



How safe is safe enough?

An introduction to risk management

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1 Introduction

"One of the common denominators I have found is that expectations rise above that which is expected."

George W Bush, US President

- 1.1 As we are sure is the experience of most writers of SIAS papers, we found it very easy to volunteer but extremely difficult to get around to actually writing it.
- 1.2 Initially, we planned to write a paper on e-commerce - a hot topic causing great interest and debate at the time that we booked this session. However, by the time we got round to writing the paper, the market for technology stocks had crashed and job losses were piling up. At the same time, Equitable Life was in the middle of the problems created by its unhedged annuity rate guarantees. This led us to consider that much had changed over the previous year. And so our thoughts turned towards how to avoid the problems which appeared to be plaguing both the e-commerce and financial services industries. And so this paper was born.
- 1.3 This paper aims to provide an introduction to some of the key risk management concepts, issues and processes. This paper is not intended to be an all-singing, all-dancing description of the risk management industry. Rather, we hope that it provides a summary of the themes and practices that we use in risk management. This may enable actuaries to understand how risk management ideas and processes can add value to their organisation and how they can use these concepts in their work.
- 1.4 We have tried to use some practical examples that illustrate the main themes of risk management in an interesting way. However, hindsight is a wonderful thing, and if we had perfect information about the future, risk management would be easy and perhaps unnecessary. In any case, we hope that the examples prove if not useful then at least interesting.
- 1.5 The thoughts, words and deeds in this paper are our responsibility and not those of our employer, the Institute of Actuaries or the Faculty of Actuaries. However we would like to thank our colleagues for their invaluable input and, in particular, our enterprise risk management colleagues for lending us many of the diagrams in this paper. Finally, we would like to thank George W Bush for his words of wisdom.

2 Why is risk interesting?

"When I was coming up, it was a dangerous world, and you knew exactly who they were. It was Us v. Them, and it was clear who 'Them' was. Today, we are not so sure who the 'They' are, but we know they're there."

George W Bush, US President

Why is risk interesting?

- 2.1 In today's dynamic business environment, companies are under significant pressure to deliver high quality products and services quickly and economically. Businesses are facing increasing levels of change, competition and globalisation.
- 2.2 Regulators and stakeholders are interacting with businesses and evaluating them in new ways. Institutional investors, in particular, have become more interested in management accountability and are now often more active participants in shareholder voting and meetings. Regulators have also become focussed on corporate governance.
- 2.3 Corporate governance standards are becoming more stringent around the world. Firms listed on the London Stock Exchange are required to report to shareholders on their risk management practices and processes. Corporate governance regulations or codes of conduct in France, Germany, Italy, Netherlands, North America and Japan all now incorporate some form of risk assessment and risk management reporting.
- 2.4 Finally, organisations are being challenged to meet ever increasing financial expectations. During the 1990's many responded by aggressively pursuing growth along with expense reduction and rationalisation. Most organisations have attempted to become lean and (theoretically) efficient.
- 2.5 All of these changes suggest the need for an integrated and flexible risk management system that focusses on the whole organisation. This system must enable ongoing evaluation of risks, risk-based decision-making and accountability for critical risks which may affect the organisation's ability to deliver its business strategy.
- 2.6 With the benefit of hindsight, it is easy to think that risks and their potential consequences could have been predicted and managed. However, business success usually requires some acceptance of risk and, by their very nature, risky strategies can go wrong.
- 2.7 Without hindsight, it is not always possible to predict the risks which are worth taking but a company with a strong analytical understanding of the risks it is facing is more likely to adopt a successful strategy that one working on "gut-feel". A good analogy here is the actuarial role within general insurance. It has taken time to become established, but it is now more generally accepted that the quantitative discipline

provided by actuaries is a good complement to the anecdotal experience of the underwriter.

Definition of risk

2.8 The following is a definition of risk which we have found most useful in our work:

"Risk is the threat that an event or action will adversely affect an organisation's ability to maximise stakeholder value and achieve its business objectives and business strategies. Risk arises as much from missed opportunities as it does from possible threats."

Corporate risk management objectives

2.9 The definition given above works well for corporations because it contains the key elements which are of interest to management. In today's environment, it is important for all companies to have a clearly defined and communicated strategy and to be seen to be achieving the business objectives contained within such a strategy.

2.10 **The ultimate aim of risk management for a proprietary company is usually to protect and enhance shareholder value.** For a mutual life insurer, the prime objective may be to meet the policyholders' reasonable expectations. In either case, the company must have clear business objectives and strategies before a risk management program can be put in place. Also, it is necessary to manage risks to objectives at all levels within the organisation.

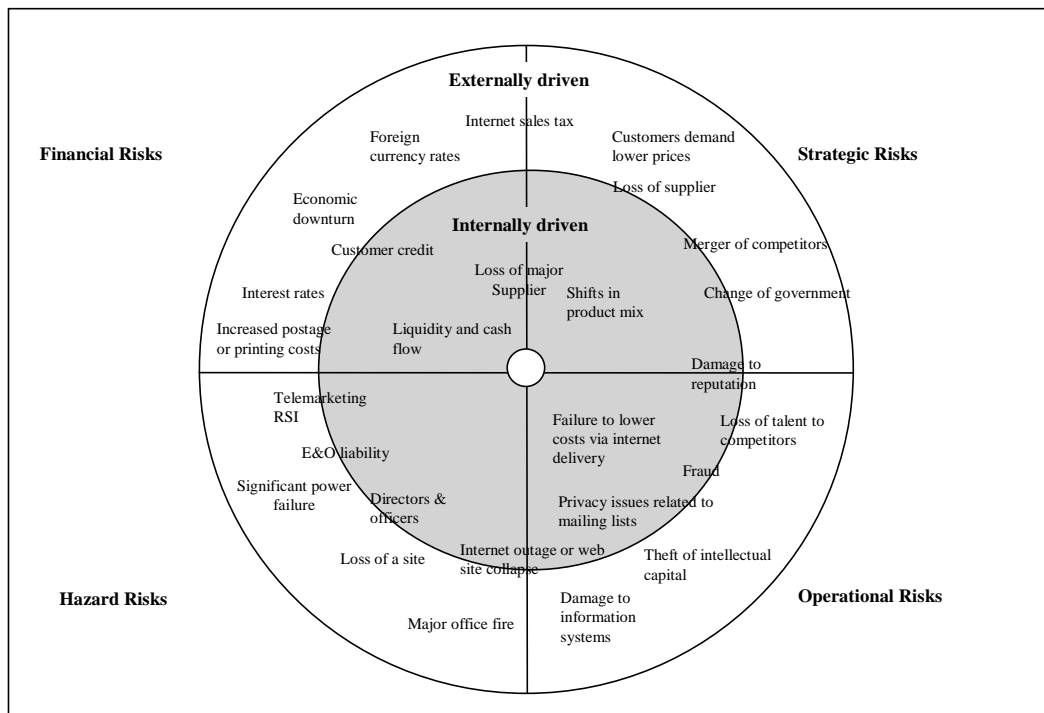
3 Types of risk

"I am not part of the problem. I am a Republican."

George W Bush, US President

Types of risk

- 3.1 Whilst a single definition of risk is useful from a theoretical point of view, in practice it is necessary to drill-down further to generate useful risk management ideas. On this practical level, risk is often broken down between a number of different types of risk. Different risk managers are likely to choose different risk groupings, depending upon the relative importance of each of the factors to the business they are working in, together with their subjective views and the cultural issues affecting the corporate view of risk.
- 3.2 In this paper we have chosen to consider risk in four **categories**:
- **Operational risk** - e.g. loss of key staff, IT system failure, image problems, health and safety issues.
 - **Financial risk** - e.g. market risk, credit risk, liquidity risk.
 - **Hazard risk** - e.g. environmental pollution, product liability issues, natural disasters, stress claims, property risk.
 - **Strategic risk** - e.g. reduced insurance company profitability due to the implementation of stakeholder pensions, mergers and acquisitions, changes in demand, political changes.
- 3.3 Some risks are difficult to allocate to just one of these four categories because they involve two or more elements. For example, merger and acquisition risks could include both strategic and operational risks. The diagram on the following page illustrates how different risks can be allocated between these four simple categories, allowing for some overlap.



Operational risk

"The risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events" - British Bankers' Association

3.4 Operational risk is one of the first risks that organisations must manage, even before they make their first transaction. More recently, there is a growing consensus that operational risk management is a discipline in its own right with its own management structure, tools and processes.

3.5 Some examples of operational risk are:

- **Process risk** - Are the processes operating efficiently? What are the weak points and what are the potential consequences of failure?
- **IT risk** - Is there a risk of total system failure? Are new system upgrades adequately tested? Are the optimal software and hardware in use?
- **Control system risk** - Are there sufficient controls to spot errors and illegal acts early enough to minimise any adverse effect on the business?
- **Human capital risk** - Is the human capital resource adequately managed to maximise intellectual capital and minimise staff turnover?
- **Health and safety risk** - Is legislation constantly monitored and guidelines updated accordingly?

- **Compliance risk** - Are adequate regulatory compliance policies in place and are they adhered to? Are compliance standards continually reviewed? Do conduct standards include an ethical element?
- 3.6 Over the last few years, a number of high profile IT failures have highlighted the potential cost of operational risks. In March 2001, British Airways was hit by a computer glitch, caused during routine maintenance, which crashed the reservations system. As a result of this failure, manual systems had to be used causing hundreds of flights to be delayed and a number to be cancelled. In April 2000, a failure in the IT system at the London Stock Exchange left investors unable to trade for eight hours on the last day of the tax year and in 1998 problems with IT systems at the Passport Agency are estimated to have cost £12.6 million.
- 3.7 We could compare these stories of IT disaster with an almost miraculous story of a successful disaster recovery operation. On August 11 1999, United Airlines suffered a fire in its headquarters which left their mainframe systems unmanned due to evacuation of the building. United had just set up a complete mirror site as part of its disaster recovery plan and this plan was implemented without a hitch. As a result, United cancelled only one flight and had five delays out of 2,500 flights that day. Whilst the disaster recovery site had cost \$3 million to set up, this one event could have incurred a loss of as much as \$600 million.
- 3.8 For readers who are interested in finding out more about operational risk within the banking industry, we recommend a discussion document published by the British Bankers' Association. This provides a comprehensive overview of current and emerging banking industry practice for the management of operational risk based on a survey and interviews with fifty five global financial institutions in North America, Europe and Asia.

Financial risk

- 3.9 Some examples of financial risk are:
- **Economic risk** - Economic trends, changing interest rates, exchange rates, input prices, output prices and labour costs.
 - **Market risk** - Stock market volatility, stock market crashes.
 - **Credit risk** - Risk that a counterparty will not repay the amount owed in part or in full.
 - **Related operational risks** - Control systems.
- 3.10 Banks have been at the forefront of understanding financial risks over the last two decades. Despite this, they have experienced some of the most traumatic losses. The near collapse of Long-Term Capital Management (LTCM) is one such case. LTCM was run by a group of high profile traders and economists whose strategy involved making arbitrage trades based on small inconsistencies in the pricing of assets, and taking highly leveraged positions to generate high returns. By early 1998, LTCM's swaps amounted to about 5% of the total global market (\$1.25 trillion notional value) but its underlying net asset value was only \$4 billion. Market changes following

Russia's devaluation of the rouble in 1998 increased LTCM's market exposure to the point that the available capital was no longer sufficient to cover its open positions. As many of LTCM's creditors were banks, LTCM's potential losses threatened a meltdown of the banking system and caused the US Federal Reserve Bank to intervene with a rescue plan. Many of the banks took huge charges in their 1998 accounts to cover the potential losses.

- 3.11 **LTCM's strategy was not necessarily flawed;** if they could have continued to operate, they may have produced profits from their trades. They simply did not have enough capital to support their open positions. A better understanding of the capital requirements could have prevented LTCM from reaching such a dominant position in the market.
- 3.12 The demise of Barings is one of the most famous failures and provides another very useful case study in risk management. Whilst it was movements in the financial markets which ultimately caused the losses on Nick Leeson's derivative trading accounts, it is generally accepted that it was flaws in the related operational risk management practices allowed the situation to build up. Nick Leeson had enough control over the operational processes to avoid the checks and balances which would normally be in place to prevent inappropriate trading. At the same time, the bank's high level control systems did not detect that the portfolio was not matched even though it was generating unusually high profits.
- 3.13 Banking risk management has also lead to the development of some practices which manage individual institution's risks, but may have increased the level of risk within the market as a whole. In March 2001, the Bank of England warned that global financial stability could be threatened by the rapid growth of credit derivatives. Banks use these derivatives to control the credit risk on their loan portfolios. However, **the spreading of credit risk around the banking system also means that it is no longer easy for lenders, shareholders and regulators to assess the exposure of an individual bank to credit risk.** The use of credit derivatives has more than tripled since 1997 to about \$600 billion and this has lead to concerns that risk understanding and management may not have kept pace with the growth of this new market. David Clementi, deputy governor of the Bank of England, said "It is important for institutions to ensure that infrastructure, documentation and risk management keep pace with the traders."

Hazard risk

- 3.14 Hazard risks are familiar to the many actuaries who work in non-life insurance either for insurance companies, Lloyd's or consultancies. They include many of the external risks which have traditionally been insured.
- 3.15 Some examples of hazard risk are:
- **Property risk** - Theft, vandalism, fire, security.
 - **Liability risk** - Threat of lawsuits.
 - **Environmental risk** - Liability for pollution.
 - **Natural disasters** - Storms, floods, earthquakes.

- **Political risks** - War, terrorism.
- 3.16 As many of these risks have traditionally been insured, it is not surprising that one of the most interesting case studies related to hazard risk is based on the problem within the Lloyd's market in recent years caused by asbestosis claims. The unique "Names" structure within Lloyd's had developed over its 300 year history. Each individual Name provided capital to its syndicate in order for that syndicate's managing agent to take on risks and, hopefully, make a profit. The syndicate's capital security was provided by a call on each Name's entire personal wealth.
- 3.17 During the 1970's and 1980's, Lloyd's was extremely profitable and the number of non-professional Names grew rapidly. Many Names did not understand that losses could be made at Lloyd's. During the 1980's significant **asbestosis claims** began to emerge in the U.S. and major losses were incurred. It was only at this point that Names began to appreciate the extent of the risk to their personal wealth.
- 3.18 As a result of this crisis, the structure of Lloyd's has been amended and there is an increasing awareness of the risks borne. Not all Names understood that in a world where there is no such thing as a free lunch, high returns can generally only be earned by taking high risks. If a deal looks too good to be true, then it probably is.

Strategic risk

- 3.19 Historically, the management of strategic risk has tended to be the domain of management consultants and other business strategy analysts.
- 3.20 Some examples of strategic risk are:
- **Mergers and acquisition risk** - Which company should be targeted? Is due diligence carried out appropriately? What is the "right" price?
 - **Business risk** - What effect could adverse publicity have on the business?
 - **Competitor risk** - What are competitors likely actions? What effect will they have on supply and prices?
 - **Customer risk** - What are the likely demographic and demand changes?
 - **Brand risk** - Are brands adequate, suitable and known?
 - **Supplier risk** - What are suppliers' possible actions? How might they affect the company's value?
 - **Legal risk** - What are the effects of changes to legislation currently being considered?
 - **Political risk** - What effect will a change of government have?
 - **Image risk** - What are the potential effects of whistleblowers and pressure groups?
 - **New opportunity risk** - Which opportunities should be exploited, which put on hold, and which ignored?

- **Product risk** - Which product mix optimises the risk-reward trade-off?
- **Opportunity cost** - Are there unexploited opportunities within the organisation?

3.21 A recent article in the Financial Times showed how, even given the best strategic analysis in the world, exposure to strategic risk can have catastrophic results.

"How the mightiest fall for the silliest ideas.

After the failure of London's Millennium Dome, its supporters resorted to two defences. First, they pointed to expert advice that said the Dome would attract the 12m visitors it needed to make a profit. Second, they said negative press comment had kept millions of people away. In doing so, they demonstrated the characteristic behaviour of those who make disastrous business decisions: a selective interpretation of the evidence in deciding to go ahead with a project and an insistence after it fails that it was someone else's fault.Why do companies make bad decisions? One reason is that people in control are determined to make their mark by doing something dramatic.In a paper subtitled 'How can experts know so much and predict so badly?' they cite a study of clinical psychologists that showed experienced practitioners were no better at judging personality disorders than advanced graduate students, although they were more accurate than untrained students and secretaries.'Training has some effects on accuracy but experience has almost none'.....Senior executives make too few decisions to learn much from them. It can be years before they discover whether their projects have failed and it is often not entirely clear why they have done so."

Probabilistic and systematic risk

- 3.22 We could also consider two different types of risk with which actuaries are generally familiar, probabilistic risk and systematic risk.
- 3.23 Probabilistic risk is that element of risk which can be eliminated (averaged-out) by diversification.
- 3.24 Systematic risk is risk which cannot be averaged-out because it affects all projects e.g. index tracker funds eliminate the (probabilistic) risk of underperforming the market but their return is still uncertain because it is dependent upon overall market returns.
- 3.25 Different types of opportunity can be subject to different levels of systematic risk e.g. the success of construction projects has a high level of correlation with the economic cycle but "bread and water" projects are more independent of the economic cycle.
- 3.26 In general, probabilistic risk can be allowed for by attaching probabilities to the various outcomes and systematic risk can be allowed for by varying the discount rate. An analysis of discount rates is beyond the scope of this paper, but the choice of discount rate should reflect the nature of the risk and any market price that may be observable for similar risks.

4 Risk perception

"I believe we are on an irreversible trend toward more freedom and democracy - but that could change."

George W Bush, US President

Public perception of risk

- 4.1 Risk perception in everyday life has changed greatly over the last few decades. Round the clock news channels and increased media interest in risk have increased the amount of public debate on risk and how it can be managed. But has risk actually increased?
- 4.2 Individuals are exposed to many different forms of personal risk e.g. risk of injury, financial loss etc. We have chosen one specific risk for consideration in this section, the risk of death.
- 4.3 Given that we now live longer and generally have better health than we did twenty years ago, one could argue that the risk of death has not increased. We are however more aware of the risks that exist. The media interest in the growing incidence of cancer is one example of how it is possible to misrepresent risk. We have become generally more aware of the growing number of cancer cases and so many people perceive there to be a higher personal risk of cancer. However, since cancer is generally an older person's disease, the increased number of cancer cases could merely be an indication of an ageing population. Higher incidence of cancer could also be associated with reduced incidence of death from illnesses which strike at much younger ages.
- 4.4 The media coverage of research findings can be misleading and is often sensationalised. Usually there is little discussion of the statistical basis of the research or of the underlying assumptions or modelling weaknesses. Once published, information can gain more credibility than the underlying scientific analysis deserves. Actuaries are skilled at separating the accurate from the spurious in areas such as analysis and reporting of results.

Personal perception of risk

- 4.5 It is important for risk management professionals to understand the difference between perceived risk and actual risk. Whilst it is not possible to give a completely accurate quantitative assessment for every risk, we can produce a reasonable estimate for many. Analysis of data relating to a particular risk can lead to surprising results when compared against "gut-feeling". As an example, we investigated the fear of flying.
- 4.6 One of the authors (try and guess who!) regularly travels to clients by plane, despite an intermittent fear of flying, and in particular a fear of turbulence. Taking off and

landing are fine, even though 70% of all aircraft incidents occur during these parts of the flight. Indeed, only 24 people have died in turbulence related incidents since 1980. Whilst statistical analysis shows that flying is the safest option for certain types of journey, this individual's personal appetite for this particular risk is so low that other forms of transport are always preferable. This is despite the fact that the odds of dying on the flight to Turkey, a journey which the (female!) author is about to take this week, are apparently 1 in 10,763,895 flying with British Airways in a Boeing 757. These odds are much lower than those for a comparable journey by car, especially if it is being driven by one of the other authors (try and guess who!).

- 4.7 This example illustrates one well proven risk perception phenomenon. In general, people have a fear of disasters, even though disasters are a smaller cause of mortality than more routine risks. Every day people need to identify, prioritise and manage the risks they face in life, but they often seem to get it wrong. They ignore serious risks like driving and heart disease and obsess about trivial risks such as flesh-eating bacteria - the set of risks that kills people and the set of risks that scares them are not the same.
- 4.8 Some interesting studies have been carried out which provide some insights into the factors affecting perceptions of risk. A study carried out by researchers in the US indicated that females are consistently more risk averse than their male counterparts, and that a number of other factors such as race and educational status can also affect risk perception. Risk managers need to be aware of these biases when attempting to quantify risks based on opinions. However, it is important not to over-generalise and each individual's contribution must be treated with equal respect.

Subjectivity of risk assessments

- 4.9 A further problem with risk assessment is that it is often subjective. There is no such thing as a true risk assessment; the nuclear engineer's probabilistic risk estimate for a nuclear accident is based on a theoretical model whose structure is subjective and whose inputs are dependent upon judgement. Subjectivity permeates risk assessments from the initial structuring of the risk problem to deciding which results or consequences to include in the analysis, identifying and estimating exposures, choosing relationships and so on.
- 4.10 For example, in a risk assessment environment, there are a number of ways of expressing the actuarially familiar mortality risk depending on the industry being examined or the question being asked. Between 1950 and 1970, coal mines became much less risky in terms of accidents per tonne of coal, but became marginally more risky in terms of deaths per employee. Deciding which measure is most important for decision making is entirely subjective. Coal mine managers are more likely to be concerned with the former and coal miners with the latter.
- 4.11 Each way of summarising deaths embodies its own set of values:
- "Reduction in life expectancy" values young lives more highly than older lives.
 - "Number of deaths" values all lives equally and also treats all reasons for death equally.

- "Number of deaths weighted by some risk factor or by type of death" involves a value judgement regarding the weights attaching to different categories of death.
- 4.12 Once a risk analysis has been carried out, a further element of subjectivity is incorporated through the presentation of results. Numerous research studies have demonstrated that different (but logically equivalent) ways of presenting the same risk information can result in different evaluations and decisions. For example, research has shown that strikingly different reactions can be generated by information framed in terms of probability of surviving rather than the risk of dying.
- 4.13 Other problems caused by subjectivity in the perception of risk are:
- **Probabilistic information processing** - People tend not to generate accurate probability statements about the frequency or severity of events. This could be due to poor memory of past events and to an inability to convert information into a probabilistic framework. All too often, intuitive analyses of events leads to systematic bias in probabilistic estimates.
 - **The law of small numbers** - There is a tendency to overgeneralise on the basis of small sample sizes and often to fail to discriminate between long and short recording periods when evaluating evidence.
 - **Perception of randomness** - People have a very poor perception of randomness. For example, in coin tossing games, there is a marked tendency to expect that a tail is more likely to occur after a head, or a series of heads, have occurred.
 - **Judgements of correlation** - Prior expectations of probabilistic relationships can lead individuals to perceive correlations where they do not really exist.
 - **Judgement of probability** - In complex situations, people have a tendency to estimate probabilities by reducing difficult problems to a series of simpler judgements. Some events are more memorable than others and these tend to be attributed a higher probability than more frequent events which are less memorable. Equally, when estimating the potential loss due to a particular hazard, judgements tend to be heavily influenced by the most recent comparable event. In actuarial terms, people tend to be poor at estimating the exposure to risk.
 - **Information processing biases** - There is some evidence to indicate that problems with the integration of information may cause people to make judgements that are inconsistent with their underlying values. For example, if a person is asked to rank a series of risks by preference, and then to state a preference between each pair of risks, the answers are not always consistent.
 - **Hindsight bias** - Looking back on events, we tend to believe that we had a better idea of what was going on than we actually did. This can prejudice the evaluation of decisions made in the past and limits what is learned from experience.

Subjectivity and risk management

- 4.14 The stakeholders in an organisation are collections of individuals: shareholders, executives, employees, customers and regulators. The organisation's utility function or set of preferences for risks is a combination of the stakeholders' utility functions, each of which is affected by the individual's perception of risk. So, individual risk perception is clearly important to risk managers.
- 4.15 Clearly, risk has a large qualitative as well as a quantitative element. Analysing organisations' risk appetites is as much an art as a science. Traditionally, risk managers have not believed that actuaries could add significant value to the process of understanding risk. However, the actuarial discipline can prove valuable in putting together a framework which enables a rigorous analysis of risk to be carried out in a way which fully documents the assumptions and potential weaknesses in the underlying model.

5 Traditional risk management

"I hope the ambitious realise that they are more likely to succeed with success as opposed to failure."

George W Bush, US President

- 5.1 Risk is an essential element of any strategy; take on too little or too much and returns may be affected. Business writing is filled with terms such as "risk-reward trade-off", "cost-benefit analysis" and "calculated risk".
- 5.2 The ultimate aim of risk management policies for a proprietary company is usually to protect and enhance shareholder value. For a mutual life insurer, the prime concern may be to meet the policyholders' reasonable expectations. In either case, the company must have clear business objectives and strategies before a risk management program can be put in place. Also it is necessary to manage risks to objectives at all levels within the organisation.
- 5.3 An important goal of risk management is to improve the quality of decision making within the organisation by putting in place a structure which identifies the organisation's exposure to all forms of risk, and analyses the potential effect of these risks on the organisation's performance.
- 5.4 Entire industries have evolved to help companies manage risk:
 - **Hazard risk** - Insurers created insurance coverages to enable companies and individuals to pool this type of risk, dramatically smoothing the financial impact on individuals and enterprises.
 - **Financial risk** - Financial services firms have developed techniques and financial instruments to help companies to dampen or hedge against the impact of financial risks such as fluctuations in exchange rates.
 - **Operational risk** - Consulting firms have devised ways to minimise risks from information, systems and processes.
 - **Strategic risk** - Management consultants have filled this space with their ever-changing views of the optimal business structure - first downsizing, then right-sizing.

Traditional risk management processes

- 5.5 It is important to consider a wide range of issues before setting up a risk management framework because it is impossible to predict exactly what will happen in the future. These issues include:

- What risks does the organisation face?
- How sensitive are the organisation's strategies, market position, financial results and other sources of value to these risks?
- Which of these risks may prevent the organisation from achieving its objectives?
- How capable is the organisation of responding to changing situations?
- What are the organisation's risk preferences?
- What is the organisation's required risk-reward trade-off?
- Does the organisation have enough capital to absorb any significant losses?

5.6 Traditional risk management tended to be carried out at the operational or financial unit level. In general, the traditional risk management process would incorporate the following stages:

- **Assess risk** - Carefully identify the risks faced by the unit and develop a clear understanding of the nature of these risks. Identify the key risks to the unit's performance.
- **Evaluate impact** - Model the risks and their effects on the unit. This should also include an assessment of the risk that the model chosen is not an accurate reflection of the risk going forward.
- **Implement risk management programs** - Develop risk mitigation programs, risk avoidance programs and risk financing solutions.
- **Set reward strategies** - Develop compensation packages which contain an element relating to risk management activities. These should be structured to ensure that managers' incentives are consistent with the risk management strategy.
- **Implement organisational structure** - For a risk management program to be successful, each individual's role and responsibilities should be clearly defined. The lines of management and the organisational structure should be clearly set out and communicated.
- **Identify risk monitoring measures** - Identify a key set of measures for each risk so that risk exposures can be monitored regularly.
- **Implement control systems** - Implement a suitable control environment to ensure that risks are adequately reported and managed. This should include well defined management structures and systems which provide sufficient checks and balances on individual's actions and business processes.
- **Training personnel** - Implement a training regime that assists members of staff in carrying out their roles.

- **Back-testing** - The risk models should be back-tested regularly against actual data to ensure that the model continues to be valid. Parameters should be reset where necessary.
- **Monitor financial and process performance** - The systems should provide risk information in a timely and consistent manner. The results should be analysed regularly and the risk management process reset if necessary.

5.7 This process of monitoring and feedback is very familiar to most actuaries and is analogous to the actuarial control cycle.

Some examples

5.8 The response to a number of recent issues provides a useful set of case studies. Could the effects of these "crises" have been mitigated if a pro-active, risk-focussed strategy to management had been in place prior to the event?

5.9 After the Hatfield train crash, speed limits were placed on many sections of the rail network and a vast program of emergency rail upgrades was put in place. This caused widespread chaos on the rail network and forced many people to drive instead. Statistically, driving is not as safe, but deaths on the roads generally occur in isolated incidents and have less media coverage. People are generally more concerned with high severity, low frequency events such as train and plane crashes than they are with low severity, higher frequency risks such as car accidents. The emergency strategy adopted was probably not the most efficient solution. A well-managed risk management strategy could have highlighted this problem earlier, so that a more structured rail replacement program could have been implemented.

5.10 The Y2K problem illustrates a very different approach to risk management. The issue was identified early, the potential risks were assessed and communicated and corrective action was taken in time to prevent any business disruption. Or was this an over hyped non-issue which cost many companies a huge amount of money? Y2K can only be considered to have been a successful risk management exercise if the perceived value of the risk which was prevented is less than the cost of the "cure".

5.11 Risk management costs money and, if done well, will reduce losses. It is therefore important to identify the likely cost savings from risks which have been successfully managed. These should be broadcast loudly to ensure that the organisation does not become complacent and scale back a successful risk management program.

Monitoring changes in behaviour

5.12 As well as measuring the success of a risk management program, it is also important to monitor any behavioural changes it may cause. The potential of risk mitigation to affect decision-making is well known to actuaries, for example, the moral hazard in insurance. Actuaries can provide a wealth of experience in monitoring and managing such effects.

6 Risk analysis methods

"It isn't pollution that's harming the environment. It's the impurities in our air and water that are doing it."

George W Bush, US President

6.1 Risk analysis is a broad term which includes risk assessment, risk ranking, understanding risk characteristics, comparative risk assessment, setting risk-based priorities, risk-reward analysis and cost-benefit analysis

Risk characteristics

6.2 Several characteristics could be of interest when assessing a risk. These include the mean, volatility, probability distribution, correlations between the risks, utility functions for various types of risk and any qualitative characteristics.

6.3 For some types of risk, there may be a credible amount of relevant historic data on which to base estimates for these characteristics. For example, a huge amount of work has been carried out on the analysis of historic stock market data for use in stochastic projections.

6.4 For other risks there may be little data on which to build probabilistic statements. In these cases, the ability to make judgements based on past experience of the business or of similar risk scenarios is invaluable. Ideally, the risk assessment team should include experts in the business, risk management professionals and others who can facilitate the risk assessment and model building process. Actuaries are particularly well suited to fill the latter roles.

Statistical analysis

6.5 It is impossible to carry out any significant risk analysis exercise without a statistical framework. Statistical analysis enables the risk manager to take a body of historical data and to produce a model which can be used to predict and analyse possible future outcomes.

6.6 Specific probability distributions are generally used for different types of analysis e.g. normal distributions for market risk, beta distribution for credit risk. Each distribution should be carefully compared against historic data to ensure that it provides the best fit to the distribution of historical outcomes. Once a suitable distribution has been chosen for a risk, it can be used to generate simulated future results for that particular risk. The model should allow for correlations between the elements of risk.

6.7 Often, the risk in one period can be expressed as a function of a variable in the previous time period if observations over time are not independent. In this case, more complex models must be used to reflect this dependency.

Extreme value theory

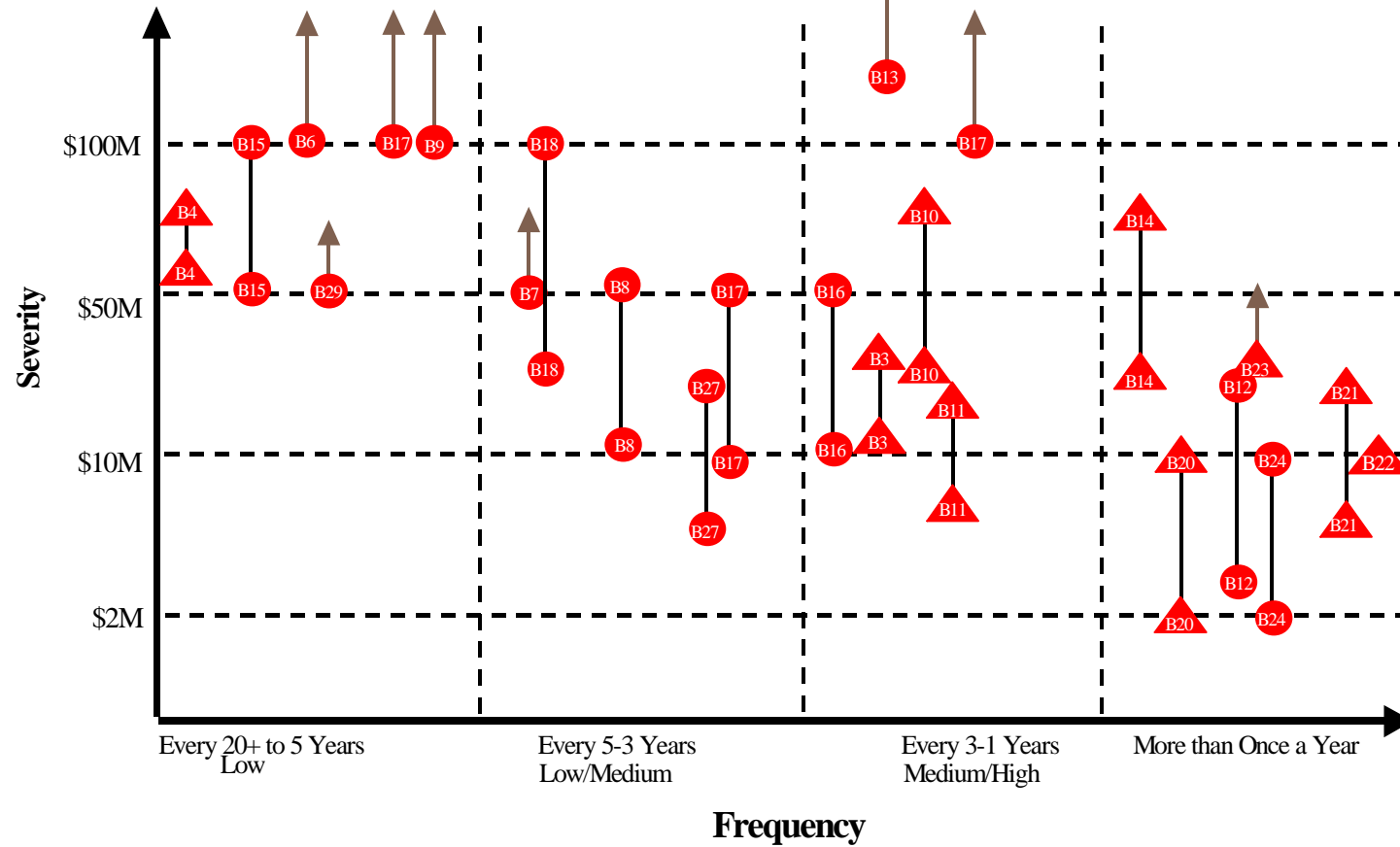
- 6.8 Extreme value theory is a subset of statistical theory which relates to the tails of probability distributions. The extreme and generally rare events in the tails of the distributions are the events which can create the catastrophic results which the risk manager is trying to avoid. However, there is usually little data regarding catastrophic events, so traditional statistical approaches tend to be inefficient at predicting them. In addition, distributions are usually fitted to data using the whole data set. A distribution which is a good fit for the whole data set will not necessarily be a good fit for the tails of the distribution, particularly if the tails are "fat" or "thin".
- 6.9 Extreme value theory concentrates on the data relating to the tails of the distribution and does not try to fit the distribution to the rest of the data. Practitioners working within this field have developed special graphs and techniques such as Q-Q plots and the Hill graph, which help data analysis and distribution fitting for the tails of distributions.
- 6.10 Extreme value theory methods can be applied to supplement other methods of risk assessment. For example, Value at Risk (see section 7) measures often assume a normal distribution of risk. A Value at Risk measure built around extreme value theory could arguably provide better estimates of catastrophic risk than measures based on the tails of common probability distributions.

Risk maps

- 6.11 Where there are significant qualitative elements to a risk we need tools to put a sound and easily communicated framework around practitioners' risk perceptions. The following two examples of risk maps illustrate the kind of output produced by the risk management process.
- 6.12 Each of these sample risk maps is a pictorial representation of the practitioners' risk perception of the severity and frequency of a number of risks. Each has a slightly different scale. The first graph measures severity in monetary amounts and frequency in terms of how many years would elapse on average between events. The second map uses different measures; both severity and frequency are measured on a scale of 1 to 5. In each case, individual risks are shown using codes (for example, T in the second map could be the risk of losing a site due to fire) and the range of possible outcomes is shown by using a line from the lowest possible outcome to the highest.
- 6.13 Risk maps are particularly useful for ranking risks i.e. deciding which risks are more important to the business, ascertaining qualitative risk characteristics, assessing which risks are perceived to be comparatively important and setting risk based priorities.

Major Hazard / Operational / Financial Risks

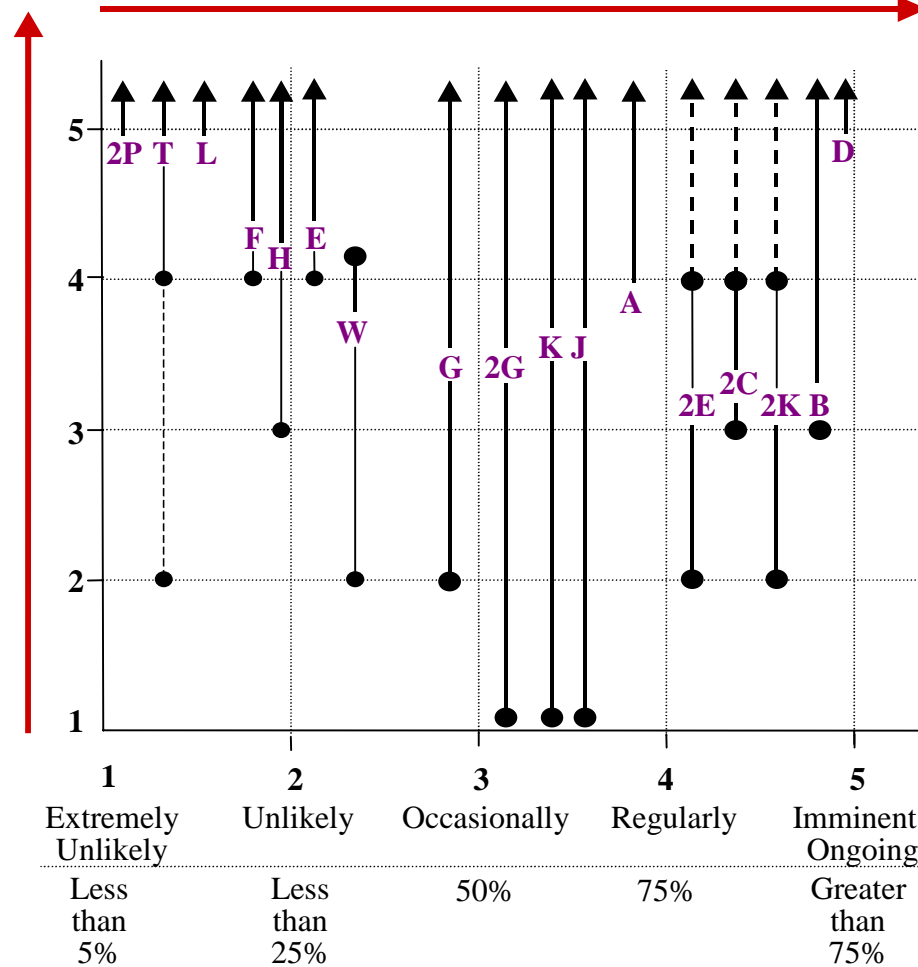
- = Single Event
- ▲ = Aggregate
- Uninsured/ Unhedged
- Insured/ Hedged
- Can't buy / Choose not to buy*
- Excluded Completely*
- Within Deductible*
- Subject to sublimits, exclusions, limits, coinsurance, deductibles, or retentions*



More severe

More likely to occur

Severity Scale
 5 - Catastrophic - £100 million
 4 - between £25 - £100 million
 3 - Significant - £25 million
 2 - between £2 - £25 million
 1 - Material - £2 million



Chance this will occur in next 3 years:

Probability Scale
 5 - Imminent / Ongoing (>75%)
 4 - Will Occur Regularly (75%)
 3 - Will Occur Occasionally (50%)
 2 - Unlikely (<25%)
 1 - Extremely Unlikely (<5%)

- 6.14 Risk maps are generated from interviews and questionnaires with key individuals within the organisation. The analysis of the data should be carefully calibrated and the underlying potential flaws of risk perception set out in section 4 should be allowed for when setting up this analysis. Questions should check the internal consistency of respondents' risk perceptions. For example, respondents could be asked to rank a number of risks and then to rank them on a pair by pair basis. The questions should also be easy for the respondent to answer. For example, questions where risks are ranked in order of frequency on a scale of 1 to 10 may be more useful in some organisations than questions which ask for an estimate of frequency.
- 6.15 The type of risk map used will be a function of the information available for mapping, the pictures emerging from the mapping exercise, and the personal preference of the users.
- 6.16 Risk maps can be presented to the organisation's practitioners to ensure that the results of the analysis are intuitively acceptable.

Utility functions

- 6.17 The risk assessment process must generate some information about the organisation's set of preferences for various outcomes before the risk manager can fully understand the risk dynamics. This can be considered as the "utility function".
- 6.18 The utility function is a mathematical method of expressing preferences for a variety of risky outcomes. Most people and organisations are naturally risk averse and need to be suitably compensated for risk by the expectation of higher rewards. Risk averse individuals or organisations tend to attach a higher utility to courses of action with less risk. To put it another way, they will require a higher level of compensation for taking on a particular level of risk compared to the more risk tolerant.
- 6.19 The utility function is best expressed as the additional reward that the individual requires for a particular level of risk in order to be indifferent between this course of action and a risk free scenario. If a particular project offers more than this reward, then it would look attractive.

Game theory

- 6.20 Game theory aims to provide a framework to systematically analyse complex decisions. Whilst this does not change the odds that a specific investment will be successful, it can help organisations to approach all investments and business decisions in a way which improves the chance of success. Instead of treating decisions as isolated from other's decisions, game theory treats every decision as the result of a series of negotiations in which the participants try to reduce uncertainty by trading off what others want in return for what they want themselves.
- 6.21 A typical example of a theoretical problem where game theory could be of use is called the "Prisoner's Dilemma". In this problem, you and a friend have been accused of committing a minor crime. You are each independently offered the chance to go free if you testify that the other person committed a more serious crime. Game theorists generally look into the effects of strategies by taking into account each competitor's likely responses. Most game theorists argue that the best strategy in this

situation is to keep quiet and risk conviction of the minor crime as testifying against a friend creates a system where everyone might betray everyone else. This theoretical result fits in with the actual behaviour of large criminal gangs such as the Mafia where the code of silence is known as the omerta. In game theory simulations, using a variety of strategies to make this decision, co-operative strategies win out more often than not.

- 6.22 In general, game theory suggests that choosing the option that is expected to provide the highest reward is often the riskiest strategy as it tends to generate the strongest defence strategies from others. So we tend to opt for the compromise solution which may lead to us making the best of a bad bargain.
- 6.23 It can be argued that traditional economics works best in a market with thousands of decision-makers and no-one controlling information. Game theory, on the other hand, works best in small markets where information is distributed less evenly amongst the participants, but where the participants gain some information from analysing other's decisions.

Traditional decision tools

- 6.24 Traditionally decisions have been made on the basis of static, non-risk related measures such as:
- **Payback period** - The decision is made to accept a project if the number of years' cash flow required to pay back the initial investment is less than a pre-set maximum. This calculation ignores the time value of money.
 - **Internal rate of return** - The decision is made to accept a project if the internal rate of return is greater than the cost of capital. When deciding amongst a set of proposals, this approach can lead to sub-optimal decision making because it ignores the total value available. For example, one project may have a slightly lower internal rate of return compared to a second project. However, if the first project is much larger than the second project, it may be better to choose the first project even though it has a lower internal rate of return.
 - **Net present value** - The decision is made to accept a project if the net present value of future cashflows is greater than zero using a particular discount rate.
- 6.25 These approaches can be adjusted to allow for the riskiness of the cashflows by risk-adjusting the discount rate. However, they do not provide any information regarding the possible spread of outcomes from a decision. Also, they do not allow for the value of contingent options within a group of proposals. For example, two proposals may both have a negative net present value in isolation but the combined proposal may have a positive net present value due to synergies within the projects which can only be achieved if both projects are successful.
- 6.26 These tools can be used to identify the consequences of possible choices together with their probabilities and thereby to derive a weighted value. In this calculation it can be difficult to choose a single discount rate which is appropriate for all elements of the risk. It is also difficult to understand the implications of all of the choices embedded

within the cashflows. Many papers have been written in this area but a discussion of these subjects is beyond the scope of this paper.

Other models

- 6.27 Some of these criticisms of traditional assessment tools are answered by some of the more modern mathematical models such as the Capital Asset Pricing Model (CAPM).
- 6.28 Actuaries are generally familiar with CAPM from their training. It is generally accepted to be intuitively reasonable, although academics and practitioners question some of the underlying assumptions.
- 6.29 So far it is mainly used in portfolio management, but its underlying structure is suitable for the evaluation of a variety of non-diversifiable risks provided there is sufficient historic information on which to measure the relative riskiness of the alternatives. To use the model it is necessary to decide upon a suitable market portfolio against which to make comparisons and to calculate the relative riskiness based on historical data.
- 6.30 The CAPM incorporates the set of risk preferences along with the expected rate of return in order to generate optimal decision-making. The expected rate of return is said to be a combination of the risk-free rate of return and a risk-related component which varies in direct proportion to the volatility of the asset's return relative to the return on the "market portfolio".
- 6.31 Other models from modern financial theory can also, theoretically, be extended from their traditional base into other risk environments. In general, the more complex the risk environment, the more difficult it is to build up a simple model for the risk. For these more complex risks, actuarial skills at model building combined with stochastic simulation techniques can prove useful in improving the organisation's understanding of the potential impact of risks.

Summary

- 6.32 These risk assessment tools are generally complementary. Each risk assessment exercise is likely to require one or more of these tools, depending on the nature of the risk under consideration and the data available for the risk analysis.

7 Basel Capital Accord

"I have made good judgements in the past. I have made good judgements in the future."

George W Bush, US President

7.1 Over the last ten years, many banking industry regulators have adopted a risk based approach to regulation. These approaches were based on the 1988 Basel Capital Accord produced by the Basel Committee on Banking Supervision. The Basel approach was based on the Value at Risk method of assessing risk and capital requirements.

Value at risk

7.2 A theoretical definition of Value at Risk (VaR) would be:

"VaR measures the worst expected loss over a given time interval under normal market conditions at a given confidence level. "

7.3 If it is based on adequate data and analysis, VaR provides a useful summary measure of risk. For instance, a bank might say that the **daily** VaR of its trading portfolio is **£10 million** at the **99%** confidence level. In other words, there is only a one in a hundred chance, under normal market conditions, of a loss greater than £10 million occurring on any particular day.

7.4 The advantages of VaR are:

- It is a single number which summarises the exposure to risk in a way which non-technical decision makers find relatively easy to understand i.e. the monetary risk to the bottom line.
- This allows the VaR of alternative courses of action to be compared easily.
- It enables decision makers to decide whether they feel comfortable with the level of risk. If the answer is no, the process that led to the computation of the VaR can be used to decide where to amend the risk
- It enables decision makers to decide whether they feel that adequate returns are available from a particular activity to justify the level of risk. If the answer is no, then the VaR for other opportunities can be used to aid decision making.

7.5 The main disadvantage of VaR is that, for complex risks, it can be difficult to calculate and therefore approximations are often made. Approximations should be used carefully as an inappropriate VaR model can lead to flawed decision-making. This is illustrated by the following problems with the original Basel Capital Accord.

Basel Capital Accord

- 7.6 The 1988 Basel Capital Accord required internationally active banks to hold capital equal to a specified percentage of the value of the bank's assets. A portfolio approach was taken to risk, with assets classified into four classes according to type of debtor. The capital requirement for each type of asset was set according to its riskiness. There was also a scale of charges for off balance sheet exposures through guarantees and other contingent claims.
- 7.7 The 1988 Accord adopted a broad-brush, "one size fits all" structure with very simple allowances for risk. The allowance for risk did not take account of the individual characteristics of the risk or of any other risk mitigation carried out by the bank.
- 7.8 As the Accord became the world standard during the 1990's, the security of banks generally improved. At the same time, it became clear that whilst this broad-brush VaR calculation had the advantage of simplicity, it introduced some distortions into the market. It allowed only one way for banks to measure their VaR. In reality the best way to measure, manage and mitigate risks varies from bank to bank. In the last decade banks have developed increasingly sophisticated internal measures of economic capital and the Accord's simple approach provided an incentive for banks to move high quality assets off the balance sheet. Effectively, the banks' internal understanding of risk overtook the regulatory position.
- 7.9 As a result, in June 1999 the Basel Committee released a proposal to replace the 1988 Accord with a more risk-sensitive framework. Reflecting the comments received on this proposal and the results of ongoing dialogue with the industry and supervisors world-wide, the Committee presented a more concrete proposal in January 2001. The final version of the new Accord is expected to be published around the end of 2001 and is to be implemented in 2004.
- 7.10 The standard approach will be a simple, modified version of the existing capital requirement. However, under the new Accord banks will be permitted to use a number of estimates of risk to justify non-standard risk weightings. These include internally generated risk estimates and estimates of credit worthiness provided by independent providers e.g. rating agencies.
- 7.11 In addition, banks will be required to include an allowance for operational risk in their capital adequacy calculation. This is proving to be controversial, as many bankers believe that it is not possible to generate this kind of simple measure for operational risk.
- 7.12 The Bank of England has already highlighted one potential problem with the new system. It has warned that regulators around the world need to be alert to the risk that the new Accord could result in the worst loans "gravitating to those banks least able to assess, price or monitor them".
- 7.13 Overall, the new Accord builds on progress made within the banking industry to assess a variety of risks on an individual basis.

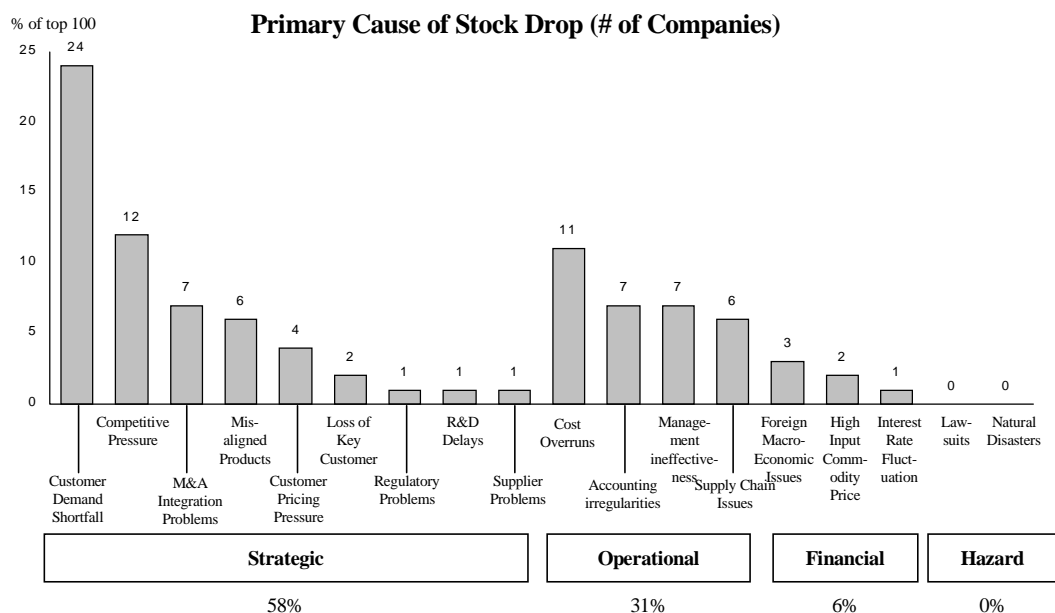
8 Enterprise risk management

"More and more of our imports come from overseas."

George W Bush, US president

The new business landscape

8.1 The following graph shows the results of a study into the causes of falls of at least 25% in one month in the shareholder value of Fortune 1000 companies, split between the four categories of risk we have discussed, namely strategic, operational, financial and hazard.



Source: Compustat, Mercer Management Consulting analysis

Note: There were also 5 stock drops for which the primary cause could not reliably be determined. These 5 stock drops are not depicted.

8.2 This analysis shows clearly that risk can have a powerful effect on share price performance. The apparent pre-eminence of strategic risks in this graph could be because they are difficult to predict and manage or because a management consultancy undertook the study! Traditionally, hazard risks have been well analysed and managed, so it should be no surprise that they are least important in causing large drops in stock market valuation. However, the focus of risk management today is changing from protecting organisations from hazards towards taking a more holistic view of the organisation's risk exposure incorporating both upside and downside risk.

8.3 The main driver for this change has been the changing business dynamics. Companies are now faced with faster product and service cycles. Managers are required to make faster decisions and often have less time to implement controls. Speed, technology and new distribution systems (among other things) are changing the risk profile. Just

in time approaches to inventories can cause supply difficulties if demand fluctuates rapidly.

- 8.4 Regulators and stakeholders are interacting with businesses and evaluating them in new ways. Institutional investors, in particular, have become more interested in management accountability and are now often more active participants in shareholder voting and meetings. Regulators have also become focussed on corporate governance.
- 8.5 These changes have created the need for an integrated and flexible enterprise-wide risk management system that helps bring the entire organisation into focus and facilitates ongoing evaluation, alignment, decision making and accountability for critical risk issues around the business strategy.

Enterprise-wide risk management

- 8.6 The risk management industry has responded to this challenge with the concept of enterprise-wide risk management. We define enterprise-wide risk management ("ERM") as:

"Enterprise-wide risk management is the process of systematically and comprehensively identifying critical risks, quantifying their impacts, and implementing integrated risk management strategies to maximise enterprise value".

- 8.7 When looking at this definition, the intent behind its key words is important:
- **Systematically** - The approach is a regular process, not a one-off analysis.
 - **Comprehensively** - Risks are considered on an enterprise-wide basis and include strategic, financial, operational and hazard risks.
 - **Critical** - Not all risks are material - it depends on their potential impact on the value of the enterprise.
 - **Risks** - Uncertainties where actual outcomes may differ from expected outcomes
 - **Quantifying their impacts** - Individual risks and their impacts are evaluated on a portfolio basis to understand and appreciate correlations.
 - **Integrated risk management strategies** - consist of:
 - ♦ Financial strategies including the design and placement of financial transactions, including but not limited to structured finance, derivatives, insurance, contingent financing, debt/equity offerings and other custom vehicles.
 - ♦ Organisational strategies including the mitigation of risks through process design, organisation structure, communication and contingency planning as well as management of risks through performance measurement and rewards, capital allocation and pricing.
 - **Maximise enterprise value** - Optimise the balance between risk and return.

- 8.8 Traditional risk management tended to look at risks in separate operational or financial silos. It did not consider the correlations between risk throughout the organisation and the risk strategies adopted were not necessarily consistent throughout the organisation.
- 8.9 The differences between the traditional risk management practices and the new enterprise-wide risk management approach are summarised in the following table:

Risk management's traditional practices	Enterprise-wide risk management approach
<ul style="list-style-type: none"> ▪ Narrow, silo-centric risk identification ▪ Limited understanding of "worst case" scenarios ▪ No systematic understanding of correlation amongst risks ▪ Protection focussed on book value of tangible assets rather than economic value ▪ Risk management not considered in strategic decisions ▪ Risk mitigation and risk finance practices not co-ordinated across functions ▪ No investment related measure of a company's tolerance for risk 	<ul style="list-style-type: none"> ▪ Risk management becomes a systematic, comprehensive and integrated activity ▪ Risk is quantified to make informed business decisions ▪ Risk is not automatically avoided; it is weighed against opportunity and optimised to ensure appropriate return ▪ Economic decisions (pricing, capital allocation, performance measurement, risk mitigation etc.) consider potential risks as well as historic costs ▪ Risk mitigation and financing ensure a minimum total (i.e. enterprise-wide) cash flow needed for strategic investments

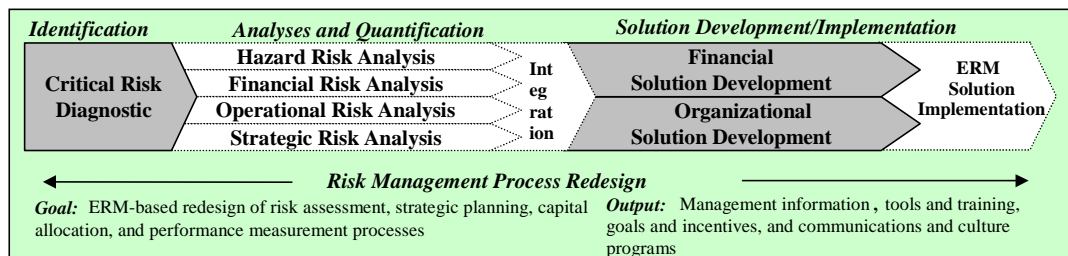
- 8.10 The aim of the new process is to enable the enterprise to develop and execute corporate level strategies to avoid, mitigate and finance risks. The risk tolerances are set at the aggregate level and then fed down through the organisation. The risk management effort is thereby focussed on the key risks to the enterprise as a whole.
- 8.11 The new enterprise risk management approach should be a process, not a one time event, and it should become an integral part of the organisation's culture and management.

An example

- 8.12 We could consider the risks within two subsidiaries of a large conglomerate. We will assume that each subsidiary has one major risk, these risks are highly inversely correlated and are of similar magnitude.
- 8.13 Traditionally, the risks within each company would be managed independently. The traditional risk management solution for these risks is likely to involve two separate insurance programs, one to protect each company. The enterprise risk management solution would recognise the correlations between the risks and remove both insurance programs. By taking a holistic view of the group's risks, an internal solution can be found which improves the overall efficiency of the organisation.
- 8.14 An example of this process can be found in the allocation of economic capital within banking groups. Each subsidiary must be allocated its share of the bank's total economic capital. The economic capital allocated to subsidiaries is related to the correlation of each subsidiary's results with the main bank's results. For example, an insurance subsidiary would be allocated relatively little economic capital, as its results are not correlated to banking results. This approach provides an automatic incentive for diversification.

The enterprise-wide risk management process

- 8.15 As organisations make continuous decisions regarding the effective use of finite resources to yield optimal business results, they face a myriad of risk issues. The following process could be used to apply an enterprise risk management approach to an organisation:



Goal:	<ul style="list-style-type: none"> • High-level critical risk assessment 	<ul style="list-style-type: none"> • In-depth measurement and modeling of critical risks 	<ul style="list-style-type: none"> • Perspective on integrated effects of risks 	<ul style="list-style-type: none"> • In-depth design and implementation of solutions to mitigate / finance risks
Output:	<ul style="list-style-type: none"> • Overview of risk management philosophy and practices • Enterprise-wide risk maps • Risk prioritization 	<ul style="list-style-type: none"> • Detailed analysis and quantification of critical risks • Analysis of risks using a common risk template • Analysis of independent volatility • Impact of risk on strategic objectives including finances and cash flows 	<ul style="list-style-type: none"> • Qualitative and quantitative analysis of correlations • Integrated model portfolio volatility • Marginal risk contribution analysis 	<ul style="list-style-type: none"> • Design and placement of financial solutions - structured finance/funding, derivatives, risk transfer products risk aggregation indexes, risk banks • Design and implementation of organizational solutions - changes in organization structure, process, systems, culture and business designs to address risks

- 8.16 The first element of the process is the high-level critical risk identification. This part of the process is devoted to identifying and prioritising the critical risks that affect

enterprise value. It will include analysis and documentation of the current risk management practices, interviews with senior management to generate high level risk maps and development of an understanding of the organisation's risk and reward requirements.

- 8.17 The next stage is the analysis and quantification of the individual critical risks. All of the critical risks are analysed in a consistent manner to identify the underlying probability distributions and their relationships to the financial results.
- 8.18 This would be followed by an analysis of the correlations between the critical risk factors. The effect of the risks on the overall volatility of the organisation's financial results should be analysed.
- 8.19 Once the risks and their correlations are understood, the risk management experts can then analyse the models to decide upon optimal risk management strategies. These could include risk mitigation processes, insurance or capital market solutions or risk monitoring.
- 8.20 The process concludes with the adoption of the organisational and financial strategies to manage risk on an enterprise-wide basis.

Benefits of enterprise-wide risk management

- 8.21 The benefits of enterprise-wide risk management for any company include:
- **Prioritisation of risks** - by evaluating critical risks according to consistent standards, companies can manage their investments and capital structures better while focusing on business management, not crisis management.
 - **Early notification of risk patterns** - enterprise-wide risk management allows firms to examine aggregating and/or offsetting risk patterns, especially across different operations and decision making areas. The analysis of these patterns can also incorporate consideration of the risks encountered by peers and other industries.
 - **Enhanced safeguards against earnings surprises** - these safeguards benefit both management and shareholders and can lead to improved share performance and lower capital costs. They also help to avoid uncomfortable discussions with shareholders, stakeholders and the media.
 - **New risk management framework** - the creation of a strong and comprehensive framework should help to identify and control existing risks while enabling the firm to understand and manage its changing risk profile.
- 8.22 These benefits improve an organisation's ability to manage and enhance its enterprise value in several ways:
- Better management of threats to enterprise value.
 - The reallocation of current and future risk management effort to the most pronounced risks.

- Reduced net volatility of cash flow and earnings. This can help to reduce the chance of defaulting on debt thereby reducing financing costs, and increasing the valuation of earnings by hitting earnings targets more consistently.
- Improved decision making through more effective cross-functional communication.
- Better consideration of risks for capital allocation and strategic planning.
- Improved pricing by risk adjusting pricing decisions.
- Improved shareholder and stakeholder confidence that risks are understood and managed.

8.23 Enterprise-wide risk management is a comprehensive and holistic framework for making risk management decisions.

9 How can actuaries add value?

"The next time we elect a president, for God's sake, can we do a background check?"

David Letterman, US talk show host

Actuarial skills

9.1 Throughout this paper, we have commented on the areas where actuaries can add value within the risk management area. Actuaries' analytical training and experience can clearly be of use in the analysis of risks within companies. In particular, as we all know, actuaries have the following valuable skills:

- Familiarity with the evaluation of the nature and effects of risk.
- Ability to create models which produce useful results from a vast amount of historical data.
- Ability to communicate complex issues to non-technical audiences.
- An understanding of the effect of risk management activities on underlying behaviour.
- An understanding of the methods available to mitigate risk.

9.2 However, the actuarial profession needs to do some selling to ensure that these skills are appreciated within the wider risk management industry.

The FSA and risk management

9.3 The FSA has adopted a risk focussed operating framework which is designed to identify the main risks to its statutory objectives and to help plan how to address these risks in line with its regulatory approach. The framework is intended to be the bridge between the FSA's statutory objectives and its regulatory activities. The operating process involves identifying the risks to the statutory objectives, assessing and prioritising these risks and deciding the appropriate regulatory response, using the full range of regulatory tools.

9.4 The FSA's approach to using risk management in its operating framework is summarised in Appendix A. This is just our interpretation of the current situation, for a more complete view we would recommend readers to consult the FSA web site.

9.5 The FSA will also be focussing its attention on the risk management processes within regulated firms. Actuaries working within regulated companies may come across opportunities outside their normal actuarial role to apply their skills to the wider field of risk management.

Risk focussed legislation

- 9.6 The International Actuarial Association (IAA) has already started the move to a risk based solvency system for insurance companies. The IAA has set up two working groups, one to survey existing capital requirements and one to research the distributions of insurance company financial outcomes. The reports produced by these working groups could begin the process of developing a more risk focussed approach to regulatory capital for insurance companies.
- 9.7 In a risk focussed solvency regime, actuaries would need to be fully aware of all of the risks within their own organisations. The actuary may then be in an excellent position to influence strategic decisions based on the additional understanding gained through analysing the risk based capital requirements.

Embedded value reporting

- 9.8 At the moment, the majority of listed companies with insurance businesses include a single point estimate of the embedded value within their report and accounts, together with a high level analysis of the movement in the embedded value from year to year. In reality, the eventual outcomes are likely to vary due to the variability of the experience over the lifetime of the policies. A risk focussed approach to embedded value reporting could lead to a number of different values being produced using stochastic projections based on assumed distributions for the underlying assumptions.
- 9.9 For example, a VaR type approach could be adopted whereby a single figure is provided to indicate the amount of embedded value at risk from extreme deviations in experience. Alternatively, a range of embedded values could be used together with an attaching probability of being within the range.
- 9.10 There are many practical and theoretical hurdles to be overcome before such measures become reality. Some of the areas requiring consideration are:
- What probability distributions should be used for the main elements of experience such as lapse experience?
 - What model could be used to allow for policyholders' selective behaviour? Game theory may be a useful tool for this analysis.
 - How can options embedded within the products be valued? Option pricing approaches could probably have been used to place a value on guaranteed annuity options.
 - How should the risk discount rate be set if the assumptions are risk adjusted?
 - Do the tails of the distributions have any unusual features? Should extreme value theory be used to fit the distributions?
 - How should the results be presented in the report and accounts?

Conclusion

9.11 Risk management is a steadily growing discipline and one which can offer actuaries a wide range of stimulating experiences. At the same time, the actuarial skill set is well matched to the needs of the risk management profession. There should be some interesting opportunities for actuaries within this field over the next few years.

Appendix A

The FSA and risk management

"One word sums up probably the responsibility of any Governor and that one word is 'to be prepared'"

George W Bush, US President

- A.1 The Financial Services and Markets Act received Royal Assent in June 2000. When implemented, the Act will establish the FSA as the single statutory body for financial business in the UK. The Government announced on 15 March 2001 its aim that the new regime will be implemented no later than the end of November 2001. The following summary is just our interpretation of the current situation, for a more complete view we would recommend readers to consult the FSA web site.
- A.2 The FSA's operating framework sets out the risk assessment process as follows:

"Risk identification

The first stage in the operating framework is to identify the risks to the statutory objectives.

In doing this the FSA will draw on a wide range of sources, including intelligence gathered in the course of supervision of firms and direct contacts with consumers, and through economic and market monitoring. We will also conduct regular focused reviews of the industry and consumers, using tools such as market research, discussions with markets and exchanges, and mystery shopping. We will regularly consult a wide range of stakeholders, including market participants and the Consumer and Practitioner Panels, and will draw on information supplied by the Ombudsman on industry trends and particular problems revealed through complaints.

Risk assessment and prioritisation

The next stage is to assess and prioritise the risks. The FSA will use a standard risk assessment process applied consistently across all its activities. This involves scoring the risk against a number of probability and impact factors. The probability factors relate to the likelihood of the event happening, and the impact factors indicate the scale and significance of the problem if it were to occur. A combination of the probability and impact factors gives a measure of the overall risk posed to the FSA's objectives. This will be used to prioritise the risks, inform decisions on the regulatory response and, together with an assessment of the costs and benefits of using alternative regulatory tools, help determine resource allocation."

- A.3 As well as operating in a risk focussed manner, the FSA will be monitoring risk management within regulated firms. During the consultation period, a number of risk management issues have arisen. The following paragraphs set out the state of play at the time of writing this paper.

- A.4 In October 1999, the Policy Statement subsequent to CP13 stated the following regulatory principle:

"Principle 3 - Management and control

A firm must take reasonable care to organise and control its affairs responsibly and effectively, with adequate risk management systems."

- A.5 FSA consultation paper 35 on the subject of senior management arrangements, systems and controls was published in December 1999 and amplified the requirements of Principle 3:

"...it is important to note that the 'risks' in question are confined to those which are a matter of legitimate concern for the regulatory system. In general, the FSA is not concerned with risks which threaten only the owners of a financial business. The main risks of concern are those relating to the fair treatment of the firm's customers and potential customers; to the protection of policyholders, depositors etc.; to confidence in the financial system; and to the use of that system in financial crime."

- A.6 In addition, this consultation paper commented on the FSA's likely requirements with regard to risk management:

"Risk management

Depending on the scale, nature and complexity of its business, it may be appropriate for a firm to have a separate risk management function responsible for monitoring and managing the risks that the firm faces. The organisation and responsibilities of a risk management function should be documented. A risk management function should be adequately resourced and staffed by an appropriate number of experienced and qualified staff who are sufficiently independent to perform their duties objectively. A risk management function should have appropriate reporting lines."

- A.7 This was subsequently superseded in June 2000 by a revised definition set out in the Policy Statement on "High level standards for firms and individuals" subsequent to CP35. The revised definition is:

"Risk assessment

- (1) *Depending on the scale, nature and complexity of its business, it may be appropriate for a firm to have a separate risk management function responsible for assessing the risks that the firm faces and advising the governing body and senior executives on them.*
- (2) *The organisation and responsibilities of a risk assessment function should be documented. The function should be adequately resourced and staffed by an appropriate number of competent staff who are sufficiently independent to perform their duties objectively.*

Management information

- (1) *A firm's arrangements should be such as to furnish its governing body with the information it needs to play its part in identifying, measuring, managing and*

controlling risks of regulatory concern. Three factors will be the relevance, reliability and timeliness of that information.

- (2) *Risks of regulatory concern are those risks which relate to the fair treatment of the firm's customers, to the protection of consumers, to confidence in the financial system, and to the use of that system in financial crime."*

"Business strategy

A firm should plan its business appropriately so that it is able to identify, measure, manage and control risks of regulatory concern"

"Business continuity

A firm should have in place appropriate arrangements, having regard to the scale, nature and complexity of the business, to ensure that it can continue to function and meet its regulatory obligations in the event of an unforeseen interruption. These arrangements should be regularly updated and tested to ensure their effectiveness"

- A.8 In addition, this policy statement sets out the responsibilities of an approved person. These include:

"Strategy and plans will often dictate the risk which the business is prepared to take on and high level controls will dictate how the business is to be run. If the strategy of the business is to enter high-risk areas, then the degree of control and strength of the monitoring reasonably required within the business will be high. In organising the business for which he is responsible, the approved person performing a significant influence function should bear this in mind"

"An approved person performing a significant influence function is unlikely to be an expert in all aspects of a complex financial services business. However, he should understand and inform himself about the business sufficiently to understand the risks of its trading, credit taking or other business activities."

- A.9 As a result of these regulatory requirements, firms regulated by the FSA should put in place well designed risk assessment, management and monitoring systems.

Appendix B

References

- 1 British Bankers' Association 2000 *Operational risk management survey*
- 2 DeLoach, James (2000) *Enterprise-wide risk management - Strategies for linking risk and opportunity*
- 3 Slovic, Paul et al (2000) *The perception of risk*
- 4 FSA consultation papers and policy statements www.fsa.gov.uk
- 5 The New Basel Capital Accord www.bsi.org
- 6 www.amigoingdown.com for information regarding flight safety.
- 7 Bernstein, Peter L. (1996) *Against the gods - The remarkable story of risk*
- 8 Walsh, James (1998) *True odds - How risk affects your everyday life*
- 9 Marsh & McLennan web site www.mmc.com