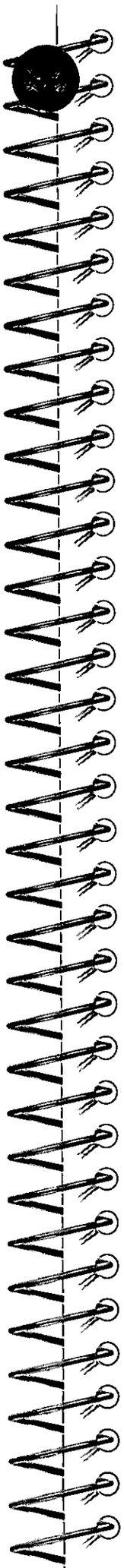

HSE
Health & Safety Executive

Risk ranking for small and medium enterprises

Prepared by
Risk & Policy Analysts Limited
for the Health and Safety Executive

CONTRACT RESEARCH REPORT
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HSE
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sk ranking for small medium enterprises

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This report was commissioned by the Health and Safety Executive (HSE) to examine the practicalities of developing a risk assessment and ranking methodology for application to small and medium enterprises (SMEs). The purpose of the intended methodology is to allow the full range of risks (however dissimilar in their nature) to be ranked alongside each other in order to develop a list of workplace risk priorities. A number of existing methodologies have been reviewed for their potential to achieve these aims. This review concluded that there were few elements of existing methodologies that would allow reliable ranking of disparate risks.

After much development and testing, a Risk Priority Assessment (RPA) methodology has been designed to focus on risks associated with incidents (acute risks) in workplaces which result in short or long-term injury and illness. No means has been found to include chronic risks (associated with longer-term exposure) within the same assessment.

The RPA method uses a mixture of historical incident data and economic values of different types of injury and illness to derive importance scores for application in the assessment. The use of a dual function severity score consisting of 'type of accident' and 'type of injury/illness' gives the resulting *Risk = Severity x No. Affected x Likelihood* relationship sufficient sensitivity to distinguish between different types of risk and thus provide a reliable rating of risk priority.

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EXECUTIVE SUMMARY

INTRODUCTION

The purpose of this study has been to consider how more comprehensive guidance on risk assessment can be provided to employers within small to medium enterprises (SMEs). The overall objective has been the development of a simple system of risk assessment and prioritisation as an optional 'bolt-on' to the existing '5 Steps' approach that the Health & Safety Executive (HSE) is committed to. Whilst the development of a complete and refined tool for all workplace risk assessments was outside the scope of the study much of the groundwork has been covered by examining the practicality and difficulties at a 'micro' level.

METHODOLOGICAL ISSUES

The risk assessment and management process can be characterised as a series of stages beginning with the identification of hazards. The level of risk is identified for each of these hazards and risk reduction options sought on the basis of level of risk. A ranking, or scoring, procedure could be applied at any of these stages in order to ensure that those risks of greatest concern or impact are given consideration commensurate with risk levels.

Three fundamental criteria have been identified for a ranking methodology to be applied effectively in an SME workplace. These are that:

- it must allow the identification, assessment and development of priorities within the context of all of the hazards/risks that may be present in a given workplace;
- it must be simple and quick enough to be operated by those persons who are responsible for health and safety within SMEs; and
- it must consistently give the 'correct' answer in risk terms.

In order to provide background information and ideas for defining and developing an appropriate risk assessment and ranking methodology for SMEs a number of different methodologies contained within both official and unofficial risk assessment guidance have been reviewed. This review concluded that, whilst these methods did allow some prioritisation within various tasks/work areas, their usefulness was limited to a fairly narrow spectrum of risks. As a result, none of the methods was sensitive enough to provide a reliable basis for comparing the disparate risks that this study has sought to address.

DEVELOPMENT OF A METHODOLOGY

Given that none of the methodologies (and few elements of these methodologies) provides a reliable means of ranking disparate risks, the study has had to draw on other resources and ideas to develop a workplace risk assessment and ranking methodology.

The result is the Risk Priority Assessment (RPA) methodology which can be applied to assess the range and relative significance of risks associated with 'incidents' (sometimes referred to as 'acute' risks). Such acute risks tend to result in consequences which materialise in the short-term (although they may persist thereafter) and, because there is usually a clear link between 'cause' and 'effect', are observable and measurable. Risks associated with 'long-term' exposure (sometimes referred to as 'chronic' risks) have been omitted from the RPA methodology as they are much more difficult to assess with any great degree of confidence.

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The RPA methodology is divided into the following six steps:

Step 1: 'What Could Happen'

The first step involves the identification and scoring of hazards present in the workplace. Rather than considering tasks or work areas, the methodology uses a series of different types of accidents to focus the assessor's attention to the question of what could potentially go wrong. These accident descriptions have been taken from the Health & Safety Commission's (HSC) categories which are used in the publication of annual health and safety statistics.

Historical data from the HSC's statistics have enabled importance values to be assigned to each category of accident, and hence the hazards identified therein. These importance values have been based on the frequency with which each 'accident type' leads to a fatality, non-fatal major injury, or an over 3-day injury. Economic values of mortality and morbidity have been used to assign weights to these three different outcomes such that, when combined with the frequency data, an individual importance value can be assigned to each hazard identified under each accident type.

Step 2: 'How likely is it to Happen'

The second step involves determining and scoring how likely each of the identified hazards is to occur according to a list of descriptors and scores.

Step 3: 'Decide How Someone Might Be Harmed'

The third step involves consideration of the likely injuries/illness that might result should each hazard be realised. This is achieved by considering a list of injury/illness descriptions, each with an associated importance score relating to their severity. As with the accident description, the injury descriptors use the categories of injury set out in the HSC's annual statistics of health and safety.

Importance values are assigned to each of the injuries identified by the 'person responsible for health and safety' (PRHS) as being the most likely to result from the realisation of each hazard. These importance values have been derived by the calculation of expected costs of each injury type on the basis of both economic mortality and morbidity values and the frequency with which each injury type results in fatality, a non-fatal major injury, or an over 3-day injury. Economic values for the cost of different illnesses have also been included. Using this calculated cost data, importance weightings have been derived on the basis of the importance of each type injury/illness relative to the least severe (and least costly) injury. For example, using this approach a 'death' is 27 times more important than a broken bone which, in turn, is 18 times more important than a superficial injury.

Step 4: 'Decide How Many are Likely to be Affected'

This step simply involves recording how many people are likely to be affected by the hazard being realised where this differs from the number of people who are exposed to the risk.

Steps 5 and 6: 'Evaluate the Risks' and 'Rank, Plan and Review'

Steps 5 and 6 involves first calculating risk ratings for each of the hazards and then examining each in turn, beginning with the highest. As with many simple risk ranking methodologies, the method of combining scores follows the general theme of ***Risk = Severity x Likelihood x No. Affected***. However, in the RPA method, 'severity' is comprised of two scores: one for type of accident; and one for type of injury. Because there are a large number of possible combinations

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of scores that make up this 'severity' score and as these scores are based on historical data, the RPA method is much more sensitive to differences in the nature and consequences of workplace hazards. This makes the RPA method sufficiently sensitive to distinguish between a large number of disparate risks.

TESTING AND REFINEMENT

The method has been refined after field tests in three separate workplaces. The first tests examined the ability of the 'scoring' system to provide rankings that were 'sensible'. Further tests examined how easy it was for an inexperienced operator to manage the scoring system and how any problems could be overcome by further refinements and improvements in presentation.

Further to comments made on an earlier version of the report (submitted in February 1998), the methodology has been refined to account for recent accident statistics (based on RIDDOR 95) and for the under-reporting of incidents.

CONCLUDING REMARKS

The key purpose of the study has been to examine the practicalities of developing an overall approach to workplace risk assessment which allows all risks to be ranked and compared on an equal footing. As evidenced by the development of the RPA methodology, the primary conclusion of the study is that such goals are achievable. However, due to the inherent complexities in a ranking method, the presentation of a such a methodology for wider use in SMEs is very difficult and requires more particular consideration.

A significant shortcoming of the RPA method as an optional 'bolt-on' to the '5-Steps' is that, it does not allow the consideration the chronic risks associated with long-term exposure alongside acute risks. However, it is believed that the method does provide a step forward for the assessment of those risks which are likely to be of prime concern to the PRHS.

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1. INTRODUCTION

1.1 AIMS OF THE STUDY

Under the Management of Health and Safety at Work Regulations and associated legislation, there is a recurrent theme that hazards and risks must be identified and assessed to ensure that appropriate equipment and procedures are employed.

As regards risk assessment for the small firm, the Health & Safety Executive (HSE) has committed itself to the approach set out in the ***5 Steps to Risk Assessment*** leaflet published in January 1994. The '5 Steps' provides the employer with a logical framework within which to begin to consider workplace safety issues and the features of the workplace risk assessment required by law. At the same time, whilst the '5 Steps' approach concentrates on "significant hazards", it provides little guidance on how these should be determined and on how priorities should be identified.

The aim of this study is to consider how more comprehensive guidance on risk assessment can be provided to employers. To achieve this aim, the overall objective is the development of a simple system of risk assessment and prioritisation as an optional 'bolt-on' to the existing '5 Steps' approach that HSE is committed to.

1.2 APPROACH TO THE STUDY

The application of a ranking methodology as a 'bolt-on' to the '5 Steps' approach for workplace risk assessments requires the development of a simple, easy to use system of assessment, the design of which is focused on the practicality of application in the whole range of Small to Medium Enterprises[1] (SME). In terms of the ranking 'component' of the methodology, the most important 'practicality' is the need to compare and rank risks of a diverse nature simply and easily.

Whilst the development of a complete and refined tool for all workplace risk assessments is far outside the scope of the study, much of the groundwork has been covered by examining the practicality and difficulties at a 'micro' level in order to develop an overall approach.

Since the issue of an earlier version of the report in February 1998, there have been two significant developments. Firstly, accident statistics under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995 are now available. As these may not be readily comparable with those from earlier years, it was thought that there may be merit is updating the analysis to incorporate recent accident statistics. Secondly, there was some concern within HSE that the issue of under-reporting had not been adequately addressed. With these points in mind and after some debate, the Consultants have revised the analysis as presented in this report.

1.3 STRUCTURE OF THE REPORT

Section 2 provides a brief overview of the health and safety regulatory framework as context to the report while Section 3 draws on some of the lessons learned from the Consultant's first review of risk

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[1] Where 'Small' is <50 employees and 'Medium' is 50 to 250 employees.

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ranking methodologies[2] to define the key qualities of the ranking methodology. Section 3 also reports on the results of the review of existing methodologies for these qualities. The Risk Priority Assessment (RPA) methodology developed as a bolt-on to the existing '5 Steps' approach is presented in Section 4 along with a discussion on the limitations of the approach. The results of field tests of this methodology and the associated 'guide to risk assessment' are presented in Section 5. Section 6 provides conclusions on the practicalities of using this methodology on a wider scale and overall conclusions on the practicalities and difficulties of including risk ranking in the workplace risk assessment process.

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[2] RPA/CERM (1997): **Risk Ranking**, London, HSE.

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2. REGULATORY FRAMEWORK

2.1 OVERVIEW

The earliest health and safety regulations in the UK were criticised as being overly specific, piecemeal, prescriptive and reactive. The Health and Safety at Work etc Act of 1974 (HSWA) was conceived to solve these problems. HSWA is based on a philosophy of self regulation and goal setting for the purposes of accident prevention and is applicable to all workplaces, employers and employees.

This proactive philosophy is also to be found in the more recent EU framework directive for worker safety, Council Directive 89/391/EEC.

The Management of Health and Safety at Work Regulations 1992 (MHSWR) were adopted to implement this EC directive in the UK. At the time of the introduction of MHSWR, the integrity of existing legislation was maintained such that virtually all of HSWA and other relatively modern legislation is still operative. There remains considerable overlap between the regulations and in such instances, the employer is generally advised to comply with the more specific regulation, unless MHSWR requires additional measures.

2.2 RISK ASSESSMENTS

The general requirement for employers to undertake a risk assessment first appeared in MHSWR. Considered to be the centrepiece of MHSWR, the risk assessments require careful consideration of all aspects of the workplace which can impact upon health and safety. The goal of the risk assessment process is to provide the employer with an inventory of the character and magnitude of existing risks as well as a basis on which to allocate finite resources most effectively to the mitigation of these risks. The ultimate goal is to enable duty holders to identify the measures they need to take to comply with legal requirements.

Rather than spelling out specific measures, Regulation 3 of MHSWR requires all employers, as well as the self-employed, to carry out a "suitable and sufficient" risk assessment of their operations. The accompanying Approved Code of Practice (ACOP) indicates that this should:

- identify the significant risks;
- enable the employer to identify and prioritise those measures required to comply with the relevant statutory provisions; and
- be appropriate to the nature of the work such that it remains valid for a reasonable period of time.

To this end, HSE is committed to the approach set out in the ***5 Steps to Risk Assessment*** leaflet published in 1994. Accordingly, the process of workplace risk assessment requires the following 'common-sense' steps:

Step 1: *"Look for the hazards"* - ie hazard identification;

Step 2: *"Decide who might be harmed and how"* - ie identification of potential consequences and 'population at risk';

Step 3: *"Evaluate the risks arising from the hazards and decide whether existing precautions are adequate or more should be done"* - ie assessment of the degree of associated risk, the acceptability of this risk and identification of appropriate risk reduction measures;

Step 4: *"Record your findings"*; and

Step 5: *"Review assessment from time to time and revise it as necessary".*

2.3 OTHER REQUIREMENTS

It must be stressed that most hazards and risks identified in a workplace risk assessment will be subject to health and safety legislation at some level. MHSWR forms part of the so called 'six-pack', where the other components cover activities across a wide range of workplaces:

- Manual Handling Operations Regulations 1992;
- Health and Safety (Display Screen Equipment) Regulations 1992;
- Personal Protective Equipment at Work Regulations 1992;
- Provision and Use of Work Equipment Regulations 1992; and
- Workplace (Health and Safety and Welfare) Regulations 1992.

More generally, most workplaces are covered not only by MHSWR, but also by requirements of the Health and Safety at Work, etc Act 1974, the Factories Act 1961 and/or the Offices Shops and Railways Premises Act 1963.

At a more specific level, there are numerous Regulations covering health and safety issues of particular workplaces or activities. By way of illustration, those beginning with 'L' comprise:

- Lead Smelting and Manufacture Regulations 1911 (as amended in 1980);
- Level Crossing Regulations 1997;
- Lifting Plant and Equipment (Records of Test and Examination, etc) Regulations 1992;
- Loading and Unloading of Fishing Vessels Regulations 1988;
- Locomotive, etc Regulations 1906 (Metrication) Regulations 1981; and
- Locomotives in Sidings in Factories Regulations 1907 (as amended in 1981, 1989 and 1997).

3. METHODOLOGICAL ISSUES AND REVIEW

3.1 INTRODUCTION

The risk assessment and management process can be characterised as a series of stages beginning with the identification of hazards. The level of risk is identified for each of these hazards and risk reduction options sought on the basis of level of risk. The risk management plan takes all of these stages into account in order to develop an effective plan for the achievement of health and safety benefits.

A ranking, or scoring, procedure could be applied at any of these stages in order to ensure that those risks of greatest concern or impact are given consideration commensurate with risk levels, thus allowing the 'person responsible for health and safety' (PRHS) to properly plan his/her response to risks in the workplace.

In any workplace, employees (and others) are exposed to a range of risks. In broad terms, the type of risk may be characterised by the nature of the hazard and the associated consequences. One means to differentiate types of risk is presented in Table 1.

Table 1
Examples of workplace risks by cause and consequence

	Consequence:	
Cause:	**'Injury'**	**'Ill health'**
Incident	Fall off ladder	Chemical spillage leads to fume inhalation causing damage to central nervous system
Long-term exposure	Poor 'manual handling' techniques lead to back problems	Stress at work leads to mental health problems

Risks associated with 'incidents' (sometimes referred to as 'acute' risks) tend to result in consequences which materialise in the short-term (although they may persist thereafter). As such, the consequences tend to be observable and, therefore, measurable. Furthermore, there is usually a clear link between the cause and the consequence.

In contrast, risks associated with 'long-term exposure' (sometimes referred to as 'chronic' risks) are much more difficult to assess with any great degree of confidence. To some extent, the rigour by which measures intended to minimise such risks are applied is an indicator the 'health' of the working environment[3]. Such measures would include comprehensive training for manual handling and use of personal protective equipment, high standards of hygiene, well lit and ventilated workplaces, user-friendly workstations (both physically and mentally), etc.

[3] Guidance on such measures is provided in a wide range of leaflets from HSE, perhaps best summarised in the leaflet *Protecting Your Health at Work* (1996) issued as part of HSE's Good Health is Good Business Campaign.

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Although the full range of hazards and risks can be entered into a '5 Steps' style assessment, it would be very difficult to assess the relative significance of the various risks - particularly when considering 'chronic' risks. For this reason, attention is now focused on developing a framework to assess the range and relative significance of 'acute' risks within a particular workplace. While it is recognised that this limits the scope of the proposed approach (as discussed further in Section 6), it is believed that it provides a step forward to assess those risks within SMEs which are likely to be of prime concern to the PRHS.

3.2 RISK RANKING SYSTEMS

The term 'risk-ranking' encompasses a suite of approaches which are aimed at establishing relative priorities. In broad terms, there are three types of ranking systems, each with their own advantages and drawbacks:

- hazard ranking;
- risk ranking; and
- ranking of risk reduction measures.

Hazard ranking methodologies use multi-criteria techniques to derive an overall score that represents the relative severity of each of the hazards under review. At the same time, ranking at this level in the assessment takes no account of the likelihood of such adverse events occurring.

Ranking at the 'risk' level generally overcomes this problem by ranking in terms of both hazard severity (consequence) and hazard frequency but may extend to incorporate a wider range of indicators governing the level of concern attached to a given risk.

The third approach, that of ranking risk reduction options, provides a means to prioritise response to risk on the basis of solutions to risk problems. Proponents of such systems[4] argue that the challenge of priority setting is not only of ranking risks but also of ranking solutions to risk problems. Although interesting, such techniques are considered inappropriate to the setting of safety priorities within SMEs owing to the great complexity of the analysis by the inclusion of quantified/semi-quantified data on the effectiveness of risk reduction measures and the incorporation of this with cost data to derive estimates of cost-effectiveness of risk reduction measures.

3.3 DEVELOPING AN APPROACH

3.3.1 Purpose of the Model

The above methodologies differ widely in scope and intent, emphasising the fact that ranking models must be carefully tailored to fit the purpose for which they are created. It is clear that the selection of appropriate criteria and methods depends to a large degree on what is to be ranked and what are the goals.

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[4] See, for example, Kadvany (1995): *From Comparative Risk to Decision Analysis: Ranking Solutions to Multiple Value Environmental Problems*, Health, Safety and Environment, Vol 6, 4.

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In the case of a ranking methodology for application to the workplace there are three fundamental criteria that the method must satisfy:

- the method must allow the identification, assessment and development of priorities within the context of all of the hazards/risks that may be present in a given workplace;
- the method must be simple and quick enough to be operated by those persons who are responsible for health and safety within SMEs; and
- the method must consistently give the 'correct' answer in risk terms.

3.3.2 Risk Ranking within the Existing Risk Management Process

From the perspective of managing workplace health and safety, risk assessments often take either a 'task based' or a 'hazard based' approach. The assessments therefore focus narrowly on either particular tasks/work areas (eg lifting and carrying/packing unit) or particular types of hazard that are dispersed throughout a company's activities (eg slips, trips and falls).

The risk management plan that is derived from a consideration of the various risk assessments widens the focus of the 'assessment' to cover all of the activities and significant hazards in a given workplace, identifying priorities for action and an overall risk reduction strategy.

From the perspective of risk ranking, this type of approach therefore deals with issues of prioritisation by reducing 'the problem' into at least two manageable stages:

- ranking of risks associated with individual tasks, work areas or hazard 'types'; and
- comparing the significance of risks under each of these categories to develop a list of priorities.

Ranking within the first of these stages is straightforward, typically involving the identification of hazards, analysis in terms of likelihood and severity, and the estimation of risks. If correctly planned the resulting risk estimates are relatively easy to compare with one another.

Ranking within the second stage is generally more subjective as the risks that are being compared are often not directly comparable. In these circumstances the PRHS is forced to make a value judgement concerning the relative significance of risks of a very different nature (eg the risk of employees being burnt by contact with hot machinery *versus* the risks associated with slips, trips and falls).

As one of the fundamental criteria for the methodology has been that it must allow the development of priorities within the context of all of the hazards/risks that may be present in a workplace, it is clear that a main focus for the development of a ranking method must be on this second stage. Thus, a major developmental obstacle for the methodology is the derivation of a system that expresses all risks in the same units so as to allow comparison between risks of a 'disparate' nature.

3 4 REVIEW OF METHODOLOGIES

3.4.1 Overview

There is a variety of official and unofficial guidance for employers/companies concerning the need for and methods to go about risk assessment in the workplace. Unofficial guidance ranges from 'paper based' guidance on the legal requirements and suggested methods for assessing risks to more complex risk assessment and six-pack compliance computer software packages.

Data collection and review for this study concentrated on identifying such information and methodologies in order:

- to examine the extent to which they provide a simple and transparent means of assessing and ranking all workplace risks/hazards (whether similar or disparate);
- to identify how this is achieved; and
- to provide background information and ideas for defining and developing an appropriate risk assessment and ranking methodology for SMEs.

3.4.2 Software

Around 38 commercially available risk assessment software packages risk assessment packages were identified from a database at Reading University. Whilst the sheer number and cost of software packages (typically in the range of £200-£700) limited the number of packages that could be formally reviewed, a questionnaire was designed to elicit key information on software so as to extend the coverage of the review and inform the selection of software.

In terms of the methodologies, the questionnaire was intended to provide information concerning:

- definitions of hazard and risk used;
- hazard identification and classification methods/guidance;
- how a quantitative/semi-quantitative expression of risk is derived; and
- the potential for hazard/risk ranking.

Of the 38 questionnaires sent, twelve were returned completed. Four of the responses related to more specialist packages not specifically designed for workplace assessments leaving eight relevant responses[5].

On the basis of the questionnaire (and other documentation) a sample of six packages was selected for more formal review. As the purpose of the review was the identification of useful elements for application in the ranking methodology, when reviewing methodologies particular emphasis was placed on the ability of the methodologies to satisfy one or more of the fundamental criteria identified in Section 3.3.1.

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[5] The fact that some of the returned questionnaires were not relevant to workplace assessments confirms that the sample of 38 includes a number of more specialist computerised risk assessment tools. It is probable that these packages made up a fairly substantial number of the 26 unreturned questionnaires.

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All of the methodologies covered by the questionnaire/review subscribed to the general approach to risk assessment and management of dividing workplace health and safety into manageable units based on tasks, work areas, or particular hazards.

Hazards within each of these units are usually analysed using a Likert[6] scale to express the levels of severity/consequence, probability/likelihood and, occasionally, exposure associated with each hazard.

In terms of the combination of these factors into an overall expression of risk, the vast majority of the software uses some form of mathematical combination, typically taking the form:

Risk = Severity x Likelihood

As would be expected, this is in accordance with definitions of risks such as: "the likelihood of a specified adverse consequence". Methods of risk estimation used by the software are summarised in Table 2.

Table 2
Methods used for deriving an expression of risk

Software	Risk expression
1	Risk is calculated using a risk nomogram (hence a combination of factors such as severity, likelihood, exposure)
2	Severity = Risk Factor x Person Factor
3	Risk = Probability x Severity x Frequency
4	The system uses a grid to graphically display the risk in terms of likelihood and severity. Values can be applied to the likelihood and severity components to enable a resultant risk figure to be calculated.
5	Risk = Severity x Probability x Probability Response will Fail. Population exposed is ranked within severity.
6	Risk = Severity x Likelihood combined with a consideration of the 'grid reference'
7	Risk = Probability x Severity x Frequency
8	Risk = Severity x Likelihood x Exposed
9	Risk = Exposure + Consequences + Likelihood
10	Risk = Probability x Severity

[6] A simple scale of, for example, 1 to 5 where increases in score are not directly proportional to the increase in the attribute (eg slight injury = 1, minor injury = 2, 3 day injury = 3, major injury = 4, fatal injury = 5).

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All of the methodologies used by the software produce estimates of risk that are, to an extent, amenable to ranking within tasks or work areas. However, even within this narrow focus, there are potential problems with the interpretation of scores for the purposes of risk ranking. These problems include:

- the inability to distinguish between high frequency, low consequence events and low frequency, high consequence events;
- the inability to distinguish between intermediate risks (eg severed finger vs. long-term health effects); and
- the fact that most assessments fall in the middle of the range.

All of these difficulties compromise the reliability and usefulness of the derived rankings. The extent to which this occurs varies according to the scope of application (in terms of the nature of the hazards) and the number of hazards within each assessment. Thus: the wider the scope, the greater the inaccuracy caused by a method's inability to distinguish between high frequency, low consequence events and low frequency, high consequence events; and the larger the number of hazards, the greater is the potential for the assessment to fall in the middle of the range.

3.4.3 Paper-Based Methodologies

In addition to the methodologies that were reviewed as part of the initial Risk Ranking project, a number of other paper-based workplace risk assessment methodologies were identified. As with the software, these were reviewed primarily for their ability to satisfy the fundamental criteria for a ranking methodology and hence their applicability to the development of a consolidated approach to workplace risk assessment and ranking. The key documents and methodologies are summarised in Annex 1.

In general, these methodologies are very similar to the approaches used by the software - ie simplified rating/classification systems which use simple categories of severity and likelihood to derive an expression of the importance of risks. As with the software, many of these methodologies subscribe to a task/work area/hazard-based approach. As such they contribute little to the development of a ranking methodology in terms of their potential to overcome the problems associated with ranking disparate risks. Using these methods the PRHS is still required to make a value judgement when establishing the significance of each risk within the context of all risks and all tasks, work areas or hazards.

3.5 CONCLUSIONS OF THE REVIEW

As has already been identified, one of the fundamental criteria for the consolidated risk assessment and ranking methodology has been that it must allow the development of priorities within the context of all of the hazards/risks that may be present in a workplace. The main focus for the development of the ranking method has been the derivation of a system that reliably expresses all risks in the same units so that risks of a very different nature can be directly compared with one another to establish relative priorities.

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HSE has reported that no general formula for rating risks in terms of relative importance is available but that there are a number of techniques which have been developed to assist in decision making[7]. The results of the software and literature review tend to support this view.

In terms of their applicability to the development of the ranking methodology, it must be concluded that none of the methods are sensitive enough to provide a reliable basis for comparing the disparate risks that this study has sought to address. Whilst the methods do allow some prioritisation within various tasks/work areas, their usefulness is limited to a fairly narrow spectrum of risks within each of these categories. The 'insensitivity' of the hazard analysis and risk determination methods do not allow the ranking of priorities at a higher level than this.

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7 HSE (1991): **Successful Health and Safety Management**, London, HMSO.

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4. METHODOLOGY

4.1 INTRODUCTION

4.1.1 Overview

As there appear to be no comprehensive methodologies already available and few elements of those available methodologies that can be directly applied, the study has had to draw on other resources and ideas in order to develop a workplace risk assessment and ranking methodology.

As has been described in previous sections, the prime obstacle has been the development of a system which allows the expression of all workplace risks in units that are directly comparable. Such a system would allow disparate risks (such as: burns, slips, falls from height, entanglement with machinery, etc) to be compared with one another in one simple assessment on the basis of importance. A secondary problem relates to the inclusion of the chronic health risks associated with long-term exposure to, for example, chemicals, poor lighting, lifting and carrying, etc. In the aforementioned methodologies, where such chronic risks are addressed, they are generally dealt with separately using a series of regulation-based 'questionnaires' and surveys to identify potential problems in the workplace. It is worth noting at this stage that the study has found no simple and meaningful way of allowing these chronic risks to be compared alongside 'acute' risks (associated with more specific events) within a single, consolidated risk ranking methodology. However, a means of accounting for the health effects associated with acute risks is included in the analysis.

This Section summarises some of the developmental issues and describes the risk assessment and ranking methodology that has been developed to allow ranking of workplace health and safety issues.

4.1.2 Summary of Developmental Issues

As has already been identified, there are three fundamental criteria that the method must satisfy:

- the method must allow the identification, assessment and development of priorities within the context of all of the hazards/risks that may be present in a given workplace;
- the method must be simple and quick enough to be operated by those persons who are responsible for safety within SMEs; and
- the method must consistently give the 'correct' answer in risk terms.

The first (and most difficult) step in the development process essentially involves determining which 'outcome' is 'worse' than which, and more critically, by how much. The critical failure as far as simple methodologies is concerned is that no two outcomes are exactly the same. Thus, while the consequences of, say, 'entanglement with moving machinery' and 'fall from a ladder' may be both be classified under a heading 'major injuries', this classification is not sensitive enough to distinguish between the two events - ie while both may result in major injuries, the simple methodologies are not sensitive enough to determine their relative significance. In addition, such classification does not take account of possible health effects in terms of illness.

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For the simple semi-quantitative methodologies this becomes particularly problematic when the frequency of the event is also included in the analysis. As has already been described, the resulting risk rating has a tendency to group a wide variety of outcomes such that a number of completely different outcomes can be scored as being equal. Taking a typical example from the review, the following combinations might be rated equally:

- "occasional minor injuries";
- "major injuries remotely possible but known occurrence";
- "no injuries almost a certainty"; and
- "multiple fatalities including offsite highly improbable".

4.2 RISK PRIORITY ASSESSMENT METHOD (RPA)

4.2.1 Introduction

The RPA method has used the following assumptions to rank at the risk level:

- in a workplace safety setting, all of the significant hazards/risks share a common category of impact, that of harm to people;

- what differentiates one outcome from another is a largely a function of the kind of accident and the likely nature of the injury/illness; and

- what differentiates one risk from another is a function of the consequence of the event, the likelihood of the event and the number of people affected.

4.2.2 Step 1: 'What Could Happen'

As has been discussed in Section 3, most approaches to risk assessment and management take a task-based or work area-based approach. In many respects this is because conceptually it is very difficult for a PRHS to define all of the hazards that may be present in a workplace without some structure to focus the assessment. Thus, breaking down the 'risk problem' into smaller units allows the PRHS to concentrate and complete a hazard identification for a discrete unit with the confidence that all of the hazards have been identified.

The RPA method provides an alternative to this approach beginning instead with a list of 'types of accidents' as shown in Table 3. These accident types are listed (with classifications used by HSE) in order of likelihood of occurrence based on statistics[8] for the years 1996/97 and 1997/98. The PRHS, in consultation with employees, works through this list identifying and recording all of the hazards in the workplace that could result in accidents of each different type. A few simple examples have been included in Table 3.

When conducting the assessment the PRHS may choose to maintain a task or area based approach so as to further structure the assessment. While this produces different accident hazard lists for each

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[8] The 'raw' statistics reported in Health & Safety Commission (1998): **Health and Safety Statistics 1997/98**, HSE Books have been adjusted for under-reporting (see Section 4.2.6).

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different task/work area, the risk ratings that are derived towards the end of the assessment allow different hazards in different work areas/tasks to be compared directly. This means that, for a company that has already undertaken a more 'conventional' workplace risk assessment, perhaps using the '5 Steps', there is no absolute need to re-run the whole analysis. Rather an existing 'conventional' assessment can be simply converted into an RPA. However, it is possible that the structured nature of the RPA method may promote the identification of hazards that may have previously been omitted.

Table 3
List of 'types of accidents' (in order of likelihood of occurrence)

Type of accident	Example hazards
Injury while handling, lifting or carrying	
Slip, trip or fall on same level	*Oil on garage floor*
Strike by moving, including flying/falling object	*Exhaust pipes stacked against garage wall*
Falls from a height up to 2m	
Strike against something fixed or stationary (including hot/very cold surfaces)	
Injury by contact with moving machinery	*Contact with grinding machine* *Trapping fingers in tyre press*
Acts of violence	
Exposure to, or contact with, a harmful substance (including hot/very cold substances)	
Strike by moving vehicle	*Car rolls off ramp*
Falls from a height over 2m	*Fall from stockroom ladder*
Injury caused by animal	
Contact with electricity or electrical discharge	
Exposure to fire	
Trapped by something collapsing/overturning	
Exposure to an explosion	
Drowning or asphyxiation	

4.2.3 Step 2: 'How likely is it to Happen'

Having identified 'what could happen' under each of the accident types, the next step is to estimate the likelihood of occurrence using the following scale of 1 to 7:

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- effectively impossible = 1
- unlikely = 2
- plausible = 3
- possible = 4
- probable = 5
- very likely = 6
- almost certain = 7.

4.2.4 Step 3: 'Decide How Someone Might Be Harmed'

The next stage in the analysis begins with a consideration of the likely outcome of each hazard in terms of the nature of injuries/illness sustained. This is achieved by examining a list of types of injury/illness shown in Table 4 which are given in order of 'importance'[9]. To attribute the most likely injury/illness scenario to a hazard, the PRHS works down this list considering whether or not the injury/illness description is appropriate. The first 'match' determines the classification that should be used in the analysis.

Table 4
Determine the nature of likely injuries/illness

Type of injury/illness
Death
Permanently incapacitating ill health
Amputation
Injuries caused by contact with electricity
Concussion/internal injuries
Damage to eyesight
Bone fractures
Dislocation
Natural causes (heart attack)
Poisonings and gassings
Burns
Lacerations, open wounds
Contusions/severe bruising
Superficial injuries
Sprains and strains
Other case of ill health (not incapacitating)
Minor case of ill health

4.2.5 Step 4: 'Decide How Many are Likely to be Affected'

Having determined injury/illness type, the PRHS also records the number of people who are likely to be affected should the hazard be realised. It is important to note that this is <u>not</u> akin to the number of people who may be exposed to a hazard (where this diverges with the '5-Steps' approach). There

[9] The derivation of Importance Values for both accident type and nature of injury/illness is described in Section 4.2.6.

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may be many people who are exposed to a particular hazard in their everyday work activity but perhaps only one or two that would actually be harmed should this hazard be realised.

4.2.6 Step 5: 'Evaluate the Risks'

By this stage the PRHS has assessed all of the hazards in terms of:

- the type of accident (ie *what could happen?*);
- likelihood of occurrence (ie *how likely is it to happen?*);
- nature of injury/illness (ie *how would someone be harmed?*); and
- the number of people affected (ie *how many people are likely to be affected?*).

The PRHS is now in a position to evaluate the risks. This is achieved by examining a series of 'look-up' tables (presented in Annex 2) giving the importance values attached to:

- each type of accident; and
- each type of injury/illness.

Derivation of Importance Values for Accident Types

In the first version of the methodology, the method for deriving importance values was the same for accidents and injuries. However, in light of criticisms regarding the extent to which the methodology takes into account health issues, the final stage of the calculation of importance values is now different for the injury/illness categories.

Importance values have been derived for 'accident types' by consideration of historical data on the annual number of fatalities, major injuries and over 3-day injuries reported by HSC (as referenced in Footnote 8). Analysis of the data presented three particular problems:

- the impact of RIDDOR;
- variation by industry; and
- under-reporting.

As indicated in Section 1.2, the introduction of RIDDOR 95 has led to difficulties in comparing recent statistics (in particular those for 1996/97 and 1997/98) with earlier years. As a result, this report is based on the most recent statistics only.

Secondly, there are variations in the pattern of accidents with industry sector. The methodology presented in this report (with particular reference to the use of look-up values) is intended for general use and is not intended to be industry specific. However, by examining the statistics for a particular industry sector, it would be possible to derive look-up tables for use in that industry.

Thirdly, the issue of under-reporting is considered in some detail in the latest annual statistics (see Footnote 8). In terms of incidents resulting in reportable injuries, HSE present reporting rates which range from 19% to 80% (derived by comparing the results of the Labour Force Survey with incidents reported to HSE). For the purpose of this analysis (and in the absence of more specific data), the following have been assumed:

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- if the number of fatalities reported to HSE is N1, then the actual number of fatalities is N1;
- if the number of non-fatal major injuries reported to HSE is N2, then the actual number of non-fatal major injuries is N2 x (1 + k), where k is an industry specific factor; and
- if the number of over 3-day injuries reported to HSE is N3, then the actual number of over 3-day injuries is N3 x (1 + 10k).

Based on this approach, it can be seen that the overall 'reporting rate' is given by:

$$\text{Reporting rate} = (N1 + N2 + N3) / (N1 + N2(1+k) + N3(1+10k))$$

By way of example, in the manufacturing sector there are currently 53, 8,385 and 40,292 fatal, non-fatal major and over 3-day injuries respectively per year. Using a 'k factor' of 7.4%, the adjusted figures become 53, 9,005 and 70,108 respectively. As can be seen, these numbers indicate that the reporting rates within the manufacturing sector for fatal, non-fatal major and over 3-day injuries are 100%, 93% and 57% respectively to give an overall reporting rate of 62% (which corresponds to that derived by HSE).

The 'k factors' were empirically derived for each industry sector and then applied to the statistics within each sector for each accident type (as listed in Table 3) to account for under-reporting. The adjusted values were then combined for each accident type. Thus, for 'struck by moving vehicle' the adjusted numbers of fatal, non-fatal major and over 3-day injuries per year are 39, 1,023 and 7,023 respectively derived from the reported numbers of 39, 898 and 2,883 respectively.

Importance values were calculated for each accident type by consideration of the probabilities that 'serious events'[10] lead to a fatality, a major injury, or an over 3-day injury. For accidents involving falls from over 2m, the probabilities are 1.08%, 39.7% and 59.2% respectively.

Having calculated these 'escalation probabilities' for each type of accident, weightings were applied to express the 'seriousness' of each of the three possible outcomes. These weightings are based on monetary values for human costs associated with work related illness or injury[11] as shown in Table 5. As weightings, the actual monetary value is less important than the ratio indicating the relative importance of each fatality, non-major injury and over 3-day injury. As can be seen from Table 5, there is no value given for the general category 'non-fatal major injury', rather there are a number of values that could be applied. For the purposes of this methodology a value of £37,500 has been attributed to a non-fatal major injury.

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[10] Those which result in a fatalities, major injuries or over 3-day injuries and, therefore, should be recorded by HSC.

[11] Davies NV & Teasdale P (1994): **The Costs to the British Economy of Work Accidents and Work-related Ill Health**, London, HSE.

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Table 5
Monetary values for costs associated with work-related illness or injury

'Detriment'	Cost (£ - 1997)	Relative cost
Fatal injury	£687,500	550
Permanent incapacity following injury	£150,000	120
Permanently incapacitating ill health	£138,750	111
Non-fatal major injury (suggested value)	£37,500	30
Serious injury (absence of 3 months)	£8,500	6.8
Non-serious reportable injury (over 3 days absence)	£1,250	1
Other cases of ill health (not incapacitating)	£1,250	1
Minor case of ill health (involving up to 7 days absence)	£63	0.05

The resulting figures provide an 'importance ratio' of 550:30:1 for fatality: non-fatal major injury: over 3-day injury. This ratio was then applied to the escalation probabilities using the following function to give an overall score indicating the importance of these events:

$$\text{Importance value} = (P_{\text{fatality}} \times 550) + (P_{\text{major injury}} \times 30) + (P_{\text{over 3-day injury}} \times 1)$$

Where 'P' is the escalation probability.

Table 6 shows worked examples of the derivation of an importance value for an accident type.

Table 6
Worked example of the derivation of relative importance value for an accident type

Example: Accident type - falls from over 2m

	Fatalities	Non-fatal major injuries	Over 3-day injury
Accident data (adjusted)	51	1873	2794
Escalation probability	1.08%	39.7%	59.2%
Importance weighting	550	30	1
Esc Prob x weighting	5.97	11.91	0.59
		Overall importance value	**18**

These calculations were repeated for each accident type to generate the 'look-up' table for accident type importance values (see Annex 2 for further details).

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Derivation of Importance Values for Injury/Illness Types

As mentioned above, the means by which importance values were applied to different types of injury/illness have changed from the initial proposals. The original methodology took no account of wider health issues/illnesses associated with acute risks such as, for example, the accidental spillage of a harmful substance. Where importance values were originally calculated for injury classifications alone using the same methodology as for accident types described above, importance values were recalculated on the basis of the derivation of expected economic costs associated with the different injury outcomes. This allows them to be compared directly with the cost data on illnesses provided in Table 5 to derive relative importance values.

As for the accident types, the calculation of expected costs for the different injury classifications that appear in the HSE statistics involves the calculation of the escalation probability that incidents involving, for example, burns result in fatalities, non-fatal major injuries and over 3 day injuries.

However, as with data on accident types, it was necessary to adjust the 'raw' data to account for the under-reporting of injuries as follows:

- if the number of fatalities reported to HSE is N1, then the number of fatalities is N1;
- if the number of non-fatal major injuries reported to HSE is N2, then the number of non-fatal major injuries is N2 x $(1 + \beta)$, where β is a constant;
- if the number of over 3-day injuries reported to HSE is N3, then the number of over 3-day injuries is N3 x $(1 + 10\beta)$; and
- the total number of 'actual' injuries should be consistent with that derived above in relation to accident types.

One further complication was that 46% of reported fatalities were classified as resulting from 'injuries of more than one type', 'injuries not elsewhere classified' and 'injuries not known'. To avoid underestimating the importance of the specified outcomes, these fatalities were distributed *pro rata* amongst the other categories by applying a factor of 1.85. Once this factor had been applied, the value of β was determined, empirically, to be 13.5%.

An example calculation is given in Table 7. Adjusted importance values, V_i, were calculated in this way for each of the different injury types reported in the HSE statistics. These were then compared directly with the quoted economic costs associated with different levels of illness given in Table 5.

Relative importance values were derived simply by considering the costs associated with each of the outcomes relative to that associated with 'sprains and strains' (£1,401). These importance values are given in the 'look-up' tables in Annex 2 along with further details of their derivation.

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Table 7
Worked example of the derivation of expected costs of injury

Example: Injury/illness type - burns

	Fatalities	Non-fatal major injuries	Over 3-day injury
Accident data (rounded)	8	870	4154
Adjustment Factor	1.85	$\beta = 13.5\%$	
Accident data (adjusted)	14	987	9762
Escalation probability	0.13%	9.2%	90.7%
Cost	£687,500	£37,500	£1,250
Esc prob x cost	£886	£3,440	£1,134
Adjusted importance value of injury (V_i)			£5,460
Importance value (relative to 'sprains and strains')			4

Risk Evaluation

Having assigned the various importance values to the hazards, the PRHS is ready to complete the evaluation by calculating a risk rating for each of the identified hazards. Table 8 uses the examples already given in Section 4.2.2 to demonstrate the classification and evaluation of the risks. As can be seen from this table the risk score is derived using the following function:

$$\text{Risk score} = (A + B) \times C \times D$$

where: A is the importance value attached to the type of accident;
B is the importance value attached to the nature of resulting injuries/illness;
C is the score attached to the likelihood of occurrence; and
D is the number of people exposed at a single moment in operational time.

4.2.7 Step 6: 'Rank, Plan and Review'

Where other methodologies have attempted to group risks in terms of tolerability, need for further action, etc the risk ratings that are derived using this analysis are interpreted simply by examining their relative magnitude. Thus, the larger the rating, the greater the risk and therefore the higher the priority. In the case of the examples given in Table 8, the risks associated with a 'fall from the stockroom ladder' are the highest, suggesting that some attention needs to be given to reducing the risk of such a fall by, for example, rearranging the stores such that less ladder climbing is required, fixing anti-slip steps, etc. The next highest risk is that associated with the operation of the tyre press. As little can be done to reduce the consequences of this event, the PRHS might consider reducing the likelihood of the event by attaching a guard such that the occurrence of the event is reduced to being effectively impossible.

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It is clear that by ranking in this way the PRHS can reliably identify priorities for further action. By working through the list of priorities, implementing risk reduction measures and reviewing the assessment accordingly the PRHS can rationalise his/her response to workplace risks considering as well the need for further assessments under regulations such as the Control of Substances Hazardous to Health, Personal Protective Equipment, etc. In terms of the adequacy of precautions, having implemented reduction measures and reviewed the assessment, there will come a point where the level of a risk rating cannot be reduced further. The 'car rolling off ramp' provides a simple example of this since the occurrence of the event is already 'effectively impossible'. In addition, little can practically be done to reduce the consequences in terms of the type of accident and the nature of injuries. As such this risk represents one that is reduced to a level that is as low as reasonably practicable. However, the level of residual risk still informs the PRHS that, although he/she may have instigated operating procedures and equipment to reduce the risk, it is still very important to ensure that such precautions remain firm.

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Table 8
Example completed evaluation

STEP 1			STEP 3		STEP 2		STEP 4	STEP 5
Type of accident	**Score A**	**Hazards**	**Nature of injury**	**Score B**	**Likelihood**	**Score C**	**Number affected D**	**Risk score (A+B) x C x D**
Slip, trip or fall on same level	*5*	***Oil on garage floor***	*Sprain or strain*	*1*	*Probable*	*5*	*1*	*30*
Strike by moving object	*5*	***Exhaust pipes stacked against garage wall***	*Contusion*	*1*	*Possible*	*4*	*1*	*24*
Fall from height over 2 metres	*18*	***Fall from stockroom ladder***	*Fracture*	*18*	*Plausible*	*3*	*1*	*108*
Injury by contact with moving machinery	*6*	***Contact with grinding machine***	*Lacerations and open wounds*	*2*	*Possible*	*4*	*1*	*32*
ditto	*6*	***Trapping fingers in tyre press***	*Amputation*	*26*	*Unlikely*	*2*	*1*	*64*
Strike by moving vehicle	*7*	***Car rolls off ramp***	*Fracture*	*18*	*Effectively impossible*	*1*	*1*	*25*

5. TESTING AND REFINEMENT

5.1 INTRODUCTION

The general methodology presented in Section 4.2 has been refined after field tests in three separate workplaces. As has already been highlighted, the success of the methodology in terms of its application to SMEs depends on both the reliability of the derived rankings and the acceptability/simplicity of the method for a (potentially) inexperienced operator. A simple 'guide' to the risk assessment methodology was drafted for testing in the field. A revised version of this guide appears in Annex 3.

The first of the tests was simply to establish the ability of the 'scoring' system to provide rankings that were 'sensible'. Both of the workplaces tested have a manufacturing base, one of them being a 'small' enterprise and one a 'medium'. After further refinements the 'guide' to the methodology was tested in a third workplace to establish how easy it was for an inexperienced operator to manage, how any problems could be overcome by further refinements/presentation as well as further testing the ability of the methodology to provide reliable rankings.

5.2 RESULTS AND REFINEMENTS FROM THE TESTS

5.2.1 Test 1

The methodology proved to be fairly quick and easy to operate. Assessments in both of the workplaces took around an hour from beginning the assessment to discussing the results with the PRHS. The structure of the assessment in terms of identifying hazards under each of the different accident types was helpful and allowed the operators to focus and structure the assessment accordingly.

Though a smaller manufacturing operation, more hazards were identified in the small enterprise than the medium. While this can be put down in part to differences in the product being manufactured it was also obvious that the medium sized enterprise (which employs a safety officer) had already taken many steps to reduce/eliminate hazards. The smaller enterprise had also taken some steps to reduce workplace risks but had not identified some of the hazards that the methodology was able to identify. The smaller operation was also characterised by less sophisticated automation than the medium sized enterprise, which, for many employees, meant that they were simply loading and unloading machines and checking their progress. In the smaller enterprise there were a number of manually operated machines with consequently more opportunity for trapped fingers, etc.

After discussions with the respective PRHSs, the derived rankings of priority were held to be fairly accurate and interesting. The PRHS in the smaller enterprise, who had already taken some action on some of the hazards that he himself had identified, was sufficiently concerned (but in agreement) with one of the hazards and associated ranking that he has since taken steps to eliminate the hazard.

In broad terms the conclusion of the first test was that the methodology worked fairly well as both a tool to identify hazards and provide a sensible ranking of priorities for the associated risks. However, there were certain details in the methodology that required further consideration. These related to the need to 'signpost' chronic risks and also to the descriptions used to characterise injuries.

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Chronic Risks

As in many workplaces, staff at both facilities were exposed to some chronic risks. In the first workplace this was associated with exposure of all staff to high pitched noise from one of the manufacturing machines. In the second this related to potential exposure to heavy metals while transferring an electrolyte paste to machinery (using gloved hands). Whilst, as already noted, little coverage of chronic risks can be included in the ranking methodology itself, the need for some kind of 'signposting' to draw PRHS's attention to these issues was obvious.

Accident/Injury Descriptions

In many respects the idea behind the classification of risks in the methodology came from the realisation that, if HSC could classify all **past** workplace accidents by accident/injury type[12] using a discrete set of descriptive terms, then these terms could also be used to classify **future** incidents. However, the terms used are necessarily broad so as to cover a wide variety of accidents and injuries. As a result, when identifying and classifying the hazards in both workplaces a little 'imagination' was required to determine, for example, which type of injury was most applicable to the named hazard. It was also noticed in the second workplace that, whilst a hazard associated with a hot solder pot had been noticed by the operators, there was no obvious 'accident type' category that would have allowed the hazard to have been identified using the methodology alone.

5.2.2 Test 2

Having found in the first test that at least the 'mechanics' of the methodology was sound, the second (and perhaps more challenging) test sought to establish whether or not the methodology would be acceptable and simple enough to be operated by PRHSs.

In light of the problems encountered with accident/injury descriptions in the first test, the descriptions were simplified and made more explicit in the guide. The text was made as simple as possible and an example table was used to illustrate how to fill in the assessment form under each of the stages.

With cooperation from the health and safety manager at a major UK installation, the guide was given to a number of supervisors who were responsible for health and safety in their various departments. Whilst the facility is not an SME, the structure of health and safety arrangements is such that each supervisor is required to assess risks in a 'unit' of similar size to an SME. As a result the opinions of a large number of PRHSs could be sought in one test.

The methodology was given to the supervisors in a risk assessment training session. Without having the methodology explained to them, the supervisors were required to read and give their opinion on the methodology and the content of the guide. The supervisors raised a number of problems relating to the application of the methodology.

The first problem highlighted was the complexity of the method. Given that the method was seeking to allow the ranking and prioritisation of all risks it was expected that there might be some problems with the mathematical nature of the methodology. However, unexpectedly, it was not the calculation of risk ratings that was highlighted as a particular problem, rather that each step seemed to require

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[12] In their annual health and safety statistics publications.

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a number of different things to be done in a prescribed order and that it was difficult to keep track of what needed doing and when. However, in terms of mathematical complexity, the listing of what were originally termed 'Accident/injury Scores' to one decimal place was said not to help matters and that, for many PRHSs in SMEs, the complexity of the methodological steps combined with the use of numbers to one decimal place would make the method unworkable.

In many respects these are presentational problems that can be overcome by more intensive design, testing and revision. In terms of the need for numbers to one decimal place, having recalculated the results of the first test, converting importance values to whole numbers seems to have no effect on the adequacy of the rankings.

The second problem highlighted by the supervisors is less easy to overcome by adjusting the presentation. The supervisors expressed resistance to the idea of using the numbers provided to score accident type and injury type. This was because they were uncomfortable with the idea of being forced to use 'scores' with little explanation as to their origin and with no control over their magnitude. Contrary to what had been thought when the guide was first developed, the supervisors expressed a need for further information on what the scores represented and how they were developed. Such descriptions had been deliberately omitted as it was thought that the explanation behind the scores would only make the method more complicated.

Whilst providing more information is clearly a presentational problem, resistance to the idea of using the numbers that are the key component of the methodology is clearly a potentially severe limitation of the method. A simple suggestion was that instead of calling the importance values 'scores' they could be given a more 'authoritative' name. It was thought that this would go some way to convincing PRHSs that they should simply accept the numbers. A further suggestion was that the 'accident types' should be listed in order of importance. This would then make the relationship between the accident type and importance much clearer and would contribute to greater acceptance of the numbers. These adjustments have been made to the risk assessment guide provided in Annex 3.

The final problem that was identified, again related to the injury descriptions. The supervisors were unsure how to classify some of the injuries. For example, they were unsure how a back injury might be classified. It was suggested that the descriptions should be made more explicit or should give some examples so that it would be easier to make classifications. Adjustments have been made to the risk assessment guide provided in Annex 3.

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6. CONCLUSIONS

6.1 CONCLUSIONS OF DEVELOPMENT AND TESTING

The centerpiece of the RPA methodology is the importance values that are used to derive an expression of the consequences associated with a given hazard being realised. In terms of their ability to provide a sensible and 'correct' ranking of priorities these importance values work well.

However, it seems that to some extent the reliability of the rankings is also likely to depend on the skill of the operator at classifying injuries under the headings used in the HSC's annual health and safety statistics. While this can be counteracted to some extent by making these descriptions more explicit, the extent to which this can occur is limited by the fact that the importance values are based on actual data, thus extending the descriptions to cover, say, 'backache' may not be consistent with the statistics.

Other criticisms might also be levelled at the intuitiveness that is required to assign categories of likelihood. Whilst the number of categories could be reduced, the testing phase of the study found that this scoring system was acceptable to those PRHSs who examined the method. As no problems were raised it seems unnecessary to surrender some of the sensitivity of the method without more justification.

Presentation

The challenges of presenting the ranking methodology effectively to SMEs are many. Whilst the Consultants perceive the ranking component of the methodology to be as simple as one is ever likely to achieve, communicating and packaging the method in the right way would be essential to its success. One of the most fundamental problems highlighted during the testing phase is the reluctance to use numbers that have been prescribed by the method without a clear explanation as to why. As is obvious from the content of Section 4, the full explanation of the theory behind the numbers is very complicated however, however, if the methodology were to be generally applied consideration would have to be given to providing sufficient explanation to 'de-mystify' the importance values without making the methodology seem too complicated.

6.2 LIMITATIONS OF THE APPROACH

The key limitation of the approach is its inability to take into account the chronic risks associated with workplaces and compare them directly with acute risks within the same ranking assessment.

The reason for this is simply that, whilst acute risks all relate to specific and more or less easily identified adverse events affecting one or more individuals, this commonality is not shared with chronic risks associated with long-term exposure to potential health hazards[13]. Thus, where an acute risk is one that is associated with abnormal operations, a chronic risk is one that is associated with long-term exposure to normal operations. As a result, where assessment of the acute involves consideration of the likelihood and consequences of something specific going wrong, assessment of

[13] When making such a differentiation between acute and chronic risks it is important not to confuse this terminology with acute and chronic episodes of ill health.

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the chronic involves assessing the long term health effects of general working conditions on all of those people who are exposed to these conditions. For such chronic risks it is difficult to translate this information into a format comparable with the acute.

Whilst the study has not identified any simple means of comparing acute and chronic risks, the use of economic values may provide a means of achieving this aim, though at a much more complicated level. Where the RPA methodology used economic values for the assignment of weights (to fatal injuries, non-fatal major injuries, etc) and importance values, such values could be used directly to derive an estimate of potential costs rather than an expression of risk. Used in combination with an assessment of potential costs associated with occupational illnesses from chronic exposure, this might provide a means of ranking both chronic and acute risks in financial terms. However, it seems sensible to suggest that such an assessment would be much too complicated for application in a workplace setting, being perhaps more applicable to the making of policy level decisions regarding risk reduction.

Regardless of the critical failure of the methodology to account for chronic risks in a single, consolidated ranking assessment, should the methodology be issued as consolidated guidance on health and safety matters it would need to incorporate some information on chronic risks. Much like the '5 Steps', perhaps the best way of achieving this would be to 'signpost' where further assessments might be required under regulations such as:

- Control of Substances Hazardous to Health 1994 (COSHH)
- Noise at Work Regulations 1989
- Manual Handling Operations Regulations 1992
- Personal Protective Equipment at Work Regulations 1992
- Health and Safety (Display Screen Equipment) Regulations 1994

Where guidance from all sources on risk assessment appears relatively vague, guidance on these (and other) regulations is fairly specific and clear. By such signposting, the PRHS would be directed towards existing guidance on any specific assessments that might be required to comply with these regulations.

6.3 SUMMARY

The key purpose of the study has been to examine the practicalities of developing an overall approach to workplace risk assessment which allows all risks to be ranked and compared on an equal footing. As evidenced by the development of the RPA methodology, the primary conclusion of the study is that such goals are achievable. However, due to the inherent complexities in a ranking method, the presentation of a such a methodology for wider use in SMEs is very difficult and requires more particular consideration and more exhaustive testing.

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ANNEX 1

METHODOLOGIES REVIEWED FOR APPLICABILITY

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BSI (1996): **BS8800: Guide to Occupational Health and Safety Management Systems**: Annex D to BS8800 provides information and advice on conducting a risk assessment. The suggested assessment method takes an activity-based approach consisting of: identification of work activities; identification of hazards; determination of risks; determination of tolerability; preparation of risk control plan; and a review of action plan adequacy.

Risk determination is achieved by determining:

- the severity of harm in terms of whether it is: slightly harmful; harmful; or extremely harmful; and
- the likelihood in terms of, for example: highly unlikely, unlikely; or likely.

The standard makes it clear that these are subjective assessments that should take into account of factors such as exposure, frequency and duration of exposure, etc. Ranking is not explicitly referred to, however, the standard suggests the use of a simple risk level indicator to classify risks in terms of their tolerability. This is based on a simple chart where different combination of likelihood and severity result in a risk being classified as: trivial; tolerable; moderate; substantial; or intolerable (where tolerable means that a risk is as low as reasonably practicable). Risks are therefore effectively 'ranked' in terms of their tolerability classification and action and timescale categories are assigned to each of the tolerability classifications.

Croner (1997): **Croner's Risk Assessment**: Croner's Risk Assessment presents a simple task-based methodology for rating risks. As with many such methodologies this involves analysing hazards in terms of their severity and likelihood and assigning scores to the various categories. The categories and scores listed in Croner's are as follows:

Severity	**Score**	**Likelihood**	**Score**
Multiple death	10	Certain/imminent	10
Single death	8	Very likely	8
Major injury, disabling illness, major damage	6	Likely	6
Lost time, illness, damage	4	May happen	4
Minor injury, minor damage	2	Unlikely	2
Delay only	1	Very unlikely	1

The multiplication of these scores provides a risk rating ranging from 1 (very unlikely delay) to 100 (certain/imminent multiple death). This rating "provides an indication of priority". Scores are then classified in terms of the need for further action according to a matrix of score. This matrix classifies risks as trivial, adequately controlled, not adequately controlled. However, these classifications are not based on the ratings, rather the need for further action is defined both by position within a matrix of severity *versus* likelihood descriptors.

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Croner's also discusses the use of risk nomograms to derive risk estimates and cost effectiveness of reduction measures. This kind of approach involves graphically joining the points marked on a series of parallel lines, where each line represents a scaling of a factor such as severity or likelihood and each point represents the level of severity, likelihood, etc that is associated with a particular hazard.

IOSH (1993): ***Risk Assessment - A Practical Guide***, The Safety & Health Practitioner, May 1993: The IOSH methodology (as reported in *Croner's Risk Assessment*) uses a location-activity-based approach. Risk determination is achieved by considering: persons at risk, worst case outcome (fatality, major injury, minor injury, no injury, environmental/plant damage), and likelihood (likely/frequent, probable, possible, remote, improbable). The methodology does not use scores to express level of risk, rather, risks are assigned into one of four 'action' categories (1st rank action, 2nd rank action, 3rd rank action, and acceptable risk - no actions) based on the 'position' of the risk in a simple severity/likelihood matrix.

Formecon (1995): **Chancellor's Health and Safety Starter Packs**: This document consists of a series of recording forms. There is no methodological basis other than the recording of information. The assessment method appears to be left to the assessor.

GEE (1996): **A-Z of Health & Safety Risk Assessment**: This uses a task based approach to risk assessment. A 'risk factor' (score) is calculated by consideration of:

- the severity of a hazard in terms of critical, serious or minor (scored 3, 2, and 1 respectively); and
- probability in terms of probable, possible, unlikely (scored 3, 2, and 1 respectively).

The risk score is calculated as the product of severity and probability giving a range of scores between 1 and 9. Risks are then categorised on the basis of: 'low risk' (1-3); 'medium risk' (4); and 'high risk' (6-9).

HSE (1991): **Successful Health and Safety Management**: A simple form of risk estimation is described where *risk = hazard severity x likelihood of occurrence* where hazards are scored on the basis of severity and probability.

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ANNEX 2

LOOK-UP TABLES FOR IMPORTANCE VALUES (AND THEIR DERIVATION)

Contents

A2.1 LOOK-UP TABLES

Table 9
Look-up table for importance values for accident type

Type of accident	Importance value
Injury while handling, lifting or carrying	2
Slip, trip or fall on same level	5
Strike by moving, including flying/falling object	5
Falls from a height up to 2m	7
Strike against something fixed or stationary (including hot/very cold surfaces)	4
Injury by contact with moving machinery	6
Acts of violence	3
Exposure to, or contact with, a harmful substance (including hot/very cold substances)	4
Strike by moving vehicle	7
Falls from a height over 2m	18
Injury caused by animal	3
Contact with electricity or electrical discharge	12
Exposure to fire	6
Trapped by something collapsing/overturning	16
Exposure to an explosion	11
Drowning or asphyxiation	19

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Table 10
Look-up table for importance values for nature of injury/illness

Nature of injury/illness	Importance value
Death	491
Ill health - permanently incapacitating	99
Amputation	26
Other injuries caused by contact with electricity	20
Concussion/internal injuries	19
Damage to eyesight	18
Bone fractures	18
Dislocation	16
Natural causes (heart attack)	15
Poisonings and gassings	14
Burns	4
Lacerations and open wounds	2
Contusions/severe bruising	1
Superficial injuries	1
Sprains and strains	1
Ill health - not incapacitating	1
Ill health - minor	0.04

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A2.2 DERIVATION OF LOOK-UP TABLES

Table 11: Review recent reported accident statistics by sector and reporting rates (as derived from comparison with Labour Force Survey). Derive 'k factors' for all sectors.

Comments: *i) note that 'finance and business' sector is made up of two sub-sector groups (as used in reported accident statistics).*
ii) overall reporting rate of 40% for service sector derived from sub-sector figures.

Table 12: Estimate 'true' numbers of injuries for each sector using the expressions N1, N2(1 + k) and N3(1 + 10k) for fatal, non-fatal major and over 3-day injuries respectively (as discussed in Section 4.2.6 of main text).

Table 13: Review accident statistics by accident type for each sector and this table presents those for the service sector. Adjust statistics using the appropriate 'k factor' (from Table 11).

Table 14: Combine results from each sector to generate overall estimated numbers of 'true' injuries by accident type. For each accident type, derive 'escalation' probabilities.

Comments: *i) note that totals are close (to around 1%) with those derived in Table 12.*
ii) note that for 'falls', those with no height stated have been factored into falls above and below 2m.
iii) 'other' and 'unclassified' accidents make up a small percentage of total (<3%) and have been ignored.

Table 15: For each escalation probability, apply a weighting factor (550, 30 and 1 for fatal, non-fatal major and over 3-day injuries respectively) and sum the results by accident type to give an 'importance value'. These have also been ranked in order of importance.

Table 16: Review recent accident statistics by 'nature of injury'. Using injury costs (£687,500, £37,500 and £1,250 for fatal, non-fatal major and over 3-day injuries respectively), derive the expected cost (RV_i) per injury type.

Comments: *i) note that totals are the same as those in Table 11.*
ii) note that injuries 'of more than one type', 'unclassified' and 'unknown' account for 46%, 3% and 5% of fatal, non-fatal major and over 3-day injuries respectively.

Table 17: Apply a factor of 1.85 to fatality numbers (but not to other injuries) to 'account' for all fatalities within the analysis. Estimate 'true' numbers of injuries by type using the expressions $N2(1 + \beta)$ and $N3(1 + 10\beta)$ for non-fatal major and over 3-day injuries respectively (as discussed in Section 4.2.6 of main text). Re-evaluate the 'true' injury cost and derive 'importance values' by comparing costs with those for sprains and strains.

Comments: *i) as before, note that totals are very close to those derived in Tables 12 and 14.*
ii) the value of β was found, empirically, to be 13.5%.

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Table 11
Raw statistics for 1996/97 and 1997/98

Sector	Injuries per year: fatal	non-fatal	>3-day	All injuries	Reporting rate (%)	Corres. k value
Agriculture, hunting, forestry and fishing	**21**	**676**	**1411**	**2108**	40%	21.0%
Extractive and utility supply industries	**13**	**649**	**3172**	**3834**	80%	3.1%
Manufacturing	**53**	**8385**	**40292**	**48730**	62%	7.4%
Construction	**60**	**3475**	**8907**	**12441**	55%	11.0%
Wholesale and retail trade and repairs	14	3428	14793	18234	34%	23.2%
Hotels and restaurants	2	918	2888	3808	20%	52.7%
Transport, storage and communication	22	2771	16690	19482	64%	6.3%
Finance & business	5	1089	3816	4909	19%	54.0%
Financial intermediation	*0*	*144*	*592*	*736*		*54.0%*
Real estate, renting and business activities	*5*	*946*	*3224*	*4174*		*54.0%*
Public administration and defence	5	2041	13582	15628	65%	6.0%
Education	2	1533	4613	6147	49%	13.5%
Health and social work	3	1881	13726	15610	36%	20.3%
Other community, social and personal service activities	10	1242	4593	5845	41%	17.6%
Total service industries	**61**	**14902**	**74699**	**89661**	*40%*	*17.4%*
Total - all sectors	**207**	**28086**	**128481**	**156773**		

Table 12
Adjusted statistics for 1996/97 and 1997/98

Sector	Injuries per year: fatal	non-fatal	>3-day	'True' injuries	Reported injuries	Reporting rate (%) (check)
Agriculture, hunting, forestry and fishing	**21**	**818**	**4374**	**5213**	**2108**	**40%**
Extractive and utility supply industries	**13**	**669**	**4155**	**4837**	**3834**	**79%**
Manufacturing	**53**	**9005**	**70108**	**79166**	**48730**	**62%**
Construction	**60**	**3857**	**18705**	**22621**	**12441**	**55%**
Wholesale and retail trade and repairs	14	4223	49111	53348	18234	34%
Hotels and restaurants	2	1402	18108	19511	3808	20%
Transport, storage and communication	22	2946	27204	30171	19482	65%
Finance & business	5	1677	24419	26101	4909	19%
Financial intermediation	*0*	*221*	*3789*	*4010*	*736*	*18%*
Real estate, renting and business activities	*5*	*1456*	*20630*	*22091*	*4174*	*19%*
Public administration and defence	5	2163	21730	23899	15628	65%
Education	2	1739	10839	12580	6147	49%
Health and social work	3	2263	41590	43855	15610	36%
Other community, social and personal service activities	10	1461	12677	14147	5845	41%
Total service industries	**61**	**17873**	**205678**	**223612**	**89661**	*40%*
Total - all sectors	**207**	**32222**	**303020**	**335448**	**156773**	*47%*
Reporting rate by injury type	100%	87%	42%	47%		

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Table 13
Statistics for 1996/97 and 1997/98 - service sector

Accident type	Injuries per year			Adjusted injuries per year k = 17.4%		
	fatal	non-fatal	>3-day	fatal	non-fatal	>3-day
Contact with moving machinery	5	298	1023	5	350	2803
Struck by moving, including flying/falling object	10	2009	9029	10	2359	24739
Struck by moving vehicle	19	513	1930	19	602	5287
Strike against something fixed or stationary	1	862	4083	1	1012	11186
Injured while handling, lifting or carrying	1	1520	28583	1	1784	78316
Slip, trip or fall on same level	1	5551	15805	1	6516	43306
Falls from a height of which	12	2395	4603			
up to 2m	*2*	*999*	*2256*	*2*	*2118*	*11154*
over 2m	*8*	*327*	*295*	*10*	*694*	*1458*
height not stated	*3*	*1069*	*2052*			
Trapped by something collapsing/overturning	4	42	108	4	49	296
Drowning or asphyxiation	3	27	66	3	31	179
Exposure to or contact with a harmful substance	2	459	2079	2	538	5695
Exposure to fire	1	45	177	1	53	485
Exposure to an explosion	1	28	86	1	32	236
Contact with electricity or electrical discharge	1	98	259	1	115	708
Injured by animal	1	71	632	1	83	1730
Acts of violence	1	612	3823	1	718	10475
Other kind of accident	2	352	2282	2	413	6251
Injuries not classified by kind	0	24	135	0	28	369
All types:	**61**	**14902**	**74699**	**61**	**24231**	**197498**

(Note: Reporting rate for all injuries = 40%)

Table 14
Statistics for 1996/97 and 1997/98 - all sectors

Accident type	Adjusted injuries per year			Escalation probabilities		
	fatal	non-fatal	>3-day	fatal	non-fatal	>3-day
Contact with moving machinery	17	1968	11286	0.12%	14.8%	85.0%
Struck by moving, including flying/falling object	38	5178	41409	0.08%	11.1%	88.8%
Struck by moving vehicle	39	1023	7023	0.48%	12.6%	86.9%
Strike against something fixed or stationary	3	1707	16910	0.02%	9.2%	90.8%
Injured while handling, lifting or carrying	2	3201	112367	0.00%	2.8%	97.2%
Slip, trip or fall on same level	2	9673	59406	0.00%	14.0%	86.0%
Falls from a height of which						
up to 2m	*6*	*3897*	*16758*	*0.03%*	*18.9%*	*81.1%*
over 2m	*51*	*1873*	*2794*	*1.08%*	*39.7%*	*59.2%*
height not stated						
Trapped by something collapsing/overturning	13	179	627	1.53%	21.9%	76.6%
Drowning or asphyxiation	8	58	263	2.29%	17.6%	80.1%
Exposure to or contact with a harmful substance	4	1056	8918	0.04%	10.6%	89.4%
Exposure to fire	2	107	815	0.22%	11.5%	88.2%
Exposure to an explosion	5	68	359	1.05%	15.7%	83.3%
Contact with electricity or electrical discharge	14	259	1155	0.98%	18.1%	80.9%
Injured by animal	1	179	2153	0.04%	7.7%	92.3%
Acts of violence	1	756	10723	0.01%	6.6%	93.4%
Other kind of accident	3	606	8440	0.03%	6.7%	93.3%
Injuries not classified by kind	1	57	612	0.15%	8.5%	91.3%
All types:	**207**	**31843**	**302016**	**0.06%**	**9.53%**	**90.41%**

Table 15
Importance values accident types

Accident type	Injury importance: fatal	non-fatal	>3-day	Importance value (rounded)	Rank
weight:	550	30	1		
Contact with moving machinery	0.68	4.45	0.85	6	8
Struck by moving, including flying/falling object	0.45	3.33	0.89	5	10
Struck by moving vehicle	2.62	3.79	0.87	7	6
Strike against something fixed or stationary	0.09	2.75	0.91	4	12
Injured while handling, lifting or carrying	0.01	0.83	0.97	2	16
Slip, trip or fall on same level	0.01	4.20	0.86	5	10
Falls from a height of which					
up to 2m	0.17	5.66	0.81	7	6
over 2m	5.97	11.91	0.59	18	2
height not stated					
Trapped by something collapsing/overturning	8.40	6.56	0.77	16	3
Drowning or asphyxiation	12.59	5.28	0.80	19	1
Exposure to or contact with a harmful substance	0.22	3.17	0.89	4	12
Exposure to fire	1.19	3.46	0.88	6	8
Exposure to an explosion	5.75	4.71	0.83	11	5
Contact with electricity or electrical discharge	5.39	5.44	0.81	12	4
Injured by animal	0.24	2.30	0.92	3	14
Acts of violence	0.05	1.98	0.93	3	14
Other kind of accident	n/a	n/a	n/a	n/a	
Injuries not classified by kind	n/a	n/a	n/a	n/a	

Table 16
Nature of injury - statistics for 1996/97 and 1997/98

Severity of accidents by nature of injury	Injuries per year: fatal	non-fatal	>3-day	All injuries	Cost per injury
Amputation	0	1215	7	1222	£37,307
Loss of sight of eye	0	123	30	153	£30,392
Fracture	29	20300	5820	26149	£30,153
Dislocation	1	1090	394	1484	£28,095
Concussion with internal injuries	33	450	766	1248	£32,439
Lacerations and open wounds	4	1399	14035	15438	£4,713
Contusions	13	489	26062	26564	£2,253
Burns	8	870	4154	5032	£8,540
Poisonings and gassings	11	225	414	649	£24,902
Sprains and strains	1	494	58649	59144	£1,559
Superficial injuries	1	361	11419	11781	£2,390
Natural causes	1	16	20	36	£26,382
Other injuries caused by contact with electricity	13	205	287	505	£33,614
Injuries of more than one type	53	390	2521	2964	£18,169
Injuries not elsewhere classified	22	313	1700	2035	£14,239
Injuries not known	20	148	2205	2373	£9,290
All injuries	**207**	**28086**	**128481**	**156773**	**£8,647**

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Table 17
Importance values by nature of injury/illness

Severity of accidents by nature of injury	Adjusted injuries per year fatal	non-fatal	>3-day	All injuries	Cost per injury	Importance value
Amputation	0	1379	15	1394	£37,103	26
Loss of sight of eye	0	140	71	210	£25,336	18
Fracture	54	23041	13676	36770	£24,965	18
Dislocation	1	1237	926	2163	£22,263	16
Concussion with internal injuries	61	510	1799	2370	£26,716	19
Lacerations and open wounds	7	1588	32982	34578	£3,061	2
Contusions	24	555	61245	61824	£1,842	1
Burns	14	987	9762	10763	£5,460	4
Poisonings and gassings	19	255	972	1246	£19,355	14
Sprains and strains	1	561	137825	138387	£1,401	1
Superficial injuries	1	410	26835	27245	£1,818	1
Natural causes	1	18	47	66	£20,665	15
Other injuries caused by contact with electricity	24	232	674	931	£28,013	20
Injuries of more than one type	0	443	5924	6367	n/a	n/a
Injuries not elsewhere classified	0	355	3995	4350	n/a	n/a
Injuries not known	0	168	5182	5350	n/a	n/a
All injuries	**207**	**31877**	**301929**	**334013**	**£5,135**	
			Ill health - minor		£63	0.04
			Ill health - not incapacitating		£1,250	1
			Ill health - permanently incapacitating		£138,750	99
			Death		£687,500	491

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ANNEX 3

RISK PRIORITY ASSESSMENT (RPA) GUIDE

Contents

INTRODUCTION

What is a Risk Assessment?

Legally, as an employer, you have to assess risks.

A risk assessment is nothing more than a careful examination of what in your workplace could cause harm to:

- your employees;
- members of the public; or
- anyone else (like a visitor for example).

What is it For?

In effect, a risk assessment allows you to identify:

- What could go wrong;
- How badly it could go wrong;
- How likely it is to happen; and
- Whether anything needs to be done about it.

There are probably a number of different things that could go wrong in your workplace, causing some sort of harm to someone. These are **HAZARDS**.

Considering all of these **HAZARDS** in one assessment allows you to think about which things are most likely to cause harm and, therefore, which things you probably need to do something about. These are **RISKS**.

Hazard and Risk

A **HAZARD** is anything that could cause harm, be it a 'thing' like electricity or a slippery floor, or an activity, like working from a height or working with an arc welder.

A **RISK** is the chance, great or small, that people will be harmed by the HAZARD.

THE 'RPA' METHOD

Assessing the Risks

The Risk Priority Assessment (RPA) method of Workplace Risk Assessment provides a simple way of thinking about these issues. The method helps you consider:

1. how particular types of accident could happen in your workplace;
2. how likely they are to happen;
3. the nature of injuries caused; and
4. the number of people who are likely to be affected.

By the use of a 'scoring system', the method comes up with a 'risk score' for each of the hazards that you will identify. These scores are based on the seriousness of past accidents in UK workplaces. The bigger the 'risk score' the bigger the potential problem.

Managing the Risks

Once you know which of the hazards to worry about first, you can start to think about how to reduce these risks. However, always remember that when trying to manage health and safety, the idea is to reduce the overall 'riskiness' of the workplace as much as possible and as cheaply as possible.

This means that as well as thinking about the hazards with the biggest scores, you also need to think about the other hazards.

What Next?

Carefully follow the steps on the following pages to complete your assessment. These steps are:

- **Step 1:** 'What Could Happen';
- **Step 2:** 'How Likely is it to Happen';
- **Step 3:** 'Decide How Someone might be Harmed';
- **Step 4:** 'Decide How Many are Likely to be Affected'; and
- **Step 5:** 'Evaluate the Risks'.

There are forms provided at the back to photocopy and fill out.

Step 1: 'What Could Happen?'

Firstly, make sure you have some copies of the assessment form that appears at the back of this document. You will be filling in the columns marked '**STEP 1**' in this part of the assessment.

Below is a list of types of accidents along with a number representing the historical importance of each type of accident in terms of the number of deaths and major injuries that have resulted from past incidents.

Type of Accident	'Historical Importance Value'
Drowning or asphyxiation	19
Fall from height over 2m	18
Trapped by something collapsing/overturning	16
Contact with electricity or electrical discharge	12
Exposure to an explosion	11
Struck by moving vehicle	7
Fall from height up to 2m	7
Contact with moving machinery	6
Exposure to fire	6
Slip, trip or fall on same level	5
Struck by moving, including flying/falling object	5
Exposure to or contact with a harmful substance	4
Strike against something fixed or stationary	4
Injured by animal	3
Acts of Violence	3
Injured while handling, lifting or carrying	2

Working down the list, begin by writing down the first **type of accident** that applies to your workplace situation in the relevant column of your form. For example this might be *'fall from height over 2m'.*

Now think about anything in your workplace that could feasibly cause this type of accident and result in harm to someone. These are **HAZARDS** and should each be given a box in the relevant column of your assessment form (see the example below)

Enter the importance value for the type of accident in the column marked '**A**' (you will find these values next to the relevant accident type in the above list).

N.B. You will find that your employees and their representatives can probably add to your list. The more widely you consult, the more complete the assessment will be.

STEP 1		
Type of Accident	**A**	**Hazards**
Fall from height over 2m	*18*	*Maintenance of ceiling air vents*
ditto	*18*	*Retrieval of items from stockroom*
ditto	*18*	*Fall from mezzanine floor*

Once you have exhausted all of the options for the first accident type move onto the next one which applies to your workplace and repeat the process.

Keep working your way down the list in this way until you have identified all of the potential causes of each of the different accident types.

The example form below shows the kind of information you might have entered by the end of **STEP 1**. This uses a few examples from consideration of the hazards present in a car workshop. We will keep completing this form as we go through the other steps in the assessment.

Risk Assessment for: *Eddy's Tyres & Exhausts Ltd.* **Date:** *18/11/1997* **Assessed by:** *Edward Buckleithwaite* **Page:** *1*

STEP 1			STEP 3		STEP 2		STEP 4	STEP 5
Type of Accident	Score A	Hazards	Nature of Injury	Score B	Likelihood	Score C	No. Affected D	Risk Score (A+B) x C x D
Fall from height over 2 metres	*18*	*Fall from stockroom ladder*						
Strike by moving vehicle	*7*	*Car rolls off ramp*						
Injury by contact with moving machinery	*6*	*Trapping fingers in tyre press*						
ditto	*6*	*Contact with grinding machine*						
Slip, trip or fall on same level	*5*	*Oil on garage floor*						
Strike by moving object	*5*	*Exhaust pipes stacked against garage wall*						

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Step 2: 'How Likely is it to Happen'

Having identified all of the things that could happen, the next step is to identify how likely they are to happen.

Below is a list of phrases that describe the likelihood of something happening. There are also some 'scores' attached to these phrases.

In **STEP 1** you have identified a number of things that could cause harm to someone in your workplace. Examine these one by one and choose a phrase from the list below that best describes how likely these are to happen. Write the phrase (and the corresponding score) in the relevant boxes in the column marked '**STEP 2**' in your form.

Do this for all of the **HAZARDS** that you have identified in **STEP 1** (see the example form over the page).

How Likely is it to Happen?	'Score'
Effectively impossible	1
Unlikely	2
Plausible	3
Possible	4
Probable	5
Very likely	6
Almost certain	7

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At the end of **STEP 2** you should have a form that looks something like the one below.

Risk Assessment for: *Eddy's Tyres & Exhausts Ltd.* **Date:** *18/11/1997* **Assessed by:** *Edward Bucklethwaite* **Page:** *1*

STEP 1			STEP 3		STEP 2		STEP 4	STEP 5
Type of Accident	Score A	Hazards	Nature of Injury	Score B	Likelihood	Score C	No. Affected D	Risk Score (A+B) x C x D
Fall from height over 2 metres	*18*	*Fall from stockroom ladder*			*Plausible*	*3*		
Strike by moving vehicle	*7*	*Car rolls off ramp*			*Effectively impossible*	*1*		
Injury by contact with moving machinery	*6*	*Trapping fingers in tyre press*			*Unlikely*	*2*		
ditto	*6*	*Contact with grinding machine*			*Possible*	*4*		
Slip, trip or fall on same level	*5*	*Oil on garage floor*			*Probable*	*5*		
Strike by moving object	*5*	*Exhaust pipes stacked against garage wall*			*Possible*	*4*		

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Step 3: 'Decide How Someone Might be Harmed'

Having completed **STEPS 1** and **2** you will have:

- identified all of the things that could cause harm in your workplace; and
- identified how likely they are to happen.

The next thing to consider is the **type of the injury/illness** that would result if what **COULD happen DID happen.**

Below is a list of different types of injury/illness with some historical importance scores attached to each. You will notice that the most severe/important injuries come at the top of the list and the less severe ones come at the bottom. As with the accident types, these numbers are based on the number of deaths and major injuries that have occurred in the past.

In **STEP 1** you identified a number of things that could cause harm to someone in your workplace. For each hazard that you identified, think about the type of injury/illness that is most likely. Do this by beginning at the top of the list of **types of accident** and working your way down. As soon as you come to a phrase that best describes the general type of injury/illness, enter this phase and its corresponding score into the relevant boxes in your form.

Death	491
Ill health - permanently incapacitating	99
Amputation	26
Other injuries caused by contact with electricity	20
Concussion/internal injuries	19
Damage to eyesight	18
Bone fractures	18
Dislocation	16
Natural causes (heart attack)	15
Poisonings and gassings	14
Burns	4
Lacerations and open wounds	2
Contusions/severe bruising; superficial injuries; sprains and strains; ill health (not incapacitating eg dermatitis)	1

At the end of **STEP 3** you should have a form that looks something like the one below.

Risk Assessment for: *Eddy's Tyres & Exhausts Ltd.* **Date:** *18/11/1997* **Assessed by:** *Edward Bucklethwaite* **Page:** *1*

STEP 1			STEP 3		STEP 2		STEP 4	STEP 5
Type of Accident	Score A	Hazards	Nature of Injury	Score B	Likelihood	Score C	No. Affected D	Risk Score (A+B) x C x D
Fall from height over 2 metres	*18*	*Fall from stockroom ladder*	*Fracture*	*18*	*Plausible*	*3*		
Strike by moving vehicle	*7*	*Car rolls off ramp*	*Fracture*	*18*	*Effectively impossible*	*1*		
Injury by contact with moving machinery	*6*	*Trapping fingers in tyre press*	*Amputation*	*26*	*Unlikely*	*2*		
ditto	*6*	*Contact with grinding machine*	*Lacerations and open wounds*	*2*	*Possible*	*4*		
Slip, trip or fall on same level	*5*	*Oil on garage floor*	*Sprain or strain*	*1*	*Probable*	*5*		
Strike by moving object	*5*	*Exhaust pipes stacked against garage wall*	*Severe bruising*	*1*	*Possible*	*4*		

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Step 4: 'Decide How Many are Likely to be Affected'

For each of the hazards that you have identified in **STEP 1** write down the number of people who are likely to be harmed in each case. In many cases there may be only one person who may come to harm.

At the end of **STEP 4** you should have a form that looks something like this:

Risk Assessment for: *Eddy's Tyres & Exhausts Ltd.* **Date:** *18/11/1997* **Assessed by:** *Edward Bucklethwaite* **Page:** *1*

STEP 1			STEP 3		STEP 2		STEP 4	STEP 5
Type of Accident	Score A	Hazards	Nature of Injury	Score B	Likelihood	Score C	No. Affected D	Risk Score (A+B) x C x D
Fall from height over 2 metres	*18*	*Fall from stockroom ladder*	*Fracture*	*18*	*Plausible*	*3*	*1*	
Strike by moving vehicle	*7*	*Car rolls off ramp*	*Fracture*	*18*	*Effectively impossible*	*1*	*1*	
Injury by contact with moving machinery	*6*	*Trapping fingers in tyre press*	*Amputation*	*26*	*Unlikely*	*2*	*1*	
ditto	*6*	*Contact with grinding machine*	*Lacerations and open wounds*	*2*	*Possible*	*4*	*1*	
Slip, trip or fall on same level	*5*	*Oil on garage floor*	*Sprain or strain*	*1*	*Probable*	*5*	*1*	
Strike by moving object	*5*	*Exhaust pipes stacked against garage wall*	*Severe bruising*	*1*	*Possible*	*4*	*1*	

Step 5: 'Evaluate the Risks'

Having completed **STEPS 1** to **4** you will have four columns on your form that have 'scores' in them. These are columns **A**, **B**, **C** and **D**. The next step in the assessment requires a little simple mathematics for which you may need a calculator.

In order to calculate the **RISK RATING** for each of the hazards that you have identified, you will need to:

a) add **A** and **B** together; and

b) multiply this **total** first by **C** and then by **D**.

The formula for this calculation is:

RISK RATING = (A + B) x C x D

Once you have calculated all of the **RISK RATINGS** your form should be complete and look something like this:

Risk Assessment for: *Eddy's Tyres & Exhausts Ltd.* **Date:** *18/11/1997* **Assessed by:** *Edward Bucklethwaite* **Page:** *1*

STEP 1			STEP 3		STEP 2		STEP 4	STEP 5
Type of Accident	Score A	Hazards	Nature of Injury	Score B	Likelihood	Score C	No. Affected D	Risk Score (A+B) x C x D
Fall from height over 2 metres	*18*	*Fall from stockroom ladder*	*Fracture*	*18*	*Plausible*	*3*	*1*	*108*
Strike by moving vehicle	*7*	*Car rolls off ramp*	*Fracture*	*18*	*Effectively impossible*	*1*	*1*	*25*
Injury by contact with moving machinery	*6*	*Trapping fingers in tyre press*	*Amputation*	*26*	*Unlikely*	*2*	*1*	*64*
ditto	*6*	*Contact with grinding machine*	*Lacerations and open wounds*	*2*	*Possible*	*4*	*1*	*32*
Slip, trip or fall on same level	*5*	*Oil on garage floor*	*Sprain or strain*	*1*	*Probable*	*5*	*1*	*30*
Strike by moving object	*5*	*Exhaust pipes stacked against garage wall*	*Severe bruising*	*1*	*Possible*	*4*	*1*	*24*

Step 6: 'Rank, Plan and Review'

By doing this assessment you have identified:

- all of the things that could cause harm in your workplace;
- how likely they are to happen;
- what the resulting injuries/illnesses are likely to be; and
- how many people are likely to be affected in each case.

You have also calculated a 'rating' that indicates the level of **RISK** associated with each of these **HAZARDS**. The bigger the number, the bigger the risk.

Using this information you now need to think about which risks are most important and what you can (or need to) do about each one.

We suggest that you look down the column of numbers in your form and identify which of the hazards have the biggest overall risk rating. These are the hazards that you will probably need to worry about most as they are most likely to:

a) happen;
b) cause severe injuries/illness; and/or
c) affect more than one person.

Armed with this information, the risk ratings allow you to prioritise your response to the workplace health and safety issues that are most important in **your particular situation**.

In terms of what to do to reduce these risks, every situation and hazard is different. For each of the hazards think about how you could reduce either:

- the likelihood; or
- the level of injury/illness.

There may be some things that you can do that will reduce both.

It is important to look at all of the hazards in this way. Some hazards, while perhaps not being of the highest priority in terms of the size of the risk rating, may be very easily and cheaply dealt with.

Other hazards might also be of a lower priority in terms of risk rating but may be very difficult and expensive to deal with. In such cases it is probably better to deal with the more 'important' (and perhaps more cheaply dealt with) hazards first. By doing this you will ensure that all of your health and safety efforts are directed efficiently so that you can achieve maximum health and safety benefits for your business at least cost/effort.

For each of the 'priority hazards' map out what you are going to do by recording:

- what you are worried about;
- why you are worried about it (with the associated risk rating);
- what you intend to do about it;
- when you intend to do it;
- how this will change the level of risk; and
- what the new risk rating will be.

Once you have done something about a hazard, go back to your original risk assessment form and record the changes that your actions have made. **Be sure to mark on the form that you have made changes as this is also evidence to show that you have done something to reduce risks.**

Keep revising your assessment and recording the changes that you have made. By doing this you will have an '**at a glance**' record of what risks are the most important in your workplace at any one time.

Other Suggestions

If you would like to think more about the cost-effectiveness of your actions in terms of money or effort and are confident when handling numbers, you might think about drawing up a 'cost-effectiveness' index.

You could do this by estimating how much the actions you have identified might cost. As you know what the revised size of the 'risk rating' is going to be you could work out how much of a risk reduction you are getting for each £ spent. If you did this for all hazards you would be able to prioritise your response to workplace risks on the basis of where the money would best be invested.

Risk Assessment for: Date: Assessed by: Page:

STEP 1			STEP 3		STEP 2		STEP 4	STEP 5
Type of Accident	Score A	Hazards	Nature of Injury	Score B	Likelihood	Score C	Number Affected D	Risk Score (A+B) x C x D

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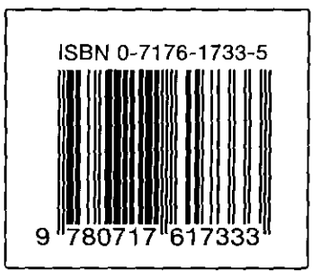

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