certain to occur | 75–99 |
| High | More likely to occur than not | 50–75 |
| Medium | Fairly likely to happen | 25–50 |
| Low | Low but not impossible | 5–25 |
| Very low | Extremely unlikely to happen | |

Table 2: Likelihood

| Description | Scenario | Guide cost % of project | Guide time % of prog. |
|---|---|---|---|
| Very high | Critical impact on the achievement of objectives and overall performance. Huge impact on costs and/or reputation. Very difficult and possibly long-term recovery. | 2.00 | 5.00 |
| High | Major impact on costs and objectives. Serious impact on output and/or quality and reputation. Medium- to long-term effect and expensive to recover from. | 1.50 | 3.00 |
| Medium | Reduces viability, significant waste of time and resources and impacts on operational efficiency, output, and quality. Medium-term effect, which may be expensive to recover from. | 1.00 | 1.50 |

| Description | Scenario | Guide cost % of project | Guide time % of prog. |
|---|---|---|---|
| Low | Minor loss, delay, inconvenience or interruption.<br>Short- to medium-term effect. | 0.50 | 0.75 |
| Very low | Minimal loss, delay, inconvenience or<br>interruption. Can be easily and quickly remedied. | 0.25 | 0.25 |

Table 3: Impact

In qualitative analysis, values are typically allocated to the likelihood and impact to assist in ordering and prioritising risks.

Example

High likelihood (rating 3) × High impact (rating 3) = total risk rating of 9

It is possible to use a skewed scoring system to rate impacts higher than likelihoods.

Risks with a very low likelihood but a very high impact (i.e. those potentially disastrous to the project) are rated higher than risks with a very high likelihood but a very low impact (i.e. those inconsequential to the successful delivery of the project).

Once the risks have been qualified, the results can be displayed in table format (see Figure 1 and Figure 2). This provides a conceptual diagram for a risk-rating mechanism. It is compiled by the risk manager who marks individual risks on the matrix to give an overall pictorial view of the main risks affecting the project

In Figure 1, the assessment of risk is against a single impact. The single impact is a combination of all relevant impacts, such as time, cost, fitness for purpose, reputation and so on. However, if required, each risk can be assessed against multiple impacts to show the effect particular risks have on their project objectives and, at programme level, the overall delivery objectives.

| Likelihood | | | | |
|---|---|---|---|---|
| | 3 | 3 | 6 | 9 |
| | 2 | 2 | 4 | 6 |
| | 1 | 1 | 2 | 3 |
| | | 1 | 2 | 3 |
| | | Impact | | |

Figure 1: Standard heat diagram (with ratings)

| | | | Opportunities | | | | | Threats | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Likelihood | VH | 5 | 16000 | 8000 | 800 | 80 | 16 | 16 | 80 | 800 | 8000 | 16000 | 5 | VH | Likelihood |
| | H | 4 | 12000 | 6000 | 600 | 60 | 12 | 12 | 60 | 600 | 6000 | 12000 | 4 | H | |
| | M | 3 | 8000 | 4000 | 400 | 40 | 8 | 8 | 40 | 400 | 4000 | 8000 | 3 | M | |
| | L | 2 | 4000 | 2000 | 200 | 20 | 4 | 4 | 20 | 200 | 2000 | 4000 | 2 | L | |
| | VL | 1 | 2000 | 200 | 100 | 10 | 2 | 2 | 10 | 100 | 1000 | 2000 | 1 | VL | |
| | | | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | | | |
| | | | VH | H | M | L | VL | VL | L | M | H | VH | | | |
| | | | Benefit | | | | | Consequence | | | | | | | |

Figure 2: Heat diagram with risk ratings skewed towards impact

Another important feature by which risks can be ranked is proximity; that is, the point in the future at which the risk will occur. Most attention should be focused on risks with high likelihoods and impacts that will occur imminently. However, it is at the risk manager's discretion to also start managing distant risks with other implications.

### 3.2.3 Risk response

The strategies for mitigating risk (see subsection 2.2 Response/mitigation strategies) for each risk rating level (red, amber, orange and green) should suit the level of risk appetite defined by the project team (risk appetite will vary depending on the client's core business and also the personnel responsible for the project). The project team should agree on the risk mitigation approach and follow this when defining actions for specific risks. Figure 3 shows an example of a risk mitigation approach.

| Description | Action required |
|---|---|
| Unacceptable | Comprehensive action required immediately. Must eliminate or transfer the risk. |
| Highly undesirable | Attempt to manage, avoid or transfer risk. Some immediate action is required plus the development of a comprehensive action plan. |
| Manageable | The team is uneasy about carrying this risk. Retain and manage the risk. |
| Negligible | The team will carry the risk but it needs to be actively managed. |

Figure 3: Example risk mitigation approach

### 3.2.4 Selecting risks for active management

Effort should be concentrated on the major risks throughout the RIBA Plan of Work (preparation stages) (i.e. 0: Strategic definition and 1: Preparation and brief) and the OGC gateways (0 Strategic assessment and business justification and 2 Delivery/procurement strategy). It is neither practical nor cost effective to actively manage all risks on the risk register. Only those that represent the greatest threat to the project require this treatment. To select risks for active management the project team should agree a threshold severity rating above which they will actively manage risks. This avoids unnecessary effort in managing trivial risks and focuses effort on the most significant risks. The threshold may vary from project to project and will depend on the project team's risk appetite.

It is not necessarily acceptable to do nothing or to defer mitigation on middle and lower range risks (in terms of impact or probability). Even if a risk falls into the middle and lower range of risks, the risk manager will need to continue to reduce its probability and impact until the residual risk is insignificant.

Further effort to reduce the risk's probability or impact is not likely to be required when the resources applied are likely to be grossly disproportionate to the risk reduction achieved. However, the risk should still be monitored to ensure that it stays within this 'safe' region.

### 3.2.5 Allocating management actions

For each risk it is necessary to consider who is accountable should that risk occur. This person is normally called the risk owner, and will be a senior manager or board member. The project team must also decide on who can best take responsibility for the action to manage the risk, either on their own or in collaboration with others. This person is normally called the action owner. Individuals rather than organisations should be nominated in each case as the latter is too ambiguous. The risk manager should allocate new 'owners' in the event of people leaving the project team.

Next, the project team needs to consider what the action owner can undertake to implement one of the strategies outlined in subsection 3.2.4, Selecting risks for active management. This will be the management action. Finally, the project team needs to decide the dates by which the action should be completed and reviewed. The risk manager should ensure that the project team nominate specific dates rather than vague terms such as 'ongoing' or 'next progress meeting'. Poorly defined dates may lead to unmanaged risk escalations and slippage, threatening the successful delivery of the project.

It is the risk manager's job to chase up the action owners to make sure that risks are being managed. Often action owners will only perform if 'encouraged' by the risk manager.

In defining the action that the action owner should take, it is necessary to keep things in proportion, assess the resources needed to undertake the action and compare these with the impact should the risk occur. There is little point in expending more resources than would be required to manage a risk if it were to occur.

## 3.3 Risk ownership v procurement route

### 3.3.1 Traditional

In the traditional route, the client owns the risk in terms of time, cost and information as they retain control of the design and of the required quality. In table 4, responsibilities are prescribed between the parties.

| Risk | Client/employer | Contractor |
|---|---|---|
| Construction programme | | x |
| Design programme | x | |
| Cost certainty | x | x |
| Control of design/quality | x | |
| Performance of design teams | x | |
| Performance of main contractor | x | |
| Performance of subcontractors | | x |
| Quality of construction | | x |

Table 4: Responsibility appointment

### 3.3.2 Design and build

For a single-stage procurement process the contractor owns the risk in terms of design and construction.

For a two-stage procurement process there is an interim share when the client appoints a design team that is later novated to the contractor and risk of design and construction is owned by the contractor. In table 5, responsibilities are prescribed between the parties.

| Risk | Client/employer | Contractor |
|---|---|---|
| Programme | | x |
| Cost certainty | | x |
| Control of design/quality | x | x |
| Performance of design teams | x | x |
| Performance of main contractor | x | |
| Performance of subcontractors | | x |
| Quality of construction | | x |

Table 5: Responsibility allocation

### 3.3.3 Management route

Table 6 shows the allocation for a management contracting (MC) form of contract.

| Risk | Client/employer | Main contractor | Works contractors |
|---|---|---|---|
| Programme | | x | |
| Cost certainty | x | | |
| Control of design/ quality | x | | |
| Performance of design teams | x | | |
| Performance of main contractor | x | | |

| Risk | Client/employer | Main contractor | Works contractors |
|---|---|---|---|
| Performance of trade contractors | | x | |
| Quality of construction | | x | x |

Table 6: Management contracting

### 3.3.4 Construction management

Table 7 shows the allocation for a construction management (CM) form of contract.

| Risk | Client/employer | Main contractor | Works contractors |
|---|---|---|---|
| Programme | x | | |
| Cost certainty | x | | |
| Control of design/ quality | x | | |
| Performance of design teams | x | | |
| Performance of main contractor | x | | |
| Performance of trade contractors | x | | |
| Quality of construction | | | x |

Table 7: Responsibility allocation

## 3.4 Contributing data for quantification

For the central limit theorem and Monte Carlo techniques, the process for compiling data is exactly the same as the qualitative process described in subsection 3.2 Qualitative risk assessment and management, except for the following additional steps that convert qualitative to quantitative assessments.

It is recommended during workshops that the risk manager ensures risks are assessed against the appetite ranges previously agreed. To ensure accuracy of results, the cost and risk manager need to work closely to ensure the respective models are aligned.

The risk manager should decide which likelihood and impact ratings should be 'managed' or 'unmanaged'; that is, they should assume that the team will undertake certain management actions and amend the register accordingly. All risks should be covered and any duplication or non-cost risks (such as time, safety or operational issues) should be removed from the risk register (see appendix B).

### 3.4.1 Central limit theorem

For quantifying cost-only risks, a simple mathematical formula is applied, which is derived from the central limit theorem.

Risk allowance for 90% confidence = ?Pi × Ei + 1.3 × v?(Ei2 × Pi) × (1 − Pi)

where Ei = The estimate for risk No. i and

Pi = The probability of risk No. i occurring

This calculates the risk allowance that should be added to the base cost estimate to give 90% confidence that the project can be completed within the resulting sum.

### 3.4.2 Monte Carlo techniques

The inputs for a quantitative risk analysis (QRA) are typically the probability values for each risk and an assessment of their impact; for example, a minimum cost impact of £10,000, a most likely cost impact of £15,000 and a maximum cost impact of £30,000.

Computer-based analysis software can generate graphs that show the following:

- probabilities of project completion at various costs, for example, 90% certainty of completion for less than £xxx
- distribution of out-turn cost outcomes, for example most likely cost outcome and
- identification of the risks that have the most impact on the project outcome.
- other statistical information.

#### Warning

The results of the QRA will only be as good as the information on which it is based. Since most uncertainty estimates will be subjective, the accuracy of the results will only be approximate.

Note that Predict! RA or @Risk may also be used to prepare cost plans; these build in the estimated uncertainties for quantities and rates.

# 4 Practical considerations (Level 3: doing/advising)

## 4.1 Advising on appropriate procurement route

The selection of appropriate procurement routes should include the identification of risks for each procurement option specified and the use of qualitative risk assessment to establish the risk profile of each option. The relative risk profiles of each of the options should be used to influence the selection of the option that provides the lowest risk solution for the project.

### 4.1.1 Tender return risk profiling

The evaluation of tender returns should include the identification of risks for each return and the use of qualitative risk assessments to establish the risk profile of each option. The relative risk profiles of each of the tender returns should be used as a criterion in the evaluation process and should be assigned a weighting appropriate to the importance of the risk profile assessment in relation to the other evaluation criteria.

### 4.1.2 Risk responsibilities

An example of the responsibilities of individuals and roles on the project are shown in table 8 (Note that where a risk manager is not appointed, the role needs to be allocated to someone else in the project team).

### 4.1.3 Applying quantification techniques and advising clients on level of risk allowance

#### 4.1.3.1 Risk allowance risk analysis and anticipated final cost

Project risk allowance is often derived as a percentage of the capital cost of a project, for example, 5% of capital cost. This approach produces a risk allowance figure that can be subjective. An alternative, which is increasingly mandated by many public bodies (such as the Office of Government Commerce (OGC)) is to use the quantitative risk analysis (QRA) to generate a risk allowance. The process produces a risk figure based on a percentage confidence that the figure will not be exceeded. It is common to report on an 80% confidence level. This is commonly referred to as the P80 risk allowance. Software tools will give any level of confidence so the level can be easily changed and tailored to specific needs (the Monte Carlo technique is a widely practiced technique to undertake a quantitative risk analysis).

Risk modelling can be used to minimise the increasing risk exposure of a project and likewise a reduction on risk allowance. Should risk materialise, these should be drawn down through a formal change control process.

It is important to know that the output from QRA is used to inform risk allowance and not used as the specific risk allowance figure.

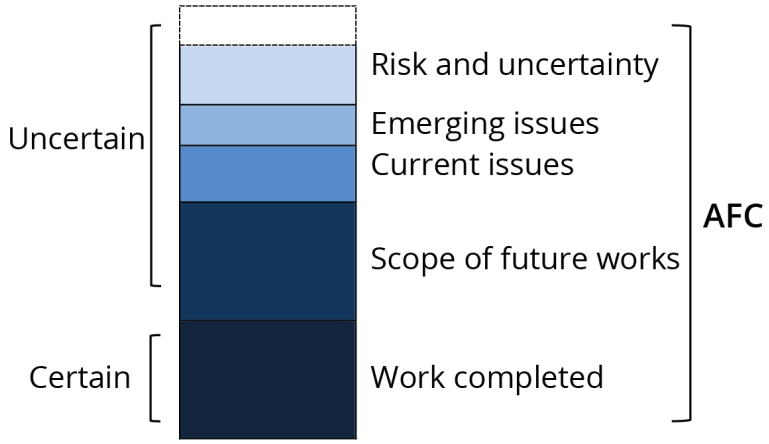


Figure 4: Anticipated final cost (AFC)

#### 4.1.3.2 Risk deliverables

The primary deliverables from the risk-management process and associated procedures are:

- a risk-management plan
- a risk register (see appendix B)
- risk ranking/critical risk identification
- quantitative cost risk analysis results
- quantitative schedule risk analysis results
- a risk-response plan
- risk-response progress reviews
- risk-management reports
- risk-management maturity assessments
- procurement option reviews and
- tender return risk reviews.

#### 4.1.3.3 Risk reporting

Agendas and minutes of meetings should be given document reference numbers and saved on the programme (project) document control management system. Risk registers

should be saved once a month (with a new document reference and date) as a record of the management of risk, once a baseline risk register has been prepared. The client monthly reports should not be saved independently of the complete reports.

Individual project risk registers, risk reports, quantitative risk analysis results and reviews generated should be saved on a central depository for easy retrieval.

Monthly project reports should describe the most serious risks, their assessment and the planned responses to reduce, remove or re-assign (transfer) the risks where retention is avoidable/not desirable.

Risk communiqués are short report documents that should be circulated to highlight an issue in a short yet formal form of communication.

| Responsibilities | CR | PD | PMs | RM | SL | CD | PDLs |
|---|---|---|---|---|---|---|---|
| **Embedding risk management** | | | | | | | |
| Embeds risk management into the project culture by encouraging participation in risk management as part of everyday working practices. | x | x | x | x | x | x | x |
| Provides leadership, strategic direction and undertakes client liaison. | | x | | | | | |
| Champions risk and opportunity management on the project. | | x | | | | | |
| Provides direction to project governance. | | x | | | | | |
| Makes staff aware of the project's risk-management requirements and drives the risk-management process from the top down. | | x | x | x | x | x | x |
| **Context** | | | | | | | |
| Agrees with the client the project objectives and the prioritised objectives. | | x | | | | | |
| **Identification** | | | | | | | |
| Collaboratively identifies risks and opportunities. | x | x | x | x | x | x | x |
| **Assessment** | | | | | | | |

| Responsibilities | CR | PD | PMs | RM | SL | CD | PDLs |
|---|---|---|---|---|---|---|---|
| Works with risk owners and the project manager to sense check the cost impact assigned to each risk to support an appropriate assessment. | | | | x | | | |
| **Evaluation** | | | | | | | |
| Provides the risk manager with the latest version of the project's cost plan (including cost spreads reflecting estimating uncertainty). | | x | | x | | x | |
| Agrees whether a risk provision is to be added to the escalation provision. | | x | | x | | x | |
| Agrees how the contingency will be calculated/determined. | | x | | x | | x | |
| Conducts quantitative risk analysis (applying @RISK software) to determine contingencies, incorporating inputs from the project team members. | | | | x | | | |
| Supplies the risk manager with the latest schedule and cost estimate in electronic format. | | | | x | | x | |
| **Treatment** | | | | | | | |
| Accepts ownership of risks and opportunities allocated to them. | x | x | x | | x | x | x |
| Prepares discrete concrete risk responses for the risks where they have been identified as the risk owner and seeks approval for their implementation from the project director to ensure a coordinated approach. | x | x | x | | x | x | x |
| As required, assigns appropriate risk actions as responsible for the definition and execution of project director-approved risk responses. | x | x | x | | x | x | x |
| **Monitor and review** | | | | | | | |

| Responsibilities | CR | PD | PMs | RM | SL | CD | PDLs |
|---|---|---|---|---|---|---|---|
| For the risks for which they are the designated owner, reviews and monitors information held in the project's risk register, to establish if it is current and accurate (as far as possible). | x | x | x | | x | x | x |
| Informs the risk manager of any updates required to the risk information. | x | x | x | | x | x | x |
| Reviews risk response proposals with the project personnel to gain agreement. | x | x | x | x | x | x | x |
| Highlights new project risks to the risk manager for inclusion in the risk register. | x | x | x | | x | x | x |
| Participates in the identification, assessment, evaluation and management of risks and opportunities. | x | x | x | x | x | x | x |
| **Process implementation** | | | | | | | |
| Facilitates project-wide risk workshops/ meetings. | | | | x | | | |
| Organises and chairs monthly multi-disciplinary risk meetings to review and update the project risk register. | | | | x | | | |
| Ensures appropriate representation of the different disciplines at the risk meetings. | | x | | | | | |
| Decides on the most appropriate attendees and issues the meeting invitations. Reports any repeated absences to the appropriate manager. | | | | x | | | |

| Responsibilities | CR | PD | PMs | RM | SL | CD | PDLs |
|---|---|---|---|---|---|---|---|
| Prepares an agenda and set of minutes for each meeting (with a copy of the revised risk register forming an attachment to the minutes). At each meeting:<br>• closes risks that have materialised or have been overtaken by events<br>• records new risks and opportunities<br>• records any changes to the probability of the risk occurring or the impact (time and or cost)<br>• captures and updates responses to the risks; and<br>• records the expected monetary value (EMV) of each risk (to support risk reporting of the most serious risks). The EMV will be updated pre- and post-implementation of mitigation actions. Mitigation costs will be assessed and balanced against the mitigation actions proposed. | x | x | x | x | x | x | x |
| Attends monthly project risk meetings. | x | x | x | x | x | x | x |
| Establishes a change control process for changes to the project brief. | | x | | | | | |
| Reviews and accepts or comments upon the risk section of the client monthly report prepared by the risk manager. | | x | x | | x | x | x |
| Supports the identification of the top ten project delivery risks for reporting requirements. | | x | x | | x | x | x |
| Incorporates the risk-management requirements into packages of work. | | x | x | | | | |
| Supports team members to update the project risk register with data supplied by the project team. | | | | x | | | |
| Provides risk progress reports as required. | | | | x | | | |

| Responsibilities | CR | PD | PMs | RM | SL | CD | PDLs |
|---|---|---|---|---|---|---|---|
| Refers to the existing project risk register to identify 'blind spots'. | | | | x | | | |
| Supports the procurement process in conjunction with the project team (i.e. not in isolation) in terms of the selection of the procurement route, form of contract and contract conditions which must reflect the employer's requirements risk appetite. | | | | x | | | |
| Examines the adequacy of insurance policies in conjunction with the commercial manager. | | | | x | | | |
| Advises on project interfaces and stakeholder involvement | | | | x | | | |
| Monitors whether there is consistency in the vocabulary/language used for the risk management and allied disciplines. | | | | x | | | |

**Key:**

- CR (client representative)
- PD (project director)
- PMs (project managers)
- RM (risk manager)
- SL (schedule lead)
- CD (commercial director/project controls)

Table 8: Responsibilities on a project

# Appendix A: Risk terminology

**Action owner:** the person responsible for ensuring that the action is undertaken.

**Allocation of risk:** how the responsibility for risk is split between the contracted parties.

**Benefit risk:** the risk to achieving benefits in full, arising from a risk occurring in a project.

**Communications plan:** document setting out how people and organisations will communicate with one another.

**Consensus:** form of agreement between individuals or organisations.

**Consequence:** the result of a risk occurring.

**Consequential risk:** a risk that may occur as a result of another risk occurring.

**Constraint:** imposed limitation.

**Contingency:** an allowance set aside or a plan as a precaution against future need.

**Cost drivers:** things or events that cause costs.

**Critical path:** project planning term linking activities for which time is critical and there is no slack.

**Escalation:** means of referring a matter to more senior management.

**Estimate:** quantitative measure of the consequence (expressed as a cost).

**Evaluation criteria:** considerations taken into account when selecting something.

**Exposure:** the potential result of a risk occurring.

**Gateway:** term used to define the passage between one project stage and another.

**Impact:** qualitative or quantitative measure of the severity of the consequence. It may be positive (an opportunity) or negative (a risk).

**Initial costs:** costs incurred in the acquisition, planning and construction, and handover of the facility.

**Issue:** an event that is certain to occur or is currently occurring.

**Likelihood:** qualitative measure of the chance that the consequence occurs.

**Matrix:** array of numbers and/or words.

**Monte Carlo simulation:** computer-generated simulation used to model outcomes.

**Nominal exposure:** the product of the probability and the estimate.

**Outputs:** the products of a study.

**Owner:** the person ultimately responsible for an action of risk, or the ultimate beneficiary of a project.

**Probability:** quantitative measure of the chance that the consequence occurs (expressed as a percentage).

**Profiles:** method of showing the distribution of value or risk in a project.

**Programme:** timetable of activities within a project; series of value and/or risk-management studies and activities throughout the life of a project.

**Project:** a defined series of activities intended to bring about beneficial change.

**Project stage:** part of a project selected to assist its orderly management.

**Prompt lists:** list of previously identified components, activities or events to assist in the identification of project specific ones.

**Proximity:** the point in the future at which a risk will occur, measured in months/weeks or by milestones.

**Qualitative:** dimensionless measure of an attribute.

**Quantitative:** measure of an attribute that has dimensions (e.g. time or cost).

**Quantitative risk analysis (QRA):** calculation of cost or time effects of risk.

**Risk analysis and management for projects (RAMP):** method for managing risk promoted by the Institution of Civil Engineers (ICE).

**Rating:** qualitative measure of the exposure to risk: the product of likelihood x impact.

**Recording:** task of capturing the outputs from a study.

**Risk:** an uncertain event or circumstance that, if it occurs, will affect the outcome of a project (commonly in terms of cost, time or fitness for purpose).

**Risk action owner:** the individual or organisation responsible for undertaking the actions to manage a risk.

**Risk allowance:** quantitative allowance set aside or a plan as a precaution against future need, linked to the risk register.

**Risk analysis:** the process of identifying and assessing risks; this may be done qualitatively or quantitatively.

**Risk appetite:** the willingness of a person or an organisation to accept risk.

**Risk management:** the overall process of managing risks.

**Risk manager:** the person responsible for leading the risk-management process.

**Risk owner:** the individual or organisation best able to control/manage a risk.

**Risk register:** a database of captured risks containing a summary of the information necessary for managing the risks.

**Risk response:** action taken to reduce exposure to a risk.

**Risk reviews:** regular reviews following the initial risk study where new risks may be identified. Existing risks, and actions relating to them, are reassessed and closed risks deleted.

**Scenarios:** group of compatible proposals.

**Sensitivity:** varying parameters used in a calculation to demonstrate robustness of its outcome.

**Strategic:** relating to the high-level planning of a project.

**Study:** a combination of activities including preparation, analysis workshop(s), decision building, reporting and implementation within the context of value or risk management.

**Study leader:** a qualified practitioner who organises and facilitates a value management (or risk management) study or programme of studies, or an individual responsible for planning and conducting a study.

**Study types:** different types of (value and risk management) study.

**Targets:** financial, time or quality aspirations.

**Time risk:** risks that have an impact on the time to undertake an activity.

**Top-down risk:** using high-level guidelines to assess the effects of risk.

**Value and risk:** activities to improve value and reduce uncertainty.

**Weighting:** method of prioritising attributes.

**Workshop:** a formal facilitated event, involving multiple stakeholders and disciplines, taking participants through a structured process to a prescribed outcome.

**Wrap-up:** term used to describe a meeting at the end of a study at which decisions are made.

# Appendix B: Example risk registers

Example 1 (split):

| | | | | | | | | | | Qualitative | | | | | | Pre-mitigated risk score (only for risks) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Title | Risk ID | Category | Status | Type | Risk (or opportunity) title and description | Cause of risk (or opportunity) | Consequence of risk (or benefit of opportunity) | Proximity of impact | Risk owner | Prob | Cost | Time | Reput'n | Envir'n | H & S | Prob | Cost | Time | Reput'n | Envir'n | H & S | Pre-mit severity |
| Route conflict | 1100 | 3. Functional specification for developing route | Active | Risk | There is a risk that a new road layout at St Johns Green conflicts with the phase 2 route | 1. Phase 1 is constructing the route at St Johns Green | 1. Additional cost of design and construction | 6. Pre construction | David Jones | 4 | 1 | 0 | 4 | 1 | 0 | 50-74% | <£5m | | H | VL | | 16 |
| Phase 1 Connection point | 1101 | 3. Functional specification for developing route | Active | Risk | There is a risk that phase 1 connection point is not build as specified | 1. Phase 1 is constructing the connection point | 1. Additional cost of design and construction | 6. Pre construction | David Jones | 1 | 1 | 0 | 4 | 1 | 0 | <5% | <£5m | | H | VL | | 4 |
| Gillington site | 1102 | 4. Delivery and commercial | | Risk | There is a risk that the project needs to pay compensation for business disruption | 1. Planning consent granted | 1. Increased cost of compensation 2. Increased cost of additional mitigation | 6. Pre-construction | John Santos | 1 | 2 | 0 | 3 | 2 | 0 | <5% | <£5-25m | | M | L | | 3 |

## Example 1 continued:

| Date next review | | | | Post-mitigated risk score or opportunity score | | | | | | | | Pre-mitigated cost estimate | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Risk mitigation or opportunity action plan | Action owners | Action date due | Comments | Prob | Cost | Time | Reput'n | Envir'n | H & S | Opp'y | Post-mit severity | Prob % | Min cost (£m) | ML cost (£m) | Max cost (£m) | Cost comments |
| 1. During detailed design, undertake monthly design reviews with phase 1 | Alasdair Smith | | | 5-29% | <£5m | | L | VL | | | 8 | 68 | 0.49 | 1.04 | 1.55 | Min: redesign (£35k) + construction (£150k) + 2 weeks prelims. ML: redesign (£50k) + construction (£400k) + 2 weeks prelims. Max: redesign (£50k) + construction (£650 k) + week's prelim. |
| 1. During design and construction, undertake bi-weekly reviews with phase 1 | Tony Harper | | | <5% | <£5m | | VL | VL | | | | 3 | 0.49 | 1.04 | 1.55 | Min: provision of accesses every 10km + access road 200m long x 5m wide + 4 accesses + 2 weeks prelims. ML: redesign + construction + 2 weeks prelims. Max: provision of accesses every 1.5km + access road 1000m long x 5m wide + 25 accesses + 2 weeks prelims. |
| 1. Keep regular liaison meetings with business ongoing to address issues early | Paul Smith | | | <5% | <£5-25m | | VL | L | | | | 3 | 21.50 | 21.75 | 22.25 | Min: property value/compensation (£10m) + disturbance + additional mitigation + 4 weeks prelims. ML: property value/compensation (£10m) + disturbance + additional mitigation + 4 weeks prelims. Max: property value/compensation (£10m) + disturbance + additional mitigation + 4 weeks prelims. |

Example 2:

| Risk identification | | | | Inherent assessment | | | | | | | Risk management | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Cause | Risk | Effect | Likelihood | Cost | Time | Objective | Reputation | Risk status | ROAG | Management actions taken | Management actions planned | Risk owner | Action owner(s) | Last updated |
| 1504 | 1. Estimating uncertainty<br>2. Development and design | Risk that following procurement the cost of projects exceeds the budget | 1. Increased costs<br>2. Potential delays | 1 | 4 | | | | 0.040 | Amber | | 1. Re-evaluate the programme budgets and evaluate all options available (design changes, budget reallocation) | John Ingram | Sam Law | 23-Apr-14 |
| 1500 | Section 106 improvements | Risk of reliance on third party developers funding infrastructure improvements | Delays | 3 | | 4 | | | 0.120 | Red | Engagement with the developer | 1. Continue to engage with the developer regarding programme and intentions | John Ingram | Sam Law | 28-Feb-14 |

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