

THE QUANTIFICATION OF RISK

By John Hargreaves and Anette Mikes

INTRODUCTION

Business decisions usually involve trade-offs that lead to different risks for management, customers, suppliers, employees and shareholders. Whilst many day-to-day management decisions may have few risks, long-term strategic decisions often involve high levels of risk. (For a practical definition of risk, based on the threat to the achievement of business objectives, see *insert 1*.)

1 *A definition of risk*
Risks are uncertain future events that could expose the organisation to the chance of loss. Loss is a relative concept: a reference level needs to be defined to measure it. A frequently used reference level (which is also recommended by the Corporation) is the list of objectives set out in the business plan. Therefore risks may be regarded as uncertain future events that could influence the achievement of your RSL's strategic, operational and financial objectives.

RSLs have completed surveys of the risks they face, and have adopted systems to control the risks they have found. The depth of this analysis has varied from one RSL to another, depending on local factors.

Many RSLs are quantifying risk to allow them to:

- prioritise risks;
- compare the risk in one part of the organisation to another;
- determine an organisation's total corporate risk;
- assess progress in reducing key risks.

EDITOR'S FOREWORD

These papers are published as part of a short series covering various aspects of risk management. They are sponsored by the Housing Corporation with a view to encouraging the ongoing development of best practice among registered social landlords. The papers follow on from previous publications that sought to introduce and develop effective risk management. In particular the publication in 2000 of 'Effective Risk and Business Management' was designed to identify the elements of a risk management framework for RSLs. ■ The views expressed in these topic papers are those of their authors and not the Housing Corporation. It is hoped that they will stimulate the development of best practice in specific areas of risk management. Roger Lustig

This topic paper examines how risks may be quantified. It explains and evaluates four approaches to risk quantification, in ascending order of sophistication. As an example, the paper gives a means of aggregating and prioritising different risks through a statistical approach. Finally the paper considers how RSLs may incorporate quantified risks in their business planning process.

The paper aims to give risk managers in RSLs some further ideas that will contribute to the ongoing evolution and refinement of their risk management practices.

RISK QUANTIFICATION

Four alternative approaches

When deciding the most appropriate method of evaluating an organisation's risks, there is a choice between the four approaches illustrated at *Diagram 1*. The most appropriate choice depends on individual circumstances, and on the RSL's attitude towards its risks.

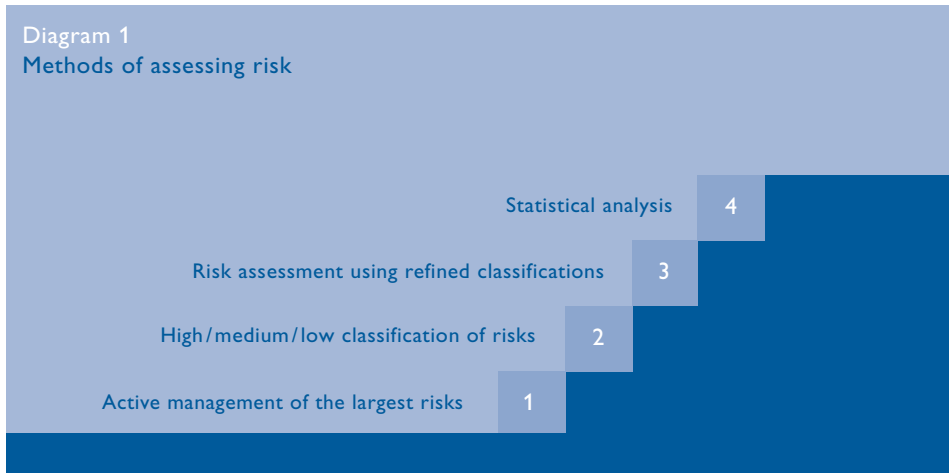
See *insert 2*.

2 *Active vs. passive risk behaviour*
People who take an active approach to risk attempt to modify the risky situations they confront by gaining time, information and control. This will allow them to work out actions to reduce the probability or impact of risks. In contrast, people taking the passive approach do not try to change the risky alternatives, they simply choose among them.

It is worthwhile to examine the main alternative approaches to risk assessment,



'A life without adventure is likely to be unsatisfying, but a life in which adventure is allowed to take whatever form it will, is likely to be short.' Bertrand Russell



and to consider issues that contribute to the choice between them.

METHOD 1
 ACTIVE MANAGEMENT OF ONLY THE LARGEST RISKS

Chief Executives will often maintain that they are already aware of the main risks facing their organisations. In view of this, the most important risk management task is to manage these risks well. This attitude is justified by practical experience. About 80% of the total risk facing an organisation is usually concentrated in the top dozen risks.

As illustrated in *insert 3*, there are very large differences between the impacts of different risks. This example is drawn from ordinary life, but the point applies to RSL risks as well. There are also large differences in risk probabilities. Some risks occur rarely, others frequently.

3 *Differences in risk magnitudes – an example*

For an American male aged 55, the life expectancy lost from:

- regular coffee drinking 6 days
 - fires 14 days
 - motor vehicle accidents..... 195 days
 - being 30% overweight 3.5 years
 - over 20 cigarettes per day 7 years
 - being unmarried.....9.5 years
- Cohen & Lee, 1979*

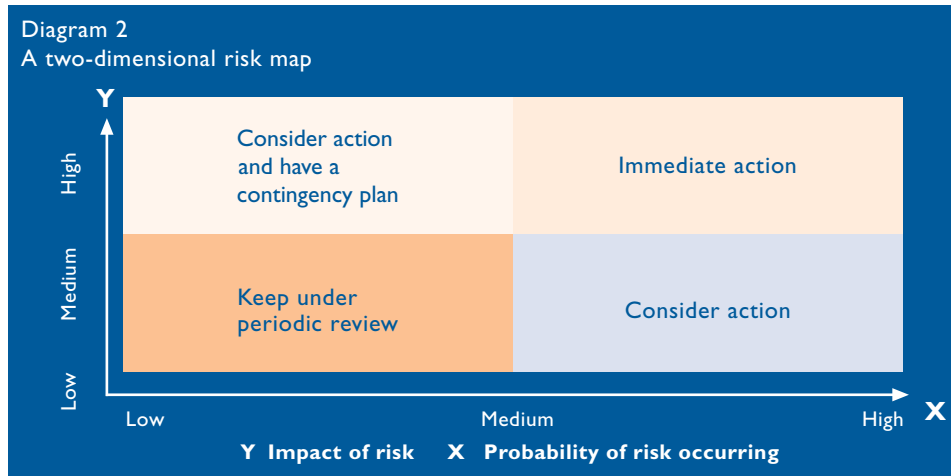
Nevertheless, to uncover the top dozen risks with confidence, it is usually necessary to consider at least three times that number of risks. This analysis often reveals a couple of large risks that have been omitted by management.

In some organisations the available resources to control risks are limited. When the risks have been identified in such circumstances, it may be best to concentrate initially on the effective management of the top dozen risks. This avoids spreading management effort too thinly and less effectively.

It is certainly better to actively manage the top dozen risks than to make a long list of risks and do little about any of them!

The idea of concentrating on only the top risks may be good as a first approach to risk evaluation. It is not an adequate basis for confident risk management in the medium term.

Active management of the top risks alone suffers from the drawback that it is not comprehensive. The business world is littered with examples of less prominent risks that have led to the downfall of organisations. The Corporation seeks to ensure that RSLs do not overlook any risks that may have significant adverse impacts. Additionally, managing the important risks successfully



can yield savings, which suggests that extending management attention to the less significant risks may also produce benefits.

METHOD 2
 ‘HIGH / MEDIUM / LOW’
 CLASSIFICATION OF RISKS

The two-dimensional risk map

A more complete coverage of risks may be obtained by using the two-dimensional risk map approach shown in *Diagram 2*.

Following this approach, the RSL draws up a detailed list of risks that, as far as possible, covers all its activities. The RSL estimates the probability of the risk occurring and the impact of the risk, expressed in terms of high / medium / low categories. These estimates are then plotted on the risk map to illustrate graphically the relative size of their probabilities and impacts.

The resulting risk map shows the position of the risks relative to each other. It distinguishes between high, medium and low risks according to their position on the map. The risks are managed according to their position as follows:

Probability	Impact	Action
High	High	Immediate
High	Low	Consider steps to take
Low	High	Consider steps to take and produce a contingency plan
Low	Low	Keep under review

It is common in reports describing this sort of approach to use the traffic-light colours red, amber and green to emphasise high, medium and low risks. High risks that cause concern are ‘red’, while low risks are ‘green’.

METHOD 3
 RISK ASSESSMENT USING
 REFINED CLASSIFICATIONS

‘Top down’ v ‘Bottom up’

The high / medium / low approach works if the risk analysis is done mainly by one person. This usually happens in what is known as a ‘top-down’ approach.

If the risks are to be tackled at all levels of the organisation, several people need to be involved. This requires a ‘bottom-up’ approach. With several people involved, there may be different views of specific risks.

Encouraging participation

Scheme managers, for example, may consider a specific risk in their projects to be high. This is because the projects they deal with represent the complete spectrum of their experience of the RSL. A board member or senior manager might only rate the risk as low in the light of a full knowledge of the RSL’s risk map. Classification differences such as these need to be reconciled so that all members of staff are encouraged to participate in risk management. High, medium and low risk classifications require clear definition.

The high, medium and low classification is rather a crude yardstick. It does not register graduations of risk within each category. So, if management expends effort to reduce the impact of a particular risk, it may well continue to register as 'high'. A system with only three graduations may consequently be difficult to use for control purposes.

Refining the classification

A possible solution is to employ a more refined classification of probabilities and impacts. For example, the graduations may be increased to five such as very high, high, medium, low, very low (as recommended in the Australian and New Zealand Standards).

Defining the graduations

In practice it is then even more important to define what each graduation means. To achieve uniformity, numeric bands can be established for each impact. So, for a medium sized RSL a high risk might be set at a level of, say £100,000 impact in the annual surplus. The level would be assessed in relation to specific circumstances.

Example of a probability scale

Percentage chance of happening in one year	
Once per year.....	100
Once every two years.....	50
five years.....	20
ten years.....	10
twenty years.....	5
fifty years.....	2
one hundred years.....	1

In relation to probability estimation, managers may not initially feel able to make quantified estimates. But assessment can be simplified. For example, the scale of probabilities above shows one way of making an appropriate estimate.

In practice, managers are reasonably confident in predicting that the probability of an event is about once every five years, as opposed to once every two years or

once every ten years. Similarly, managers can usually make a rough estimate of a financial impact, to the level of accuracy required by a system of scales, without too much effort. The scales to be used need to be carefully designed for each RSL, depending on their individual circumstances and capabilities.

Risk perception biases

It is known that estimates of impact or probability are prone to estimation bias, whether in quantified form or expressed as high / medium / low.

See *insert 4*.

4 Risk perception

A desire for certainty is common in all people. Although we are risk averse to varying extents, one way to reduce the anxiety of confronting uncertainty is to deny it, leading to blind spots and the danger of unpleasant surprises. Probability and impact estimates may be biased by several factors:

- *Availability bias: People tend to over-estimate the probability of an event if instances of it are easy to recall or imagine.*
- *Illusion of control: In some circumstances people behave as if they are able to exert control when this is highly unlikely. Goal-focused leaders in stressful conditions are especially prone to this illusion.*
- *Confirmation bias: Having formed an opinion, people tend to pay more attention to information that confirms it and to ignore information that contradicts it.*
- *Group think: Reality testing can deteriorate as a result of group pressures to maintain unanimity and coherence.*

Documenting the risk appraisal

It is essential for RSLs to keep good documentation of the causes of the risk they are evaluating, and the assumptions they make as to its consequences. This discipline should underlie the quantified estimates, as it enables biases to be

corrected and a good understanding of the nature of the risks to be shared between management team members.

Risk databases

RSLs may want to hold detailed risk assessments in a risk database with all the other information on each risk. In particular, the database may contain specifications and control information in relation to all the actions that are currently under way to reduce the risks that have been found, together with associated risk-reduction targets. It is also useful to differentiate in the database between the short-term impact of risks, i.e. their surprise element, and their medium-term effects.

Risks whose impact is mainly short-term are likely to need managing differently, and RSLs need to be able to analyse their vulnerability to short-term shocks.

METHOD 4

STATISTICAL ANALYSIS

So far this paper has discussed the use of bands or single 'best guess' estimates of the impact and probability of each risk to represent its importance. However, this simplifies reality.

In practice there may be uncertainty in the probability estimate, and the impact of the risk may vary considerably depending on its severity. It may be possible for a given risk, for example a hike in interest rates, to be either relatively benign or far reaching in its implications.

Risks with a wide range of possible impacts can be represented by a probability distribution of the risk impact. This degree of sophistication allows risks with a wide range of impacts to be represented and aggregated using spreadsheet based methods.

An example, using two risks, is shown overleaf to demonstrate the logic of this approach. In the example, the two risks lead to only four possible

combined outcomes. In practice there will be a number of risks, each with a range of outcomes. Combining these cannot be done manually, but easy-to-use spreadsheet-based models are available to do the analysis. See *insert 5*.

5 *Dealing with correlations between risks*
Sometimes risks are highly correlated with one another. The correlation might be positive (both risks are likely to happen together) or negative (if one risk materialises, then the other is less likely).

Spreadsheet-based methods exist for dealing with correlations, but often getting sufficiently accurate information on the degree of the correlation is difficult.

However, experience shows that most RSL risks are only weakly correlated with one another – this eases risk quantification in the sector significantly!

TOTAL CORPORATE RISK

An illustration:

The total corporate risk faced by an RSL is not a single loss outcome. There is a wide range of possible outcomes that may be illustrated in the form of a distribution graph.

Diagram 3 shows the risk distribution for an RSL, calculated over a 5-year planning period.

The graph shows that the average loss for the association is £2.4m over the planning period, as seen from the 50% (0.5) probability level.

The graph also shows an 80% chance that the association will have a loss of less than £3.3m over the planning period – or a 20% chance that the loss will be more than this.

On the other hand, there is only a 20% chance that the association will have a loss of less than £1.4m over the planning period, so there is a worryingly large 80% probability that the loss will exceed this level.

AGGREGATING RISKS TO A CORPORATE TOTAL

- a worked example

Risks do not ‘add up’ in a straightforward manner, but can be aggregated using statistical techniques. This may be illustrated by the two-risk example set out below.

The example assumes two maintenance risks, which happen independently of one another.

Risk A. Lack of quality maintenance contractors, means there is a risk that maintenance may not be of suitable quality if work is allocated to an incompetent contractor. The risk has been assessed at a probability of 25% a year and an impact of £30,000.

Risk B. There is a risk that taking legal proceedings against a maintenance contractor to achieve agreed performance may be disproportionately expensive due to slow court procedures. The risk has been assessed at a probability of 50% a year and an impact of £10,000.

Then the average cost of **Risk A** over a number of years will be 25% of £30,000 a year or.....£7,500 a year

and the average cost of **Risk B** over a number of years will be 50% of £10,000 a year or.....£5,000 a year

So the **average cost of both risks together** over a number of years will be.....£12,500 a year

In this way the average costs of a set of risks can be readily calculated and simply aggregated to the corporate total.

Comment:

As a rule of thumb, the average cost of a risk indicates the maximum amount of money it is worth spending to get rid of it. But in the case of insurance, the premium may cost more than this to cover the insurer’s administration costs and profit margins.

Aggregating probabilities and impacts

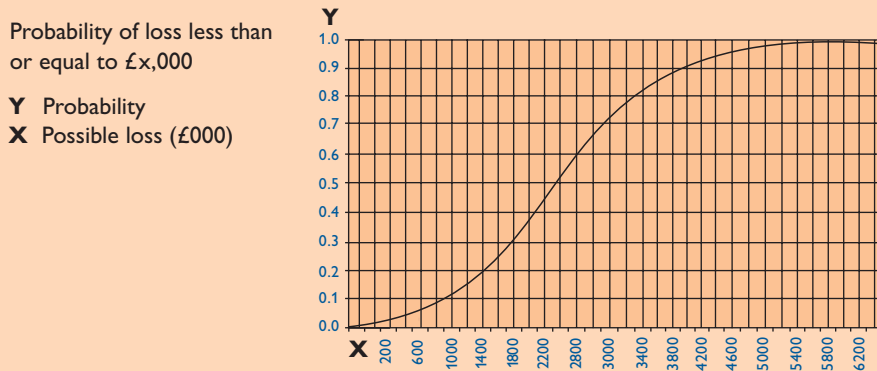
To calculate what might happen in a particular year, say the next one, the combinations of possibilities must be assessed.

RISK A			RISK B			Combined Risks A & B	
Happens?	Probability	Impact	Happens?	Probability	Impact	Probability	Impact
	%	£		%	£	%	£
Yes	25	30,000	Yes	50	10,000	12.5	40,000
Yes	25	30,000	No	50	–	12.5	30,000
No	75	–	Yes	50	10,000	37.5	10,000
No	75	–	No	50	–	37.5	–

The table gives the distribution of combined impacts for the year. For example, there is a 12.5% probability of a combined loss of £40,000, but a 37.5% probability of no loss at all. This shows the importance of knowing the distribution of out-turns, as well as the average cost of the risks.

In practice there are many risks in an organisation’s risk profile so it would be a daunting task to do this analysis by hand!

Diagram 3
 Medium-term total corporate risk of a housing association
 (before risk management actions)



Information of this type is crucial in setting the risk strategy and appetite for an RSL, and in deciding what level of contingency should be included in the RSL's business plan.

In the case concerned, a vigorous risk reduction programme was implemented, and the total corporate risk was cut by more than half.

INCORPORATING RISK QUANTIFICATION IN BUSINESS PLANNING

It is good practice to use the business plan (excluding any general contingencies) as the basis for the evaluation of risks, so that the risk management process can be integrated into the RSL's normal planning and control mechanisms.

RSLs that apply high/medium/low categories

If the classification in the risk assessment process is based on the high / medium / low graduations, the risks cannot be aggregated accurately. The consideration of risk in the business planning process must then be based on the analysis of individual risks using sensitivity analysis.

RSLs applying statistical analysis of risks

If risks have been quantified using quantified impact and probability estimates of risk distributions and based on the business plan, then it follows that the total corporate risk represents the risk

profile of the business plan. The RSL can use the analysis as the basis for any general contingencies included in the plan. In the previous example, the level of contingency would need to be £3.3m to achieve 80% certainty that the target financial performance assumed in the plan would be met.

Similarly, by looking at the extremes of the distribution, the RSL can evaluate a 'Worst Case Financial Scenario'. The result can be compared with its financial covenants, and help in confirming its financial security.

These considerations assist in confirming the urgency of implementing the risk action programme to drive down the total corporate risk to lower levels.

It follows that an RSL's risk management strategy should be closely related to, and consistent with, its overall strategy. In particular, the overall strategy should not conflict with the risk appetite of the organisation. This might be set in the risk management strategy statement as limiting the total amount of risk taken so that it does not exceed agreed quantified limits.

In this way, the reliability of the business planning process can be significantly enhanced by the incorporation of risk quantification techniques.

SUMMARY

The authors discuss four alternative approaches to the quantification of risk in an RSL. The appropriate choice for an RSL depends on its own circumstances and capabilities. The paper assists RSLs to improve their risk assessment methodology and the quality of their analysis and control. In particular the paper proposes a method of quantifying risks and deriving the total corporate risk in the business plan. The members of the Board need to be confident that they have adequately assessed the risks facing the RSL and that the residual risk, after reduction measures and controls, is acceptable.

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