

GIRO 2003 - Risk

Measurement or bust

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30 August 2003

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1 Introduction

- 1.1 So near, yet so far. This year's GIRO working party charged with taking thinking about operational risk further has been the usual curate's egg. We have managed to maintain the very or at least the quite respectable involvement of 7 people. This is of itself an achievement. More importantly we have managed to produce a series of papers on various aspects of the subject.
- 1.2 We tried, in vain, to find a sensible data set, for the quantification aspects of our work. Such does not (yet) exist for operational risk in general (or for that matter life) insurance companies. Banks are making better progress and are ahead. We exhort actuaries and others to do their best to bring the insurance industry forward.
- 1.3 In the absence of finding real useful data we started to develop a fictitious case study. This took longer than we had hoped which coupled with the usual resource constraints (that is we could not find people or time) meant we did not manage to produce the cohesive set of illustrated methods we had set ourselves as our goal. Nevertheless we did produce some initial attempts at applying various methods using earlier or other data sets.
- 1.4 We appreciate that the fictitious case study therefore has further to go. It is our intention to refine and develop this study. We believe it could become a useful tool for general insurance actuaries. We would particularly welcome comments on Sections 7 and 8, especially in terms of the business scenarios, assumptions and stress testing aspects. We would also welcome access to any relevant data. It would be our hope to publish these in due course as a self contained paper for the profession.
- 1.5 Rather than waste all the good work we had completed, we decided to present our words as work in progress - a series of linked thoughts and articles. We believe and hope readers will find it interesting. We beg forgiveness for the lack of completeness and the inevitable discontinuities. We hope the reader will be able to see through these fault lines to some of the underlying concepts and join with us in believing that this could be the seed corn for the development of the actuaries' role in wider risk management.
- 1.6 Operational risk has become a high profile discussion topic, driven by a combination of regulatory push and shareholder pull influences.
- 1.7 As management in insurance companies gradually familiarise themselves with concepts and definitions so the questions like "is it possible to quantify operational risk", "why should we bother about operational risk", "how do we organise ourselves to deal with operational risk" and "what's the difference

between operational risk and insurance risk" arise and are debated (sometimes very hotly!).

1.8 The terms of reference we set for this paper, building on last years GIRO report were:

- To explore the definitional issues further
- To illustrate the application of different methods for quantifying and managing operational risk
- To consider the pros and cons of each method
- To discuss issues that may not be capable of quantification
- To consider professional issues arising from the above
- To report on relevant industry developments
- To consider how actuarial thinking may develop and possible future work.

The structure of the paper

1.9 After this introduction we present a section reviewing progress in the various regulatory forums.

1.10 Section 3 summarises a series of interviews we held with company and industry representatives.

1.11 In Section 4 we revisit aspects of definition. We observe that this is still evolving and that there is still no one globally accepted set of categories.

1.12 Sections 5, 6, 7 and 8 are based on our developing case study. We set out a fictitious company and then explore the application of methods. We consider how the findings could be presented in a report and start to touch on professional matters arising.

1.13 Section 9 is a monograph about the "soft issues" - the people and the psychology surrounding operational risk.

1.14 In Section 10 we try to pull the threads together and summarise our feelings about the topic - the issues and the role of quantification.

2 Update on progress - regulatory developments

Recent developments (to 30 July 2003)

2.1 There have been many developments in the last 12-18 months. We describe below some of what we consider to be the more significant in terms of insurance and banking within

- The EU
- Basel accord
- The UK Financial Services Authority
- The UK Insurance Industry
- The UK Actuarial Profession
- Corporate Governance.

EU

2.2 Within the EU insurance regulatory thinking has focussed on "Solvency 2". For some time it has been commonly accepted that solvency regulations which date back to the 1970's are out of date. The general level of required regulatory minimum solvency is far below that at which most soundly managed organisations operate. If companies had operated at these minimum levels in the middle of 2001 most, if not all, would now be insolvent.

2.3 The first response was a new directive (ref: 2002/13/EC) dated 5 March 2002, commonly known as Solvency 1. Its objectives included:

- Updating regulations substantially unchanged since their creation in 1973
- Member states are now free to adopt more stringent requirements to take account of specific local risks
- Simplifying and generally increasing the quantum of "minimum guarantee funds"
- Giving authorities the right to intervene earlier if policyholder rights were threatened
- Refining approaches to handling high levels of reinsurance cover for run-off business and certain potentially volatile lines of business.

2.4 This was always seen as an interim step, and real discussion has focussed on the 3 pillar approach used by the banks and envisaged under Solvency 2. It is unlikely that Solvency 2 will be passed by the EU parliament until 2005 or even 2006, and hence not passes into national laws until 2007 or even 2008. How its progress will fit with that of the proposed new International Accounting

Standard (the so called fair value principles) is unclear. In an ideal world the two would be fully synchronised with common terminologies but whilst there is an acknowledgement about accounting changes in Solvency 2 draft papers, we live in an imperfect world.

2.5 Solvency 2 incorporates the 3 pillar principle used in banking supervision:

- Pillar I - a formula based calculation recognising certain risk characteristics (for example classes of business underwritten, reserving run-off characteristics and asset mix)
- Pillar II - an internal assessment of required capital, based on a full risk assessment. The regulators reserve the right to supplement this without having to give reasons if in their judgement a higher figure is required
- Pillar III - an external market based "pressure" approach.

Basel Accord/Bank for International Settlements

2.6 Much of the FSA's risk and regulatory framework (see below) can be said to have its conceptual roots in the Basel Accord (the worldwide convention governing the approach to the international regulation of banks), as well as in Solvency 2.

2.7 Notable events over the last 18 months include:

- The recent release of two papers, one entitled "Trends in risk integration and aggregation", the other "operational risk transfer across sectors". The first concerns the management of risks on a firm-wide basis and efforts to quantify aggregate risk eg using economic capital models. The second is about the potential for transferring risk from protection buyers (such as banks and securities firms) to protection sellers (that is mainly insurance companies)
- In March 2003 the "2002 Loss Data Collection Exercise for Operational Risk" was released. (Oh that the insurance industry would produce something like this)
- There was a paper entitled "Sound Practices for the Management and Supervision of Operational Risk" (February 2003) suggesting 10 principles covering the risk management environment, risk management (identification, assessment, monitoring and mitigation/control), the supervisors role and approach to risk disclosure
- In April 2003 an interesting paper "Using Loss Data to Quantify Operational Risk" was published. This investigated "large operational risk events" (over \$1 million) using the two databases "OpRisk Analytics" and "OpVantage".

- 2.8 In general terms it now seems likely that operational risk will be an explicit addition to Pillar I regulatory capital (there was much public discussion with a figure of a 12% loading on calculated credit/market risk capital requirements being discussed at one time). The Basel Committee on Banking Supervision published a Consultative Document in April 2003 (Overview of the New Basel Capital Accord) suggesting three options for calculating Pillar 1 operational risk capital - a Basic Indicator Approach, a Standardised Approach and Advanced Measurement Approaches. This talks about the basic indicator approach being the bank's average annual gross income over the last three years being multiplied by a factor of 0.15. This amount is then added to the other forms of required capital. The standardised approach is similar except that it is calculated at business line level with different factors for each line. However a considerable degree of flexibility is implied as the subject is rapidly developing - hence acceptance that many banks may be able to convince regulators that their internal approach is rigorous enough to be regarded as an "Advanced Measurement Approach".
- 2.9 During this time the Basel Committee on Banking Supervision suffered a slight setback when the USA indicated it would reduce its contribution to discussions unless it takes into account the interests of the US banking industry. It may not have yet exited the Accord, but it looks like a warning shot that one powerful group feel things are becoming too detailed and prescriptive. This emerged in June 2003 in testimony before the Senate Banking Committee.

The UK FSA

- 2.10 Since legislation requiring the combined regulation of all financial services business in the UK (the Insurance and Financial Markets Act 2000), the FSA has been aware of the need for urgent and fundamental change in the way all financial services organisations are regulated, and in particular insurance companies.
- 2.11 The Integrated Prudential Source Book is due for implementation in 2004, to take effect for the year end 2004. The FSA is trying to anticipate the outcome of Solvency 2, although it accepts there may have to be some subsequent adjustments to ensure complete alignment. The FSA's treatment of operational risk is not inconsistent with both Solvency 2 and Basel. We are seeing strong convergence between regulatory strands.
- 2.12 There has been a plethora of Consultation Papers, Policy Statements and other publications. For completeness sake, the most recent and relevant to operational risk include:
- Policy Statement "Building a framework for operational risk management": the FSA's observations (July 2003). Based on interviews with 22 firms this

provides the FSA's feedback on the state of industry preparedness to handle operational risk in light of feedback on CP 142 and other papers. Generally the FSA expresses concern that the insurance industry is nowhere near ready and needs to be far more active in its preparations

- "The firm risk assessment framework" issued in February 2003
- CP189 Report and first consultation on the implementation of the new Basel and EU Capital Adequacy Standards, issued in July 2003
- Consultation Paper 190 – "Enhanced capital requirements and individual capital assessments for non-life insurers". This indicates that Pillar 1 risk based capital calculations will include an implicit allowance for operational risk based on historic data. Pillar 2 can incorporate explicit models if a company has sufficiently strong framework in place to justify this
- Policy Statement "Operational Risk Systems and Controls" (March 2003). This gives the FSA's feedback on responses to CP 142
- Consultation Paper 142 "Operational Risk Systems and Controls", issued in July 2002, with feedback in March 2003
- Consultation Paper 136 "Individual Capital Adequacy Standards" set out the original framework for determining required regulatory (risk based) capital levels
- London Working Group papers (December 2002). The first being Occasional Paper 20 "Managing risk: practical lessons from recent 'failures' in EU insurers", and the second being the FSA working group report on the prudential supervision of insurance undertakings, entitled "Conference of insurance supervisory services of the member states of the European Union"
- ORIAG (Operational Risk Implementation Advisory Group) Working Paper (January 2002) "Implementation of the Capital Accord for Operational Risk"; note that ORIAG comprises mainly banking experts but interestingly enough has one insurance member.

2.13 In all publications, the FSA clearly recognise the vital nature of systems and controls to control operational risk - see the inclusion of guidance in SYSC (Senior Management Systems and Controls) as well as in the Integrated Prudential Source Book. This does not mean they deny the role of capital and other financial buffers to mitigate risk, but clearly the industry is neither fully ready nor in support of explicit margins for operational risk in Pillar 1 calculations.

- 2.14 In CP190 it is made very clear that the actual amount of capital to be held over and above the amount calculated as the Enhanced Capital Requirement will depend on the FSA's view of strength of the firm's risk management framework and the effectiveness of its system and controls.

UK Insurance Industry

- 2.15 More detailed comments about progress within insurance companies are made in the next section of this paper. As a high level observation, we note that the larger organisations have started to institute formal approaches to operational risk over the last 9-12 months. Medium sized and smaller companies are really only just starting on the journey.
- 2.16 The ABI held a conference on 30 May 2003. One of the ideas floated was the concept of a (simple) industry operational risk database - possibly modelled on the BBA GOLD approach. This idea has not been progressed, partly due to other priorities, partly due to lack of central resources to support it, perhaps partly due to companies not accepting the importance of the subject and perhaps partly due to the belief that at present the need is for more practical action within companies to develop the right internal management frameworks.

The UK Actuarial Profession

- 2.17 The President of the Institute is keen to promote actuarial involvement in the developing and wider aspects of risk, with an open approach to lessons from other disciplines including financial economics and banking risk frameworks.
- 2.18 A Risk and Regulation in Financial Organisations Steering Group was established in December 2002. It is to consider all aspects of risk, but only those aspects of regulation that relate to risk. 'Financial organisations' is to be interpreted widely to include all entities that provide financial products. This group will be a focal point for work on risk and regulation in financial organisations within the profession. It will liaise between the various Boards of the profession, and also with other organisations and professions. It is working to ensure the profession raises its profile as experts in risk matters.
- 2.19 Two seminars are due to take place in the autumn of 2003, one being the 2003 Actuarial Risk Forum on 8 October. This will be a multi-disciplinary evening seminar and attendance will be by invitation to senior figures in the financial services industry, other industries and other organisations.
- 2.20 The other will be a specific seminar on operational risk on 27 November. This will address the management of operational risk in the whole financial services sector.

- 2.21 Discussions and working groups continue to make progress on all fronts. Some would argue that quantification of operational risk is at best difficult and at worst misleading. The argument is that any change in the people, processes or systems within which operational risk evolves changes the nature of the risk - the future outcomes cannot be related to the past and hence statistical models are flawed.
- 2.22 General Insurance actuaries have lived with these sorts of concerns for some time and are perhaps more inclined to the view that a statistical model is only a guide: it is not seen as a definitive predictive device, but a way in which additional insight may be gained into the possible outcomes from a volatile experience. Perhaps our attitude, approach and experience can prove of benefit to the wider professional body?

Corporate Governance

- 2.23 Operational risk is also an issue that comes up in current developments on the corporate governance front.
- 2.24 The Higgs report, reviewing the role and effectiveness of non-executive directors, was issued in January 2003.
- 2.25 The Smith report, looking at the role of Audit Committees, was also issued in January 2003.
- 2.26 The Institute of Internal Auditors issued a position statement on the role of Internal Audit in risk management in June 2002.
- 2.27 Sarbanes Oxley in the USA is also influencing the separation of roles between audit and advisory, with consequences for systems and controls and approaches to risk.

3 Update on progress - industry developments/interviews

- 3.1 This is a period of rapid change in operational risk: both the regulatory environment (see the previous section, 2) and practice on the ground are affected. We wanted to map out the approaches to managing and measuring operational risk in various financial services industries and organisations. We were particularly interested in finding out how the state of play in general insurance companies compares to that in other companies and industries.
- 3.2 To this end we conducted a series of interviews with people from the organisations listed in Appendix B. We should like to express our gratitude to all those who participated. We conducted 16 interviews using the interview template presented in Appendix B. Some interviews included more than one participant; all results are quoted on the basis of interviews rather than participants. The interviews took place in the period May to July 2003.
- 3.3 As we were preparing this report the FSA released their document "Building a framework for operational risk management: the FSA's observations." This is a review of how the management of operational risk is evolving in the firms that they regulate.
- 3.4 The FSA held discussions with 22 firms actively developing risk management systems for operational risk; the discussions were held between May 2002 and January 2003. The FSA's report thus necessarily does not cover firms who are not actively developing systems for managing operational risk, and is therefore likely to overstate the level of sophistication of risk management processes. We do not know which firms contributed to the FSA's report, how large they were, or what sectors they were in, although from internal evidence it appears that at least several of them were banks.
- 3.5 In this section we discuss the results of our survey, and compare our findings to those of the FSA. It should be noted that the FSA's report is very different in both scope and objectives, but we believe that it provides a useful comparison.

Summary

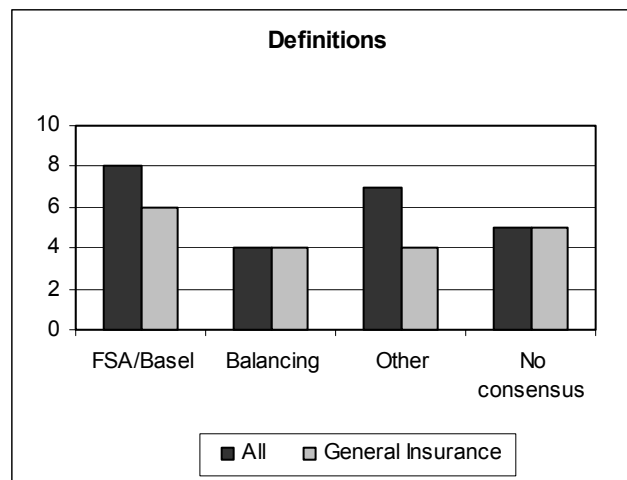
- 3.6 Our findings agree with those of the FSA that insurance firms tend to have a less developed approach to operational risk than firms in some other sectors, such as banks. However, some insurance firms do have effective frameworks and processes. Not all of our respondents appeared to be aware of all aspects of the management of operational risk in their organisations. This does not necessarily mean that there were gaps in the management of operational risk in the organisations, but would at least indicate gaps in the internal communication of how it is being managed.

- 3.7 The approach to operational risk was generally driven by the regulators. This is true across the board, not only in general insurance firms. There is also a check-box mentality among a significant proportion of insurance company management. Neither the check-box mentality nor the communication gap is consistent with the FSA's desire for a culture of risk management extending throughout the firms they regulate.
- 3.8 We found general support for the view that quantitative analysis of operational risk will happen in the future, but that the techniques and data are not currently available. Given the undeveloped state of operational risk management in many general insurance companies, they are currently unprepared to apply any sort of quantitative analysis. Before measurement is possible, firms must be clear about what it is they are measuring, and they must have sufficient data. There is a huge gap to bridge.

Who we interviewed

- 3.9 We interviewed a wide variety of people, both in terms of the organisations they come from (see Appendix B) and in terms of their roles within those organisations. Some of those from trade associations or similar bodies gave views from two perspectives: how operational risk is managed within their organisations, and how it is managed in their industry. Of the 16 interviews, 14 provided us with explicit information about the management of operational risk within the organisation, and 6 provided an industry view. 11 of them were with people from the general insurance industry, 8 from general insurance companies.
- 3.10 Of our interviews, 6 were with actuaries, many of whom had job titles such as "Group Actuary". Overall, we conducted 6 interviews with people who had job titles that explicitly mentioned risk, such as "Head of Group Risk" or "Global Head of Operational Risk." Others had job titles that included words such as "Compliance" or "Regulation" 12 of the 16 interviews were with people who have responsibility for setting policy for operational risk, or for measuring it, or who were otherwise involved at what one might call the strategic level. This is mainly because we deliberately targeted interviewees with expertise in the area of operational risk.
- 3.11 6 interviews were with people who had some day to day responsibility for managing operational risk. In many organisations the responsibility for managing operational risk was explicitly stated to be with all managers; the responsibility of the central risk management function (if any) was to set policy and standards, coordination, and measurement.

- 3.12 We performed one interview with each organisation; some interviews involved two people. The respondents gave their replies in the light of their own personal knowledge, and some of them may not have been aware of all the initiatives relating to operational risk that were current in their organisations. The results of our survey may thus underestimate the level of sophistication of operational risk management processes (whereas the FSA's report may overestimate it, as discussed above).

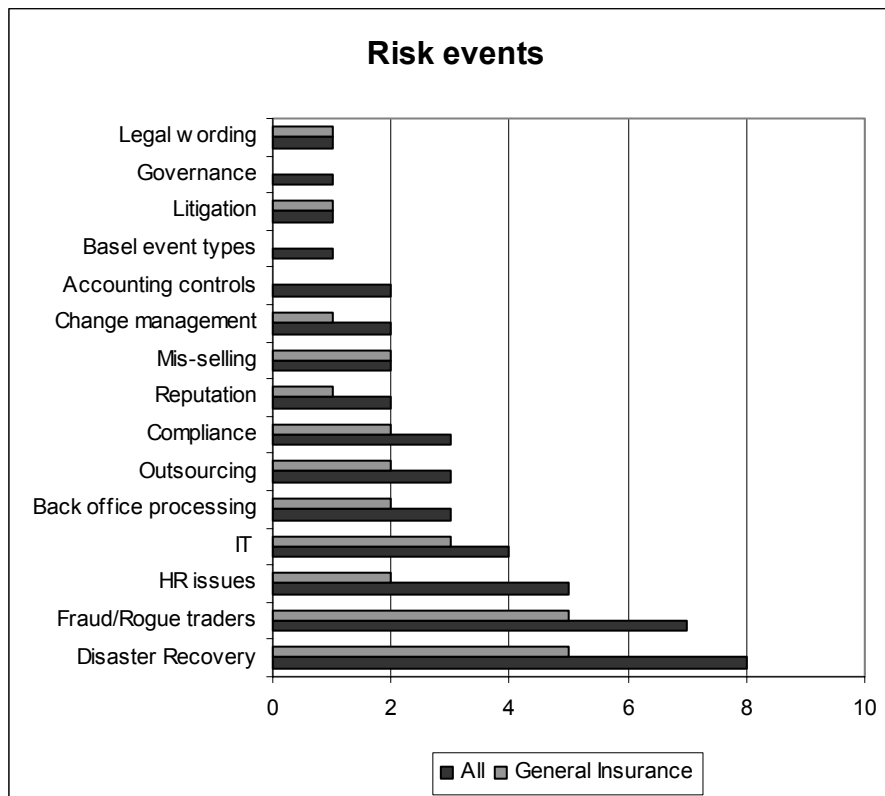


Defining operational risk

- 3.13 There are a number of different definitions of operational risk in use. Many organisations use one based on the FSA or Basel definitions, which are so similar that they cannot be separated in our results. However other definitions are also used, including the definition of operational risk as a balancing item, the risk that is not included under other headings such as credit risk or market risk. Some respondents mentioned more than one definition, which is why the numbers shown in chart 3.1 do not add up to 16. In addition, many people made the point that there is no agreed definition of operational risk, sometimes with reference to the world at large and sometimes with reference to their own organisation.
- 3.14 Some of the other definitions that were quoted were:
- Risks arising from management
 - Anything that could threaten achieving an organisation's objectives or prevent an organisation from seizing opportunities
 - Risk of corporate goals not being achieved, including lost opportunities and any adverse impact on shareholder value, on reputation or earnings, whether foreseen or unforeseen
 - Things which might go wrong and hurt the business

- The day to day issues that the organisation is confronted with as it strives to deliver its strategic objectives.

3.15 There appeared to be little use of different definitions for different purposes, although one respondent indicated that they use a less technical definition



("Things which might go wrong and hurt the business") for Approved Persons and a more formal, Basel-type definition for the Risk Committee.

- 3.16 It was noticeable that the explicit use of the Basel definition and event types was by no means limited to banks, but extended to the insurance industry as well.
- 3.17 The FSA found that 73% of the firms they surveyed used the Basel definition, or a closely related one. This is consistent with our finding that 6 out of the 8 respondents from general insurance companies in our survey mentioned the Basel definition, although some of them mentioned other definitions too. The FSA observed that the risk management framework was more effective when there was a clear scope of the category of risks that the firm was trying to manage; we believe that the definition of operational risk as a balancing item will make it difficult to meet this criterion.

- 3.18 There was little agreement on the types of events that might give rise to operational losses, with many different events being suggested as shown in chart 3.2. The event type mentioned by the largest number of respondents was disaster recovery, which included such things as floods and terrorist attacks.

Awareness and influences

- 3.19 The level of awareness of operational risk in the organisation varied a lot, and was quite closely aligned with the sophistication of the overall approach to managing it. In those organisations with a formalised approach including regular reporting, the level of awareness was thought to be quite high. In organisations that were only on the threshold (if that) of formal operational risk management, there were fears that awareness was low at all levels of management. In some cases it was thought that awareness of the issues was high, but that they were not thought of explicitly as operational risk issues.
- 3.20 In the general insurance industry in particular there was a strong view that Arrow visits from the FSA had done a lot to increase awareness among senior management.
- 3.21 Overwhelmingly, the FSA was seen as the main regulatory issue affecting the approach to operational risk, being named by 14 respondents. Basel II, mentioned by 3 respondents, came next. Other bodies or issues that were mentioned by one or two respondents included:
- Other financial regulators, such as MAS in Malaysia
 - Health and safety legislation
 - Lloyd's
 - Higgs report, Smith report and other corporate governance issues
 - Sarbanes-Oxley
 - Pressure from clients (a reputational issue)
 - OPRA
 - GISC
 - EU
 - Audit Commission
 - National Audit Office
 - NHS requirements
 - Housing corporation requirements
 - Local government requirements

- Inland Revenue
 - HM Customs and Excise.
- 3.22 This list reflects the variety of people we interviewed and the industries they come from, but it was interesting that the FSA was mentioned by so many people (and also that there was one respondent from the General Insurance industry who did not mention it). It was also surprising that so few people mentioned issues of corporate governance. The replies we got are consistent with the findings of the FSA, although we did have one respondent who mentioned customer expectations as an influence and the FSA had none.
- 3.23 Many respondents said that they did not use consultants for operational risk issues. There was a feeling that consultants tended to talk "consultantese" and were not really looking at the specific situation. Having said that, 10 respondents mentioned the Big Four, or auditors, or accountants, as professions from whom they would seek advice. Actuaries and lawyers were each mentioned 4 times. There was a strong feeling that there was no particular skill set that was particularly relevant, but that an understanding of the business was very important.

Techniques and methods

- 3.24 The overall impression gained from the survey was that many general insurance companies are on the brink of getting to grips with operational risk, but are not quite there yet. Few of the respondents from general insurance companies mentioned specific techniques that they use to manage operational risk; indeed, one of them said that they do nothing specifically for operational risk, but rely on proper ownership and management of the processes in the company: it is all just part of good management. If risk management is part of the overall management philosophy, this would be a reasonable approach.
- 3.25 A number of specific techniques were mentioned by respondents, both from the general insurance industry and elsewhere, as being currently in use or planned for the future. These include:
- Risk maps: identifying risks and categorising them (often by frequency and impact)
 - Risk indicators: simple statistics that may indicate problem areas
 - Issues tracking: a database of issues that have been flagged, through risk maps, risk indicators or other processes, and that should be addressed
 - Loss database: a record of losses that have occurred usually categorised by cause or event type, and with associated amounts. The definition of loss varies, but is commonly any incident caused by failure that gives rise to a

loss or profit. Near misses, or failures that give rise to neither loss nor profit, are not generally included, though one respondent said they planned to do so in the future

- Scenario testing
- Risk modelling.

3.26 On the whole, the specific techniques mentioned above appear to be less widely used in the general insurance industry than in other financial service industries. Risk maps are currently used by 2 general insurance respondents, with one intending to use them in the future, loss databases by 2, scenario testing by 1. 2 general insurance respondents said that they were intending to model operational risk in the future.

3.27 In general, there was a feeling that good quantitative analysis is not currently possible, due to lack of data and lack of agreement on good techniques. There was general agreement that more analysis will be performed in the future, and that other sectors of the financial services industry are probably ahead of general insurance in this regard. A couple of respondents mentioned that the BBA has started an operational risk loss database.

3.28 Some respondents said that they were in the very early days of data collection, and could not yet tell what sorts of data were the most useful. Others have not yet started data collection at all. Everybody agreed that there would be much more data collection in the future.

3.29 The FSA found that all firms that they surveyed had a plan for a loss database, and about 90% of firms were developing or implementing one, or had nearly completed implementation. This contrasts strongly with our findings: only 2 out of 8 respondents from general insurance companies mentioned loss databases explicitly.

3.30 As there is little data collection and modelling currently being undertaken, the issue of separating out operational losses from credit, market or other losses has not been generally addressed. One respondent, from outside the general insurance industry, said that this was not really a problem as they did not have significant credit or market losses. Other respondents recognised that this would be a problem in the future, as they collected more data and started to perform more quantitative analysis.

3.31 Although risk indicators were mentioned by a number of respondents, specific examples were few and far between. The examples that were mentioned included

- Number of complaints

- System downtimes
 - Membership levels/renewals
 - Conference attendance
 - Numbers of subscribers to website
 - Sickness.
- 3.32 Many of these are not directly applicable to general insurance companies, but there are some obvious parallels.
- 3.33 The FSA found that 86% of the firms they surveyed had at least started development of a tool for risk indicators. Again, the general insurance firms covered in our survey are less advanced in this respect.
- 3.34 Reporting practices vary widely, depending on the sophistication of the risk management framework. At one end of the scale there is monthly reporting from business units up through a risk committee hierarchy, together with quarterly reporting to the management committee. At the other end of the scale there is no regular reporting at all.
- 3.35 The FSA found that no firms had yet completed implementation of their operational risk frameworks. We would agree with this. Indeed, many general insurance companies are still only at the beginning of planning a framework, and are not yet either developing or implementing it.

Vision

- 3.36 At the end of the interview we asked people about the strengths and weaknesses of their approach to operational risk, and what they considered to be the important issues in operational risk today.
- 3.37 The characteristic most often seen as a strength was the embedding of operational risk management in the business, so that it is part of the culture of the organisation and is owned by the business. This reflects the view that risk management cannot be just an add-on to existing management practice. Other strengths that were mentioned included a commitment from top management, flexibility of approach, and established tools and processes.
- 3.38 Many respondents said that a big weakness was the lack of quantitative analysis, and that risk based capital requirements were not yet possible. Other common comments concerned a lack of commitment from top management, lack of tools and processes, and lack of value to the business.

3.39 There is clearly a common view as to what constitutes good practice, as shown by the fact that the strengths and weaknesses are so consistent.

3.40 There was less agreement on the important issues in operational risk. Some respondents talked about specific areas of risk, and others made more general points. General points that were made included:

- Commitment from senior management, and organisational culture
- Regulatory certainty: finishing and finalising the regulations, then implementation
- Capital requirements, and level playing field between banks, insurance companies and asset managers
- Data gathering and quantitative methods
- Better understanding of what operational risk actually means
- Developing frameworks and formal processes
- Establishing risk appetite
- Recognising upside risks as well as downside.

3.41 Specific risk areas that were mentioned included:

- Business continuity planning
- Outsourcing
- HR issues
- IT systems security
- Financial crime
- SARS
- War.

3.42 We also asked how the issues were expected to have changed in five years time. Most people thought that progress would have been made, but that the basic issues would stay the same. There was a general hope that things would have moved on beyond ticking boxes, and that some of the cultural change that is required would have happened. There would be more explicit management of operational risk, with formal processes, and more quantitative analysis. The advent of risk-based capital would lead to changes in the way management decisions are made. Also, there would be issues that we cannot now foresee!

4 Definitions and philosophy revisited

Definitions

- 4.1 There is still no definitive agreement about the boundaries between operational risk and other high level risk categories. The FSA indicates that it is more important to make sure each organisation has thought through the issues and has a holistic approach than to impose a standard set of definitions. This means whoever you talk to has slightly different boundary lines and concepts - a little like the early days of VHS/Beta Max and other Video Standards. In some ways this is not a problem - but it is a little confusing or cumbersome leading to the need check the specifics each time.
- 4.2 The high level words remain similar - "the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events" (Basel) or "losses arising from people, processes systems or external events" (FSA).
- 4.3 There still seem to be two main definitional areas to consider
- How to categorise risks at the "higher levels"
 - The treatment of specific items such as strategic risk and reputational risk.
- 4.4 At present the Basel higher level categorisation appears to be gaining favour. That is
- Internal fraud
 - External fraud
 - Employment practices and workplace safety
 - Clients, products and business practices
 - Damage to physical assets
 - Business disruption and system failures
 - Execution, delivery and process management.
- 4.5 As a contribution to the discussion and a practical illustration we attach a matrix of possible risks facing a Commercial Lines Underwriter (be it direct or broker based) as Appendix D. This shoes both the above "category level 1" headings, and the next level of detail "category level 2" - 20 categories in line with both Basel and the British Bankers Association "GOLD" database.

- 4.6 We could not agree amongst ourselves what the right approach to the following major risk headings should be:
- Reputational
 - Strategic
 - Legal.
- 4.7 In general the reason for the disagreement was not that these risks should not be considered but that in a pure sense of the word they were not truly "operational" - and further that identification, description, quantification and general treatment were at best difficult.
- 4.8 The arguments for including them were that they might as well be classed as operational risk as anything else and that the general approach to handling them was far more closely aligned with operational process management than anything else.
- 4.9 More specifically:
- Reputational risk could be the result of something else happening (which might have been operational in nature/origin eg poor claims handling, FSA fines) and so is a derivative not a risk in its own right. The alternative view is that an organisation's reputation could suffer without any operational (or other) failure having occurred eg due to general concerns about that type of organisation as a result of other companies' problems (arguably this would then be captured as an "external event")
 - Strategic risk - is determining strategy a "process or system" that should therefore be covered in operational risk? Or is it the implementation of the chosen strategy that is the operational process to be covered, ie not implementing the strategy properly is the operational risk loss? And what about failing to implement an inappropriate strategy?
 - Legal risk - a commonly used phrase and may not be a risk type in its own right eg as an external event if it's an (unexpected) change in law that causes the loss or eg perhaps it's a people/skills/process event if it's a problem with contract wordings that led to the loss.

Philosophical approach

- 4.10 We suggest that the traditionally different approaches of banks and insurers account at least in part for emerging differences of approach to the explicit quantification and treatment of operational risk.

- 4.11 Banks developed "pure" models of credit, market and liquidity risk. These models used assumptions based on pure measures of such loss event. Insurance companies developed risk based (stochastic) models at company or portfolio level using company wide profit and loss data. The former explicitly excludes operational risk, the latter implicitly includes it.
- 4.12 Banks have also tended to adopt process management techniques well ahead of insurers - the likes of "six sigma" and so on. It became natural for them to see the way forward as being the explicit modelling of operational risk.
- 4.13 Insurers tend to be more traditionally run (a sweeping generalisation) and slower to adopt new ways of doing business. Given their approach to financial management - the great swings in liabilities and assets making precise capital management difficult - it has been more natural for them to develop implicit approaches.
- 4.14 The two schools of thought are converging. The FSA has many of its senior people from the banking world. We speculate that taking the implicit approach is a short term solution. Insurance management teams would do well to take the explicit approach, and this will involve data collection and the inexorable move to explicit quantification.

5 Case Study - introduction

5.1 The working party had spent considerable time in its last report agonising over definitions and a risk assessment framework. They were determined this time to make progress with the issue of quantification.

5.2 However, and it is a big however, to undertake quantification requires data. Try as they might they were unable to find suitable sources: confidentiality was one issue, but more fundamentally few (if any) insurers yet collect information on operational risk issues. We perceive this is changing - but only slowly. In a year or two data will almost certainly be available, but we could not wait that long and for now we needed another approach.

5.3 We decided to create a fictitious case study: Middle England Life & General (MELG) plc. Whilst we have not illustrated every aspect of operational risk in this case study we have attempted to ensure it is:

- Based in reality. By pooling data from public and private sources the underlying figures are intended to be reasonably illustrative of the type of losses, both in terms of order of magnitude (severity/impact) and likelihood (frequency)
- Practical. By building on the personal experiences of working party members as well as published case studies we hope it is sufficiently "real life" to be a helpful tool - not just for this paper, but for other uses
- Easy for readers to relate it to their own circumstances.

5.4 The case study is written in three major sections:

- An outline of the company (MELG); its background, organisation, financials and a commentary on risk matters
- An exploration of several key methodologies
- An outline "Operational Risk Report" to the "group risk committee".

For the sake of clarity the case study only discusses the general insurance aspects of the business. Furthermore only 3 out of a possible 110 or so operational risk categories are described in detail. These were external fraud, systems development and implementation of strategic decisions.

5.5 As a newly appointed director of group risk you are charged with producing a report that:

- Reviews the enterprise wide risk management practices of MELG plc, with particular references to operational risks

- Ensures that MELG plc takes steps to establish and maintain appropriate risk management practices, adhering to any FSA regulatory guidelines to operational risk management and other best practices
- Informs the Group Risk Committee about past and current enterprise wide risk management issues, with a focus on exposure to operational risks.

5.6 The report is to investigate the past, current and projected future of the company quantifying issues wherever possible, and setting out findings, without fear of retribution, under the "whistle blowing rules" from the Group Procedures.

6 Case Study - description

MELG plc

- 6.1 This case study is completely fictional. While the company overview, historic accounts and other data are based on realistic elements of various UK companies using FSA returns, any resemblance to any specific company is purely co-incidental.
- 6.2 MELG plc is a large insurance company underwriting life and general insurance (both personal and commercial lines). There was a hostile takeover bid (which eventually succeeded) in the summer of 1998. It became (with an effect from January 1999) the UK subsidiary of a large multinational company with its parent (Megacentral Insurance Corporation Inc [MICI]) based in New York, USA.
- 6.3 The date is now April 2003. The company has just finalised its 2002 Accounts.
- 6.4 The company's origins in the UK may be traced back to the early 1900s when it started as a small life office, based in the Midlands. In these early days it diversified into non-life business and started to offer private motor insurance and then other "personal" lines. Although it developed a commercial motor account it was only when it acquired a commercial insurance company in 1995 that it became a serious commercial insurer.
- 6.5 The gross earned premiums and some financial outcomes for 1995 - 2002 (actual) are set out below, together with a breakdown between personal and commercial lines.

(£ million	1995	1996	1997	1998	1999	2000	2001	2002
* Personal lines	1,001	1,204	1,297	1,305	1,409	1,597	1,709	1,908
F Commercial lines	77	112	139	167	199	240	298	497
o Gross premium	1,079	1,316	1,436	1,473	1,609	1,838	2,008	2,406
U/W result	298	421	239	205	39	-124	4	-76
a								
s Net assets	539	959	1,372	1,728	2,100	1,983	1,813	1,384
e Solvency ratio	50%	73%	96%	117%	130%	108%	90%	58%

(For ease of construction the figures are based on the consolidated of FSA returns of the leading 6 household and leading 6 employers' liability insurers. It is accepted that motor insurance is omitted).

- 6.6 MELG plc currently operates through 3 major sites (one in the north, one in the Midlands which is where its head-office is co-located with an operational site and one in the south) with 10 local offices. Its profitability has generally been in line with market averages.
- 6.7 There has been recent change in senior management, with its current CEO being appointed by the parent company (MICI) in January 2002. After 3 months he appointed his own senior team, including one outsider, the FD who came from a "FMCG" background, and had previously worked with the CEO in retail environment.
- 6.8 The new CEO's own background included spells at a bank, and before that at a firm of accountants; he accepts this was some time ago. His most recent experience was in retail (in New York, USA) where he gained a reputation for acquiring smaller businesses and implementing centralised back office functions that enabled significant staffing level reductions and associated cost savings. He is also a personal friend of the parent company Chairman, having known him since their university days.
- 6.9 In July 2000, the parent company (MICI) set an aspect of policy that had a detrimental effect on the insurance firm because of its group investment objectives. You understand that MELG plc did not completely check the suitability of the investments made on its behalf by the parent company. It appears that the MELG plc balance sheet was used to make strategic investments for the USA parent. The subsequent market downturn in the USA has resulted in significant losses, as at April 2003.
- 6.10 The Group Management decision to try and achieve 70% personal lines and 30% commercial lines was also taken in July 2000, such that the 70%:30% split could be achieved for 2001 onwards. This Group Management was imposed on the UK management team, who at the time would have preferred to maintain a 90%:10% split between personal lines and commercial lines. Their projection for group was:

£ million	2001	2002	2003	2004	2005	2006	2007	2008
Personal lines	1,709	1,908	2,004	2,099	2,194	2,290	2,481	2,710
Commercial lines	298	497	697	1,045	1,145	1,219	1,294	1,369
Gross Premium	2,008	2,406	2,701	3,145	3,340	3,510	3,775	4,079
U/W Result	4	-76	130	232	342	196	28	-134
Net assets	1,813	1,384	1,803	2,277	2,764	3,191	3,543	3,826
Solvency ratio	90%	58%	67%	72%	83%	91%	94%	94%

- 6.11 Their minority report at the time showed the following final projections on a 90%:10% basis (adjusted in all other respects to be comparable with the 70%:30% split).

£ million	2001	2002	2003	2004	2005	2006	2007	2008
Personal lines	1,709	1,908	2,004	2,099	2,194	2,290	2,481	2,710
Commercial lines	298	497	500	450	425	400	380	360
Gross Premium	2,008	2,405	2,504	2,549	2,619	2,690	2,861	3,070
U/W Result	4	-76	130	240	360	210	200	180
Net assets	1,813	1,384	1,803	2,277	2,764	3,200	3,600	3,900
Solvency ratio	90%	58%	67%	72%	95%	100%	110%	120%

- 6.12 The parent company (MICI) is a global insurance company based in New York, USA. It is a centrally managed global firm with operations in 50 countries. The group management is powerful and has tended to determine the group strategic and investment policy on behalf of the local operations. MICI found itself to be in financial difficulties with its UK operations result of the group (strategic investments) already mentioned and a large external weather catastrophe in 2001, combined with inadequate reinsurance planning.
- 6.13 MELG plc has a limited degree of autonomy from its parent company. Its Board meets 8 times a year and as well as 3 executive directors, the Chief Executive Officer, the Finance Director and the Group Operations Director. It has 3 representatives from its parent and 2 external non-executive directors.
- 6.14 It is required to submit plans on an annual basis with results and updated forecasts on a monthly basis. As well as accounts, it submits a series of key performance indicator management information.
- 6.15 The management structure of MELG plc is outlined below. (omitted).
- 6.16 There are 2,600 general insurance staff, of which 900 are in its Midlands office, 600 in each of its north and south offices and 500 spread over the 10 local offices, including a team of [50] inspectors (broker sales force), and [50] external claims staff.

- 6.17 It operates a matrix management philosophy. Each executive team member "owns" one of the key business processes and has a responsibility for its improved quality across the whole organisation. The main customer processes are defined as:
- Customer and customer needs definition
 - Product design and product review
 - Pricing and underwriting
 - Sales (both direct and indirect, including agency control)
 - Renewals and servicing
 - Claims handling
 - Support processes of IT, HR, Planning, Financial control, Investments, cash handling, Risk assessment and management (including compliance, internal audit and special investigations), Administration and Secretarial.
- 6.18 The organisation is now considered as 3 main strategic businesses:
- Commercial insurance
 - Personal intermediary insurance
 - Personal direct insurance.
- 6.19 The MELG management decision making process changed during 1999, following its acquisition by MICI. Prior to that time it operated on a more consensus, delegated basis. The cultural change has been a difficult one, leading to the eventual resignation of its long-standing UK Chief Executive Officer, and the Financial Director a few months later. There was no suggestion of poor management at that time - the culture clash had become a real point of friction: however since then many problems have been blamed on previous management.
- 6.20 The personal lines business has been more profitable than the commercial lines. This differential profitability is expected to remain so in future years.
- 6.21 The personal lines financials are as indicated below, on a comparable basis to the actual results and the projections to 2008. (Omitted).
- 6.22 The commercial lines financials are as indicated below, on a comparable basis to the actual results and the projections to 2008. (Omitted).

- 6.23 The UK management team's preferred 90%:10% split would have been produced plans as follows. (Omitted)
- 6.24 The Financial Results and Projections for 1995 to 2008 have been summarised via Appendix C of this report. The figures in this Appendix are on a comparable basis, with a projected 70%:30% split between personal and commercial lines being applied throughout the projection period 2001 to 2008. The years 1995 to 2002 are actuals, whereas the years 2003 to 2008 are projections, based on a reasonable set of business assumptions.
- 6.25 In mid 1993 a new direct channel was launched. The projected cost at that time was £30m to P & L, based on new marketing budget of £10m pa., extra staff costs, £5m investment in systems all offset by growth of business and eventual profit. A retrospective analysis undertaken in 1998 suggested that the actual cost was in the region of £70m, partly due to expense overruns and partly to lower than expected business growth.
- 6.26 The structure of the 3 current, separate strategic business units was established in January 1997. The commercial business was self contained and largely staffed by people from the acquired commercial company. The Personal direct business which had previously been considered a sales channel of the Personal lines business was now given autonomy for all aspects of its business. In the event it decided to outsource its claims handling to the personnel intermediary business (after initial notification). The projected cost of this change was £10m. A retrospective analysis suggested the real cost had been nearer £60m, comprising loss of revenue £40m, extra expenses £5m (not saved) and poorer loss ratio £15m as a result of taking eye off underwriting and claims handling. There were a number of cultural tensions.
- 6.27 A commercial policy underwritten in the 1980's has brought to light a loss (as at December 2002) of £50m and a reserve increase of £20m, which was unexpected as it was thought that there was full reinsurance protection for losses in excess of £25m.
- 6.28 The MELG stop loss reinsurance treaties for its gross loss of £50m should have recovered £25m, but there was a nil recovery. The company blamed the Megacentral Insurance Corporation Group Risks department who had reviewed the reinsurance programme and agreed terms with the lead reinsurer. The Group Risks department blamed the UK company's management for failing to spot the problems with the final draft reinsurance treaties that had been sent to the UK team for final approval. The result was an unexpected loss of £25m.

- 6.29 As previously mentioned the parent company has in effect set an aspect of investment policy that had a detrimental effect on MELG plc because it had group objectives other than prudent management of the UK insurance firm. Group management in the USA have in effect overridden local decisions in the UK. Consequently, local management have either lost some autonomy or they did not properly check the suitability of their investments. Group management in USA effectively used MELG's balance sheet to make strategic investments on a group wide basis. The Group had also used the company's balance sheet to make a strategic investment. This investment (loan to a key producer in the USA) has now defaulted (in October 2002), costing £20m.
- 6.30 A key corporate relationship for MELG plc collapsed in January 2001, primarily as a result of Group initiated management changes at MELG plc in September 2000. The key corporate partner was unimpressed by the new Business Development Manager from Chicago (USA) and decided to invite competitive tenders for the contract renewal on 1 January 2001. As a result, the £100m "block account" (personal lines) was lost.
- 6.31 Fraud led to a further loss of £5m. The fraud involved a third-party supplier selected by the UK Company to provide services to insurance clients. The fraud was reported by an employee at the supplier. Subsequent investigation revealed that a junior manager at the Company was aware of potential irregularities but had not disclosed this information due to lack of confidence in whistle-blowing procedures.
- 6.32 A recent "Delphi" method assessment of fraudulent and "misrepresented" claims leakage leads to an assessment of over payment of claims as follows:
- 15,000 incidents in 1995 costing £30 million in total
 - 12,000 in 1996 costing £30 million
 - 22,000 in 1997 costing £45 million
 - 15,000 in 1998 costing £36 million
 - 23,000 in 1999 costing £42 million
 - 20,000 in 2000 costing £47 million
 - 15,000 in 2001 costing £40 million.
- 6.33 These figures are not out of line with levels asserted as realistic by the ABI.
- 6.34 Group management also overrode local management with respect to reinsurance policy. On the occurrence of a large external catastrophe in March 2000, with a gross loss £100 million, only £10 million was recovered from the reinsurance treaties, instead of the £50 million that had been expected. The local UK

management blamed the Group Risks department in New York, who had reviewed the reinsurance programme and agreed the terms with the lead reinsurer. The Group Risks department blamed the UK management for failing to spot the problems with the final draft reinsurance treaties that had been sent to the UK team for final approval. The Group Internal Audit department blamed both parties for their evident lack of communication. The overall result was an unexpected loss of £40 million.

- 6.35 Systems developments have traditionally lead to over spends. In the last 7 years there have been 12 major overspends averaging £2.2 million. A new project is planned (again influenced by Group management). Its outline budget cost for 2003/04 is £20 million. It is already 3 months behind schedule and there is an over-spend of £2m compared to the phased budget. The system specification had been developed to incorporate Group and Company requirements but without effective co-ordination. The result also appears to be probable weaknesses in reporting of third-party supplier transactions.
- 6.36 The overall result of the above was that the FSA Arrow monitoring visit in mid 2002 resulted in a series of issues and concerns and then a full investigation. The net result was that FSA required MICI to transfer £100m to the UK to maintain an adequate solvency margin for MELG plc over the foreseeable future.

General comments based on the risk directors preliminary assessment

- 6.37 Large composite insurance firms can be hard to manage efficiently at the best of times, particularly those that have grown up through a series of acquisitions and mergers.
- 6.38 Further complications can arise for UK subsidiaries of multinational corporations. In the case of MELG plc, Group Management in New York, USA thought that they understood the UK insurance market very well, as they had carried out a major desk research study on the UK prior to acquiring the business in late 1999. Furthermore, there was no perceived language barrier, and they had read UK English text assessments of the UK market and its prognosis for the years 2000 to 2005. With hindsight, it would now seem that there might have been some cultural differences between the UK and USA approach to the management of long term corporate relationships.
- 6.39 MELG plc still faces multiple legacy systems and ongoing system integration problems, so production of consolidated management information is unreliable. This further hampers the effective running of the group from the centre. The three separate business units have diverse types of cover, structure and culture, which again make centralised control difficult and exacerbate already poor financial and underwriting disciplines. There appears to be a very high expense

ratio and large losses as the firm tried to compensate for previous under-pricing and under-reserving. Merger costs were higher than expected and MELG made little headway in achieving the forecast cost-side synergies.

- 6.40 Early warning indicators (the high expenses combined with poor results) and general conversation indicate that management is under pressure to achieve volume (at the expense of underwriting profitability). Management may also be under pressure to report better results in the light of negotiations for further mergers or acquisitions, or to meet capital market expectations for a listed company.
- 6.41 In the 1990's MELG was concentrated in "traditional" markets with declining profitability. In response it sought to grow, and moved into non-core business areas. A major problem was that management had little wider experience and moved outside their field of expertise. Areas they moved into were:
- Non-insurance activities (garage management): these businesses undershot revenue targets and overshot expense budgets, leading to losses which threaten solvency
 - Illiquid, risky, concentrated property investments that performed poorly and where further losses that had not been provided for arose on sale
 - New classes of insurance (a specialist commercial lines account): systems and controls over underwriting were poor and the MELG was unable to assess risks properly leading both to incorrect pricing and to a reinsurance programme poorly matched to the claims profile of the business.
- 6.42 There have also been "procyclical" effects as investments, particularly those in other insurers, fell in value when market conditions deteriorated. This was made worse by group pressure to provide more loans and capital to the investee rather than less - inadequate credit provisions also became a problem. This carried a systemic contagion risk, i.e. that the collapse of one insurer is more likely to bring down others.
- 6.43 Support services for MELG plc include IT, HR, Planning, Financial control, Investments, cash handling, Risk assessment and management (including compliance internal audit and special investigations), Administration and Secretarial services.
- 6.44 The support services risk is largely the result of internal business processes, which if they fail can lead to operational losses.

7 Case Study - methods applied

- 7.1 Hope springs eternal. The working party had hoped to demonstrate the application of various methods based on real data. Failing that they next hoped to use the preceding case study. Time got the better of us. The following illustrations can best be described as being loosely based on the case study - or earlier versions of it. They were developed with the case study in mind, but the timing of production meant that they were produced at different times and became "out of sync" with the final version of the case study.
- 7.2 Nevertheless the working party felt that they were a useful addition to thinking in this area and in the spirit of GIRO present them with this warning in mind. They fully intend, as mentioned in the introduction (see 1.4) to refine and develop this, in order to produce a useful tool for the actuarial profession.
- 7.3 Based on the previous descriptions the working party has explored the application of a number of methods. Each method is explored using the following headings:
- Description of method
 - Illustrated application based on data
 - Observations.
- 7.4 Last year the working party set out a number of methods. These were grouped into four main families.
- Statistical (curve fitting):
 - empirical
 - max loss
 - theoretic pdf
 - regression
 - Extreme Value Theory (EVT)
 - stochastic differential equations.
 - Statistical (Bayesian)
 - systems (dynamic) models
 - influence diagrams
 - Bayesian belief networks
 - Bayesian causal models

- process maps and assessments
- TQM/process mgt
- neural networks.
- Expert
 - fuzzy logic
 - direct assessment of likelihood
 - preference among bets
 - delphi method
 - CAPM (market view less insurance/asset risk values)
 - RAMP.
- Practical
 - stress testing
 - business/industry scenarios
 - comparing market betas for individual companies with market sectors.

7.5 Following discussion, this year's working group has examined 5 of these:

- Basic curve fitting
- EVT
- Bayesian causal modelling
- Delphi
- Stress and scenario.

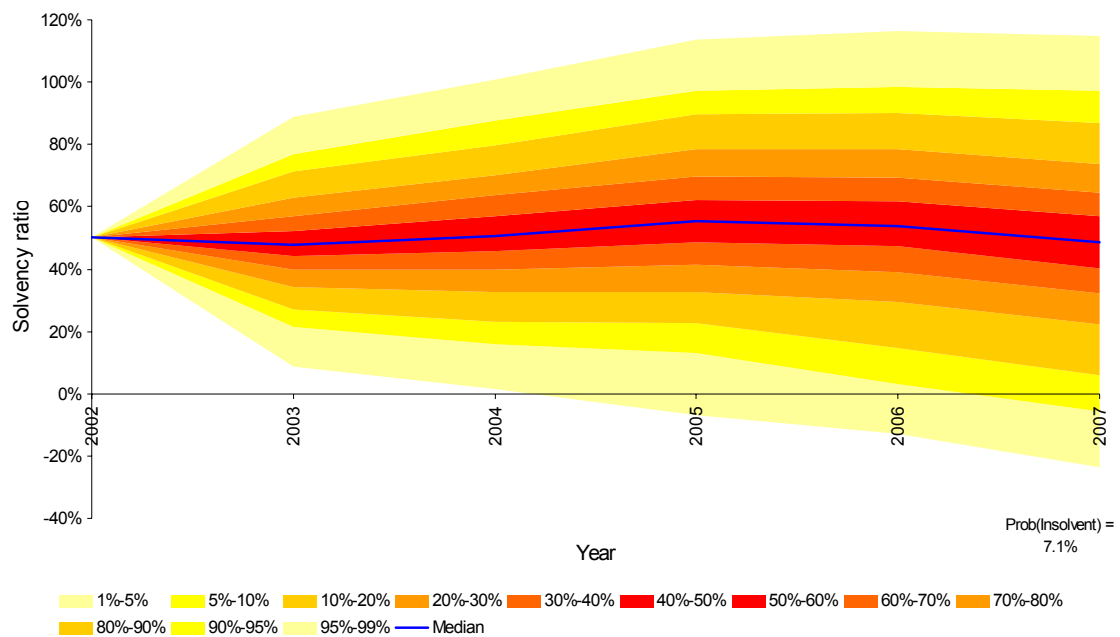
Basic Curve Fitting

7.6 We present two approaches to curve fitting. Both are natural developments of standard actuarial stochastic modelling, or dynamic financial analyses.

Approach A (DFA modelling)

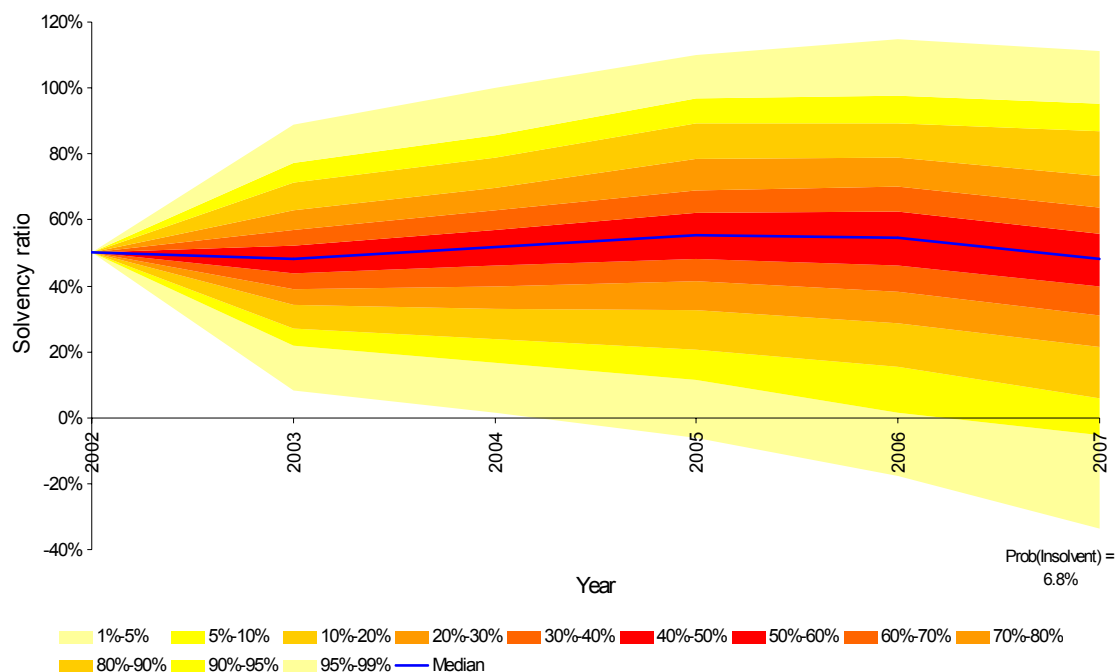
7.7 The basic approach is to take historic data and the separate out each operational risk from the underlying company information. That is to develop "adjusted" base data with operational risk stripped out. Having done that a standard dynamic financial model is produced for the company, assuming in effect zero operational risk.

- 7.8 The operational risks are then separately modelled, using desired probability distributions. In this case we used poisson for frequency and gamma for amounts.
- 7.9 The various models can then be combined, and a composite model with operational risk explicitly incorporated is produced
- 7.10 To illustrate the point the following uses three explicit operational risks - strategic, systems development and claims fraud. The reader will note the inclusion of strategic risk which may be seen as controversial. For those who feel strategic risk lies outside operational risk please accept this as purely for illustration purposes. We ask however when considering the causes of loss whether in reality they are clearly operational implementation of strategic decisions.
- 7.11 First we show the median and "funnel" projections for the company incorporating the segregated operational risks on an implicit basis:



You can observe here that the probability of ruin (defined here as the probability of insolvency in 5 years) is 7.1%.

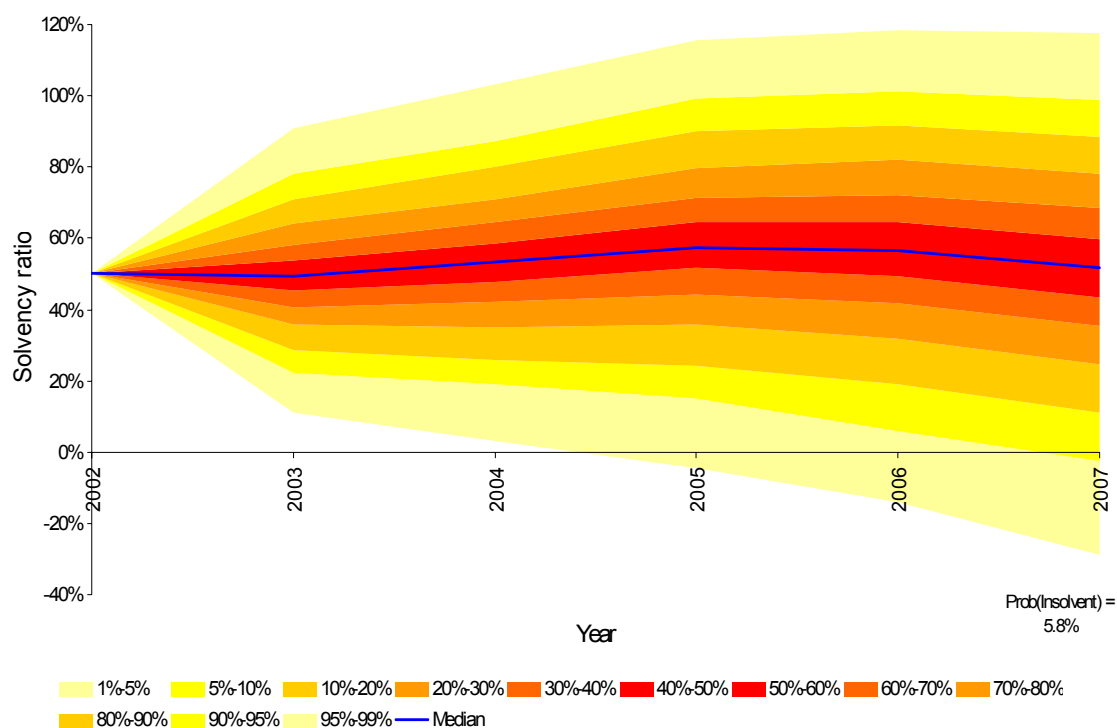
- 7.12 Next we recreate the model with the three types of operational risk being explicitly modelled. We assume they are not correlated with other aspects of the model. (See output below).
- 7.13 The mean projected solvency ratio remains similar to the implicit model (thankfully as the underlying data is the same), but it shows a reduction in the probability of ruin to 6.8%. This small reduction is due to the small diversification benefit.



- 7.14 A closer inspection of the tails shows that:
- The -0.1% moves from -48.4% to -66.2%, and
 - The -0.5% moves from -33.6% to -32.2%.
- 7.15 A moment's reflection may help readers to realise why this apparent contradiction occurs. The nature of the losses now being explicitly modelled is that from time to time there will be very large events - much larger than that modelled in the implicit approach. Overall the diversification benefit reduces the risk of ruin - seen here in the movement in the -0.5% point on the funnel. But just occasionally there will be a large event and this pushes the -0.1% point out from -48.4% insolvency to -66.2%. A logical consequence of the modelling assumptions.

Observations

- 7.16 Clearly the ability to use this approach is dependent on data. If reliable data is available it does start to enable the risk manager to make informed judgements about how changes to systems and controls, or the risk environment might affect required levels of risk based capital.
- 7.17 For example if the nature of the management approach and the number of strategic decision was in some sense made more "prudent", it would be possible to change assumptions about some of the risk categories - either reducing the assumed mean frequency, or mean amount. Remodelling on an explicit basis would then show improved probability of ruin figures. The following shows the position if the probability of a strategic risk event is judged to be 75% of the past level.



- 7.18 The nature of this thinking leads naturally to considering whether the use of poisson/gamma distributions is correct, or if some other might be better. The obvious place to look is at "extreme value theory".

Approach B (Mathematical curve fitting)

- 7.19 The data being sparse, no attempt was made to model different loss types separately. The aim was to model the annual loss due to operation risk events and hence the data as presented in paragraph 6.38 was used as a starting point.
- 7.20 The number of losses was modelled as a poisson variate with mean equal to the mean of the number of events in the table in paragraph 6.38. Note that although the poisson is commonly used to generate numbers of losses it may not be entirely appropriate in this case as the observed mean and variance are not equal.
- 7.21 For the distribution of loss severity, the full set of individual loss amounts was used as per the data in paragraph 6.37. We looked at three distributions commonly used to model insurance losses and which are simple to apply using Excel, these being the lognormal, weibull and gamma distributions. The parameters were estimated using the data and then the fit examined by graphing the cumulative distributions for the actual and model data and looking at the Q-Q plots of actual versus model for each distribution. A chi squared test was also used to look at the appropriateness of the three alternatives.
- 7.22 The frequency and severity distributions were then used to model annual losses stochastically for a large number of simulations using @Risk.

Basic Curve Fitting – Results

- 7.23 From the observed distribution of outcomes the table below shows the expected loss and a selection of the higher percentile points – those corresponding to 1 in 100, 1 in 250, 1 in 500 and 1 in 1000 scenarios.

	Poisson/ Lognormal	Poisson/ Weibull	Poisson/ Gamma
Expected annual loss (£m)	30.1	25.0	25.3
99.0 th percentile	241.4	157.9	128.1
99.6 th percentile	328.0	204.1	158.6
99.8 th percentile	435.2	235.6	161.9
99.9 th percentile	522.4	266.1	182.0

- 7.24 Visual inspection of the graphs suggests that the weibull or lognormal better represent the loss experience to date than the gamma, but no more than that. A simple chi squared test suggests that the lognormal is the better fit.

Basic Curve Fitting – Comments/Issues

- 7.25 With small amounts of data, deciding which is the most appropriate distribution type to use becomes very subjective. Note the wide variation of outcomes just between the three distributions used above.

Extreme Value Theory - Methodology

- 7.26 Just as a reminder, the extreme value distribution has distribution function $1 - \lambda(1 + \xi(x-u)/\sigma)^{-1/\xi}$, where u is large and a threshold size above which the distribution holds, $\lambda = \Pr(X \geq u)$, ξ and σ are shape and scale parameters.
- 7.27 The working party decided to use EVT for the loss size distribution, using the same Poisson distribution as above to model loss numbers.
- 7.28 The working party used a pragmatic approach to parameterising the extreme value distribution. The starting point was to determine u , the loss size above which the extreme value distribution could be assumed to be appropriate. This was done by plotting loss size against the mean excess above this loss size. The point at which this graph became linear could be taken to be u . It also determines the value of λ .
- 7.29 The shape and scale parameters, ξ and σ are then determined by maximising the log likelihood function for the extreme value distribution $(-\log \sigma - (1/\xi + 1) \sum \log(1 + \xi(x_i - u)/\sigma))$, for $i=1$ to r , the number of observations larger than u .
- 7.30 This then defines the distribution for losses above u in size (or alternatively for losses where $\Pr(X \leq u) > \lambda$). For losses below u in size, normal curve fitting approaches can be used to determine a distribution and this can be scaled so that at size u , the two distributions meet smoothly.
- 7.31 The frequency and Extreme value severity distributions were then used to model annual losses stochastically for a large number of simulations using @Risk.

Extreme Value Theory – Results

- 7.32 From the observed distribution of outcomes the table below shows the expected loss and a selection of the higher percentile points - those corresponding to 1 in 100, 1 in 250, 1 in 500 and 1 in 1000 scenarios. We also show the basic curve fitting results alongside for comparison.

	Poisson/ EVT	Poisson/ Lognormal	Poisson/ Weibull	Poisson/ Gamma
Expected annual loss (£m)	32.8	30.1	25.0	25.3
99.0 th percentile	101.2	241.4	157.9	128.1
99.6 th percentile	196.9	328.0	204.1	158.6
99.8 th percentile	423.4	435.2	235.6	161.9
99.9 th percentile	831.4	522.4	266.1	182.0

EVT – Comments/Issues

- 7.33 Although in this case the choice of u , the threshold loss size, was reasonably obvious from the mean excess plot, it was clear that this might not always be true. The smaller the dataset used, the more subjective the choice of u could become, as any linear relationship becomes less obvious and more a matter of interpretation.
- 7.34 The working party used Excel to perform all the calculations required. This was a little time consuming to set up initially, although thereafter could be easily replicated. Statistical software packages might be expected to do this more efficiently and more robustly.
- 7.35 It is interesting to see that the extreme value approach actually gives less extreme outcomes at the less extreme percentiles.

Causal modelling

Introduction

- 7.36 Cause-effect risk mapping has been used in many fields and industries, including motor car diagnostics, medical diagnosis, patient monitoring, epidemiology, environmental management, military planning, banking regulation and financial services. The insurance industry is a late convert to causal modelling, following on behind the late entry of the banking sector and other financial services organisations.
- 7.37 Cause-effect risk mapping has been used by the UK and EU regulatory authorities to investigate the likely causes of "failures" of EU insurance companies. FSA Occasional Paper 20 reported on the London Working Group of EU regulators study of such "failures". They dissected recent experiences of

failed insurance companies and "near misses", across the life and non-life sectors. The group identified the risks that have threatened firms' solvency during the period 1996 to 2002, including how multiple risks interacted in individual cases. It also assessed existing supervisory practices, particularly those aimed at prevention and advance detection. The principal conclusions were:

- Management problems appear to be the root cause of every failure or near failure, so more focus on underlying internal causes is needed
- Firms need to anticipate how risks can interact in complex ways, including causal links between different types of risk (e.g. operational risks and underwriting risk or claims evaluation risk) and unexpected correlations (e.g. between certain asset and underwriting risks)
- Moving to a risk-based approach brings benefits and at the same time has implications for policy-making and supervision; different supervisory approaches may be needed, including more forward-looking tools as well as greater international cooperation
- It is important to strike the right balance between prescriptive rules, principles, incentives and diagnostic tools.

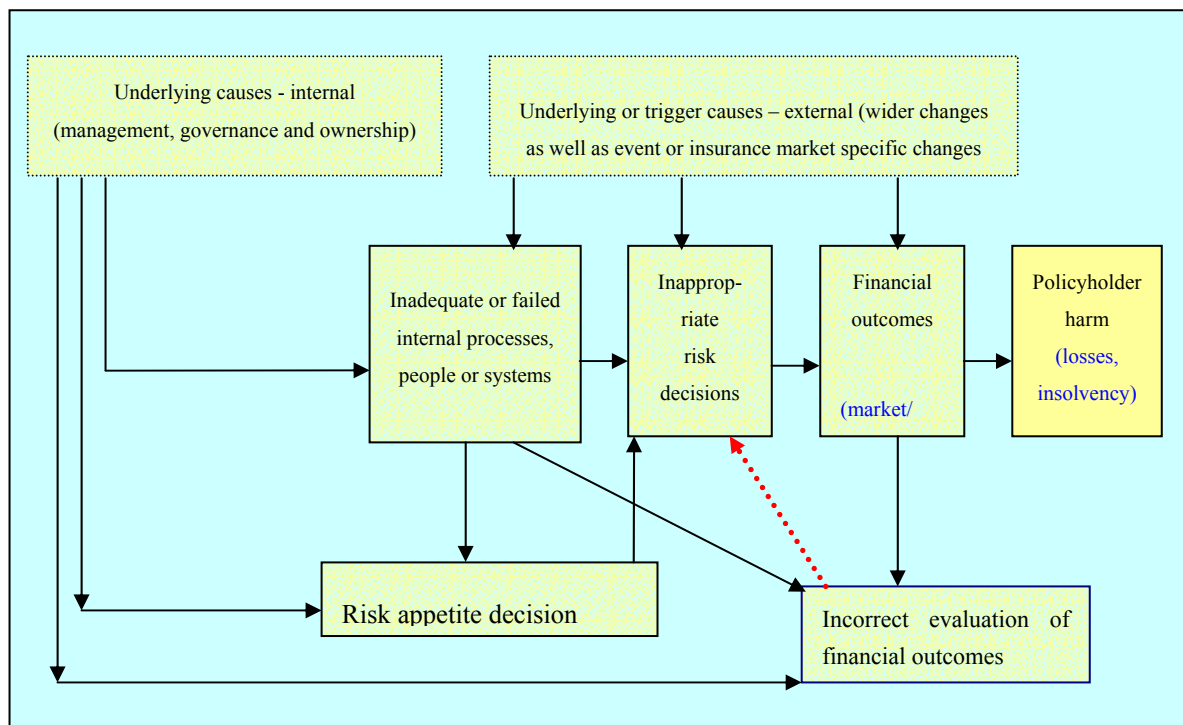
7.38 The paper presented some useful insights emerging from the work on a wide range of "failures" of EU insurers since 1996. One of the aims was to explain and make the findings more accessible to firms, professional advisers and front-line supervisors. The case studies and risk analysis were deemed to be of interest to those involved in the governance of regulated firms and those within the firms who have particular responsibility for monitoring risk, as well as those interested in policy development.

7.39 The group identified about 50 generic risks that had led to or threatened to lead to solvency problems at insurers, and concluded that the risks are linked in causal chains. For example, the risk of adverse claims development may arise from poor risk selection (underwriting risk), which may in turn arise from poor underwriting policy or controls (underwriting systems and controls risk), which may itself be due to lack of experience (management risk). This led to the design by the group of the cause-effect risk-map as a practical tool to help in analysing the case studies. Although there are many other ways to classify risk, the group looked at cause and effect because they wished to distinguish the root of a firm's problems from among all the issues that presented themselves, and to assess both the relative importance of the causes and their ultimate impact.

7.40 The high-level and detailed cause-effect risk maps shown in the FSA Occasional Paper 20 illustrate how the different risk types fit in, together with their causal relationships. These risk-maps were compiled from insurer risks that had recently caused difficulties. The risk-maps were structured by supervisors with extensive experience of how these risks can arise.

High-Level Risk Map (enterprise wide risk management)

7.41 Our interpretation of the high-level risk map shown in the FSA paper is shown below.



7.42 It is noteworthy that the FSA cause-effect risk mapping has an adaptive feedback control loop, from "incorrect evaluation of financial outcomes" back to "inappropriate risk decisions", which then leads on to "financial outcomes" and then cycles back to "incorrect evaluation of financial outcomes", and so on.

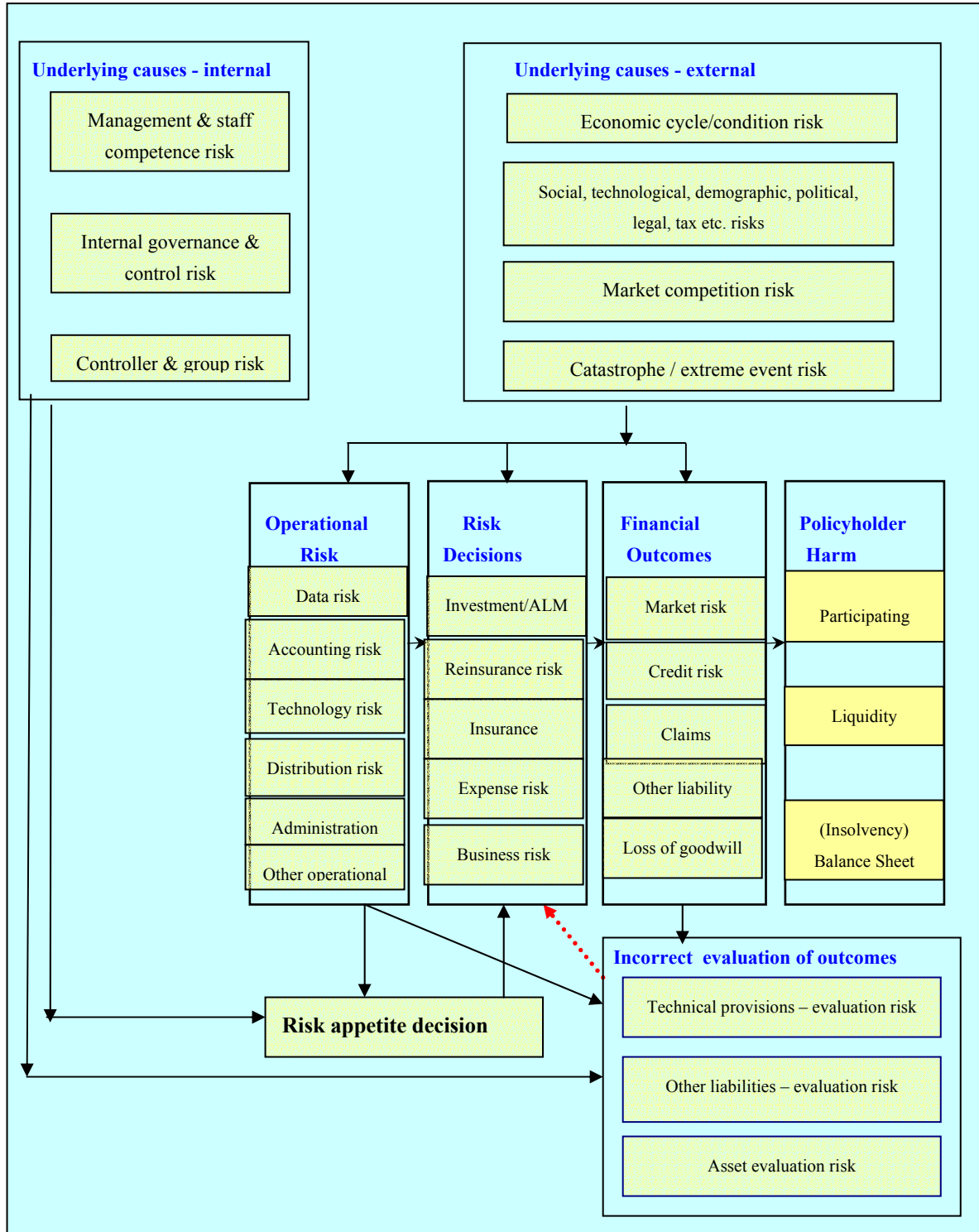
7.43 Our causal model recognises this adaptive feedback control cycle loop and then deals with it via examining the output from "incorrect evaluation of financial outcomes" to determine whether there is a continuing need to modify the inputs to "inappropriate risk decisions". In practice, this is a manual process requiring a sound interpretation of the model office outputs.

7.44 The FSA has in effect suggested 6 potential operational risk exposures, as outlined below, for the purposes of assessing the adequacy and impact of processes, systems and people.

- i. **Data Risk** - The risk that insufficient, inadequate or incorrect data is held or collected.
- ii. **Accounting Risk** - The risk that inadequate, inappropriate or incorrect financial reporting policies are adopted or applied. This includes both internal and external reporting.
- iii. **Technology Risk** - The risk of inadequate or inappropriate use (or non-use) of information technology or failure to understand the consequences of advance in information technology e.g. as a cause of increased claims size or faster claims settlement.
- iv. **Distribution Risk** - Inadequate control of distribution especially where distribution is through agents or other intermediaries or relies upon new technologies (e.g. Internet).
- v. **Administration Risk** - The risk of inadequate or failed administrative systems or staff including inadequate or failed communication between front and back office systems.
- vi. **Other Operational Risk** - Other risks of inadequate or failed internal processes, people and systems, including in respect of outsourced processes ('outsourcing risk').

Detailed Risk Map (enterprise wide risk management)

7.45 Our interpretation of the detailed cause-effect risk map is shown below.



Causal Model for Enterprise Wide Risk Management

- 7.46 Our starting point was the risk map used by the London Working Group of EU regulators, as documented in FSA Occasional Paper 20. This was subsequently followed up (in December 2002) by the FSA London Working Group report on the prudential supervision of insurance undertakings, entitled *"Conference of Insurance Supervisory Services of the Member States of the European Union"*.
- 7.47 The cause-effect risk map has both qualitative and quantitative components. We have used a simplified version of the cause-effect risk map, which allows for 15 nodes (for the Belief Network and the Influence Diagrams) and the relationships between them.
- 7.48 The software used for the research was Netica version 1.12 (limited functionality version), from Norsys Software Corp. The application uses Belief Networks and Influence Diagrams to enable the building of causal models for a wide variety of applications, including medical diagnosis, car diagnostics, military planning, environmental management and enterprise wide risk management for insurance companies.
- 7.49 The example Insurance Belief Network contains 15 nodes to indicate some generic risks that might be appropriate for an insurance provider. Each of these nodes could be the starting point for a series of risk constellations which examine in more detail the causal factors which contribute to the overall risk factor e.g. Governance / control is a product of different factors such as staff competence, adequacy of corporate governance and influence of shareholders, parent companies.
- 7.50 We believe that the development of a practical extended Belief Network would in practice need to be a multidisciplinary project involving members of the each company's strategic key business units. The actual business outcomes might then be tested versus the Network's output, where there is a divergence the risk components should be assessed and the causal relationships in order to restate the actual business outcome using the Network.
- 7.51 It is noteworthy that the FSA cause-effect risk mapping has an adaptive feedback control loop, from "incorrect evaluation of financial outcomes" back to "inappropriate risk decisions", which then leads on to "financial outcomes" and then cycles back to "incorrect evaluation of financial outcomes", and so on. The prototype causal model recognises this adaptive feedback control cycle loop and then deals with it via examining the output from "incorrect evaluation of financial outcomes" to determine whether there is a continuing need to modify the inputs to "inappropriate risk decisions". In practice, this is a manual process requiring a sound interpretation of the model office outputs.

Decision nodes - Causal Model for Enterprise Wide Risk Management

Node 1: Management and Staff Competence Risk

The risk that management, staff or other "insiders" lack the skills, experience or other personal or professional qualities to enable them to perform their tasks adequately/successfully. It includes the risk of over-reliance on 1 or more persons ("key person risk").

Node 2: Internal Governance and Control Risk

The risk of inadequate or failed systems of corporate governance and overall control, including the risk that arises from an inadequate control culture.

Node 3: Controller and Group Risk

The risk of inadequate or inappropriate direction, control or influence from connected persons (natural or corporate) including from major shareholders, parent undertakings and other group undertakings and the management of those undertakings.

Node 4: Economic Cycle / Condition Risk

The risk of adverse change in the economy, including adverse changes in economic variables such as interest, inflation, exchange rates.

Node 5: Market Competition Risk

The risk of adverse change within the insurance markets, including increases or decreases within a market of the demand for, or supply of, insurance products.

Node 6: Social, technological, demographic, political, legal, tax etc. risks

The risk of adverse change in the social, technological, demographic, political, legal, tax etc. environment

Node 7: Catastrophe / Extreme Event Risk

The risk of a catastrophe or other extreme event, including an extreme accumulation of events from the same or related originating cause.

Node 8: Strategy Risk - Incremental

The business strategy risk that emanates from all activities other than business innovation.

Node 9: Strategy Risk - Innovation

The business strategy risk that emanates from business innovation.

Node 10: Operational Risk

Operational risk can result from inadequate or failed internal processes, people or systems, and includes:

Data Risk - The risk that insufficient, inadequate or incorrect data is held or collected.

Accounting Risk - The risk that inadequate, inappropriate or incorrect financial reporting policies are adopted or applied. This includes both internal and external reporting. T

Technology Risk - The risk of inadequate or inappropriate use (or non-use) of information technology or failure to understand the consequences of advance in information technology e.g. as a cause of increased claims size or faster claims settlement.

Distribution Risk - Inadequate control of distribution especially where distribution is through agents or other intermediaries or relies upon new technologies (e.g. Internet).

Administration Risk - The risk of inadequate or failed administrative systems or staff including inadequate or failed communication between front and back office systems.

Other Operational Risk - Other risks of inadequate or failed internal processes, people and systems, including in respect of outsourced processes ("outsourcing risk").

Node 11: Risk Decisions

Inappropriate risk decisions generally result in an excessive risk appetite that is in due course proved to be unwarranted. The risk components can include:

Investment / ALM Risk - The risk that an appropriate investment strategy is adopted or that chosen investment strategy is inadequately implemented, including risk that assets and liabilities might not be matched due to an inadequate understanding of their liquidity, maturity and interest-rate structure; and the market, credit and other risks inherent from holding assets are not properly understood

Reinsurance Risk - The risk that inappropriate reinsurance strategy is adopted or that the chosen strategy is inadequately implemented, including the risks that the characteristics of gross underwriting or of reinsurance products are inadequately understood leading to the selection of inadequate reinsurance protection; and the credit-worthiness of reinsurance counter-parties is not properly investigated or understood

Insurance Underwriting - The risk that an inappropriate underwriting strategy is adopted or that the chosen strategy is inadequately implemented, such that the circumstances and events which might lead to the incidence of aggregation or loss, or expense, under insurance contracts are not properly investigated or understood; and the terms and conditions in insurance contracts are not properly understood

Expense Risk - The risk that an inappropriate expense management strategy is adopted or that the chosen strategy is inadequately implemented, including the risk that* uncontrolled cost escalation may occur, particularly on large projects, or financial and other (e.g. human) resources are used wastefully; and techniques to forecast, monitor and control expense levels may be poorly understood

Business Risk - The risk that other aspects of the business strategy are inappropriate or inadequately implemented including the risks of mis-selling ("mis-selling risk"); uncontrolled or rapid growth (or lack of planned growth) and its consequences for the adequacy or control of administrative resources, expenses or liquidity ("growth risk"); excessive concentration of business to a particular region or sector or accumulation of exposure to a particular type of risk ("business concentration risk"); non-insurance activities are inappropriately or inadequately controlled ("contagion risk")

Node 12: Financial Outcomes

The financial outcome risks have several risk components, including:

Market Risk - The risk of loss from general or specific changes in the value of assets, including adverse changes in stock exchange indices and interest and currency exchange rates

Credit Risk - The risk of loss from the failure of counterparty to meet its obligations as they fall due

Claims Deviation Risk - The risk of loss due to adverse deviation in the amount, frequency or timing of claims

Other Liability Risk - The risk of unexpected loss from other causes including liability arising from regulatory non-compliance, e.g. mis-selling; and loss or expense from non-insurance activities

Reputational Risk - The loss of goodwill or reputation, leading to loss of business and erode the firm's value

Node 13: Risk Appetite Decision

The risk appetite decision risk is that the senior management team will be excessively optimistic and/or have business objectives that are at odds with the prudent management of the business. For example, it is important that the insurer does not have a performance assessment and bonus policy for senior management that encourages an excessive risk appetite. Furthermore, the key assumptions that are most critical to pricing or reserving should be reasonable and not overly optimistic.

Node 14: Incorrect Evaluation of Outcomes

The incorrect evaluation of financial outcome risk has three components, as indicated below.

Technical Provisions Evaluation Risk - The risk that the technical provisions may prove to be insufficient

Other Liabilities Evaluation Risk - The risk of non-recognition or under recognition or delayed recognition of liabilities

Asset Evaluation Risk - The risk that assets are incorrectly valued

Node 15: Policyholder Harm

The incorrect evaluation of financial outcome risk has three components, as indicated below.

Participating Policyholder Loss Risk - The risk that variable benefits to participating (with profits) policyholders will fail to meet their reasonable expectations

Liquidity Risk - The risk of delay in meeting policyholder claims due to inadequate liquidity

Insolvency and Balance Sheet Risk - The risk of inability to meet policyholder claims in full due to insolvency, i.e. liabilities exceed assets

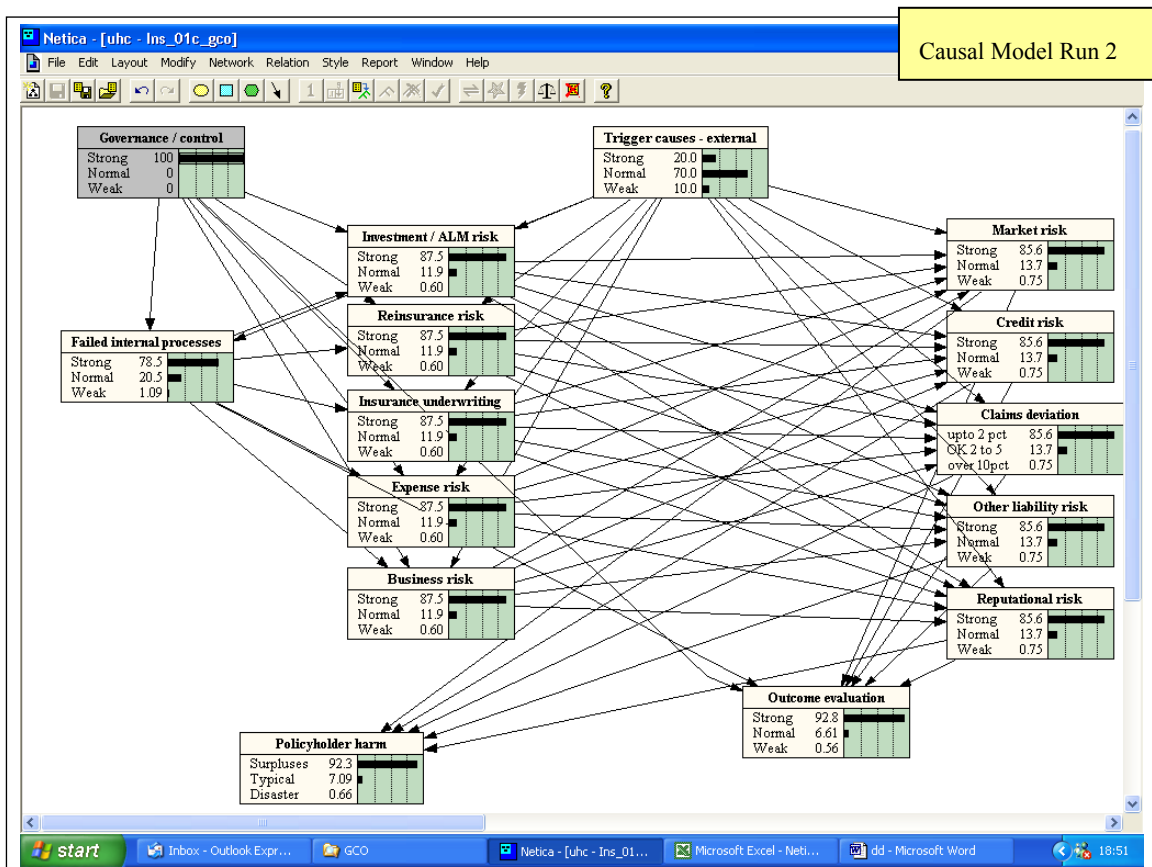
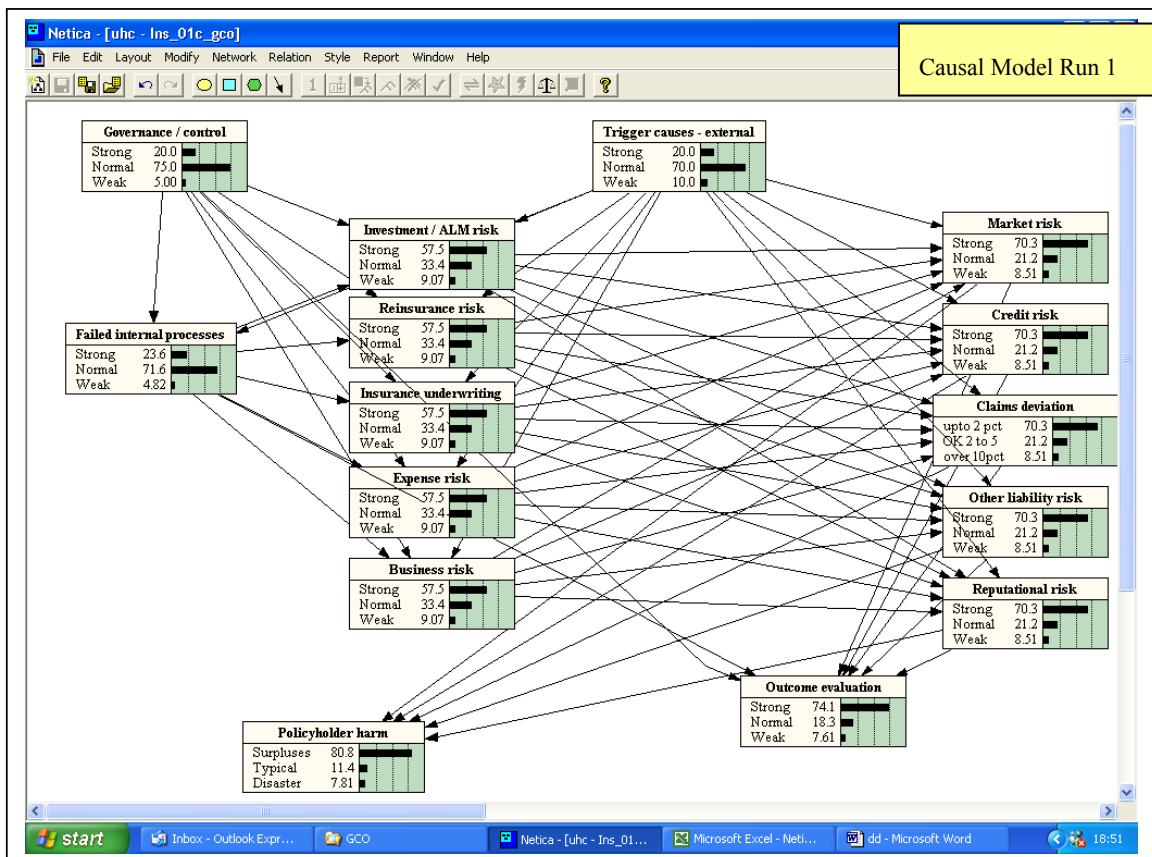
Inconvenience and Market Disruption Risk - The effect of negative risk experience on policyholder and market e.g. policyholder may transfer their policy to another provider on disadvantageous terms.

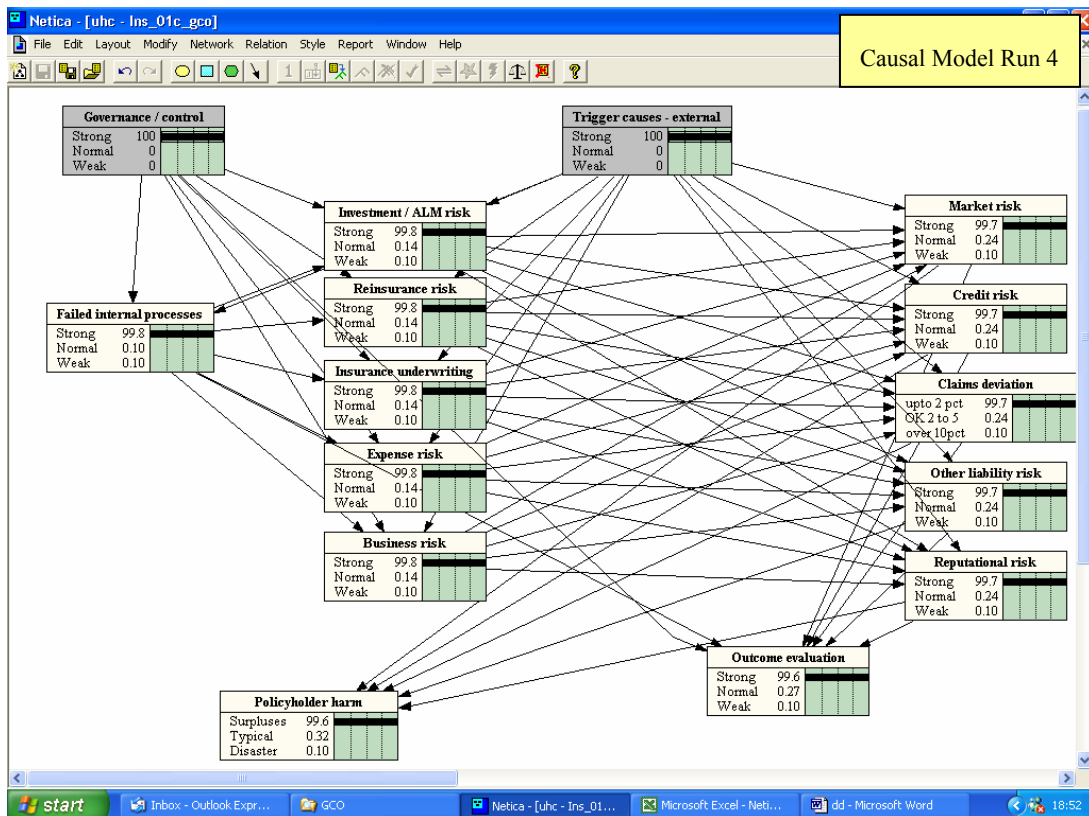
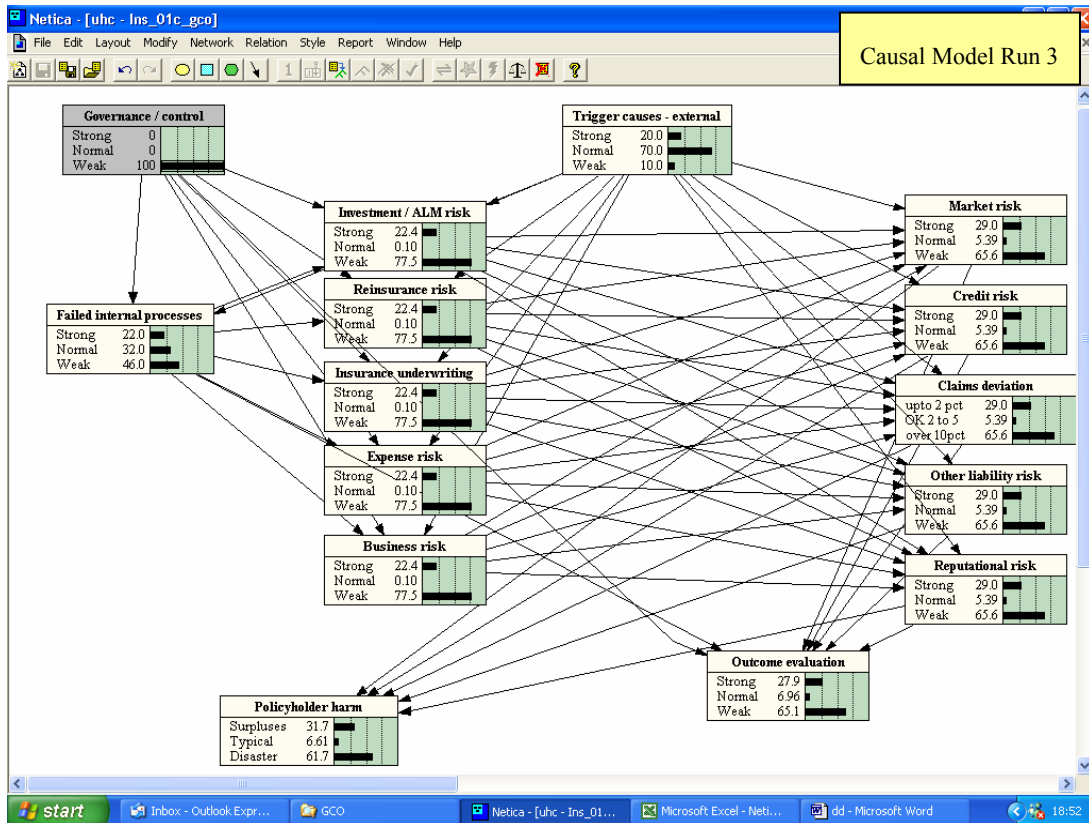
Selected Images - Causal Model (enterprise wide risk management)

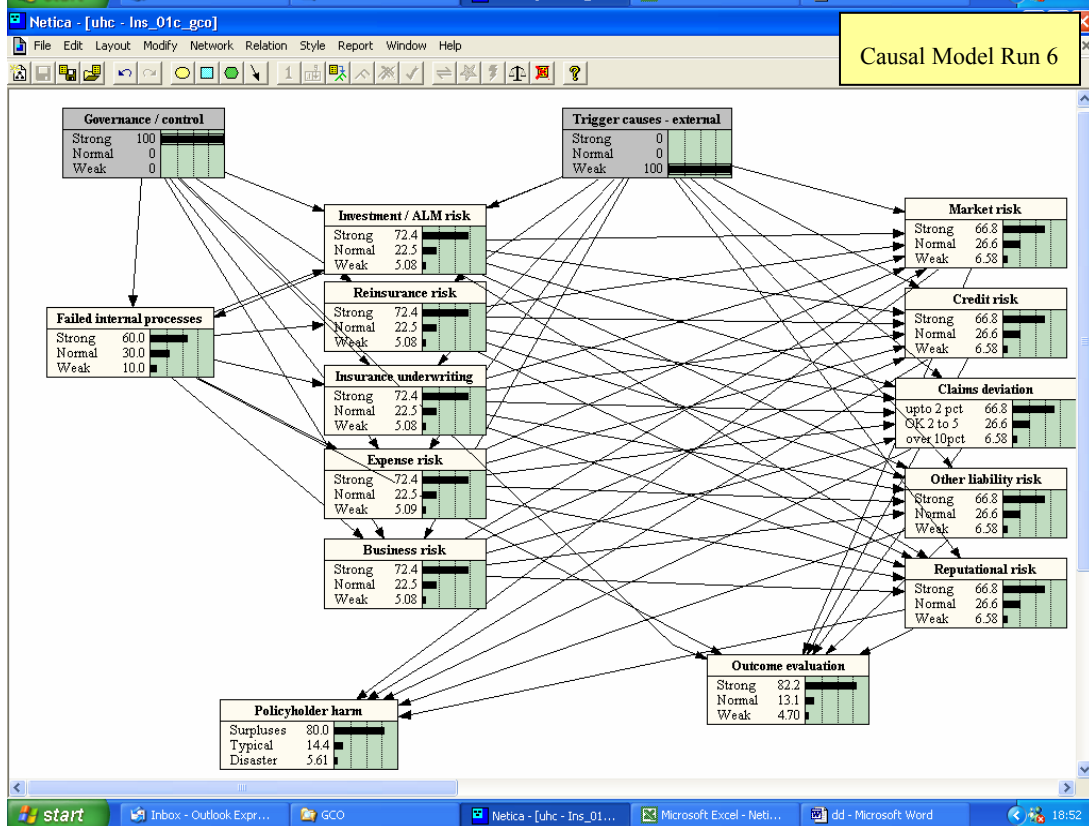
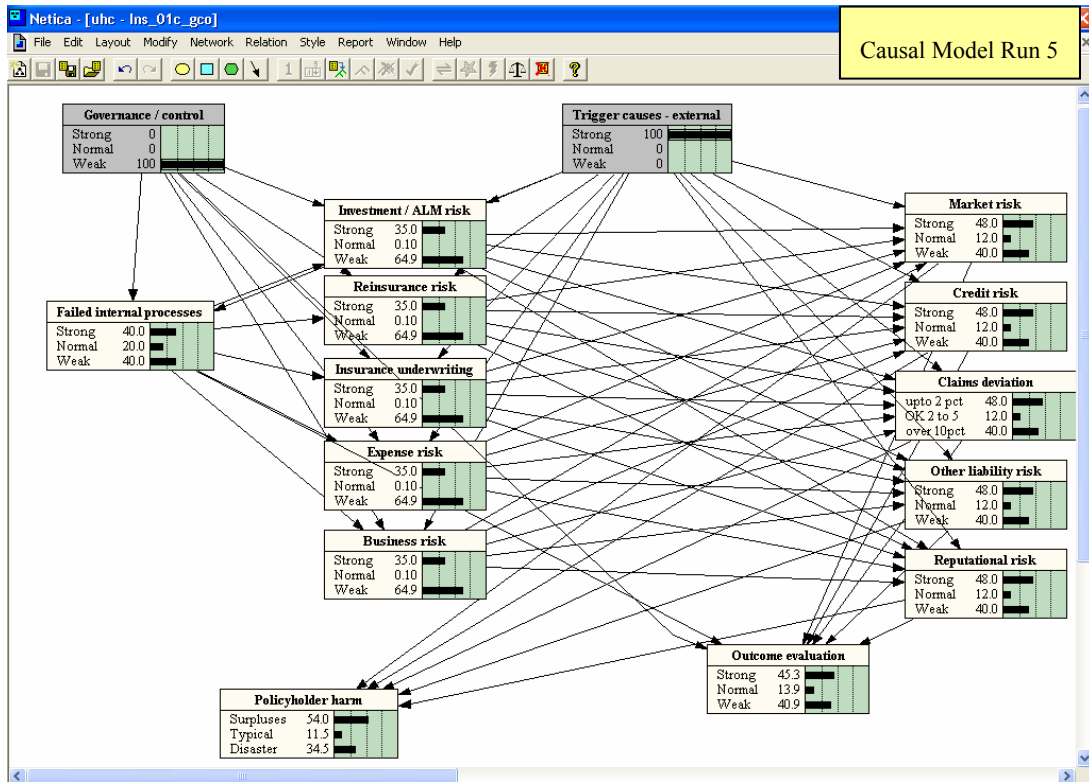
- 7.52 We have prepared some illustrative trial runs in respect of a causal model for enterprise wide risk management. The key modelling output is a measure of **Policyholder Harm**.
- 7.53 In practice, the causal model would be trained in the light of data and empirical evidence to learn, using Bayesian learning methodologies, to learn from the evidence database. Some tests on the causal model have already been applied to test the Bayesian learning methodologies, and the results were satisfactory. As a proxy to using actual data or strong empirical evidence, the modelling case files can be simulated. The untrained causal model can then be applied to the simulated database, leading to a learning causal model that has learned from the case events and has become a trained causal model.
- 7.54 It is outside the scope of this paper to show the development and nurturing of a trained causal model. However, the initial research in this area has already shown promising developments.

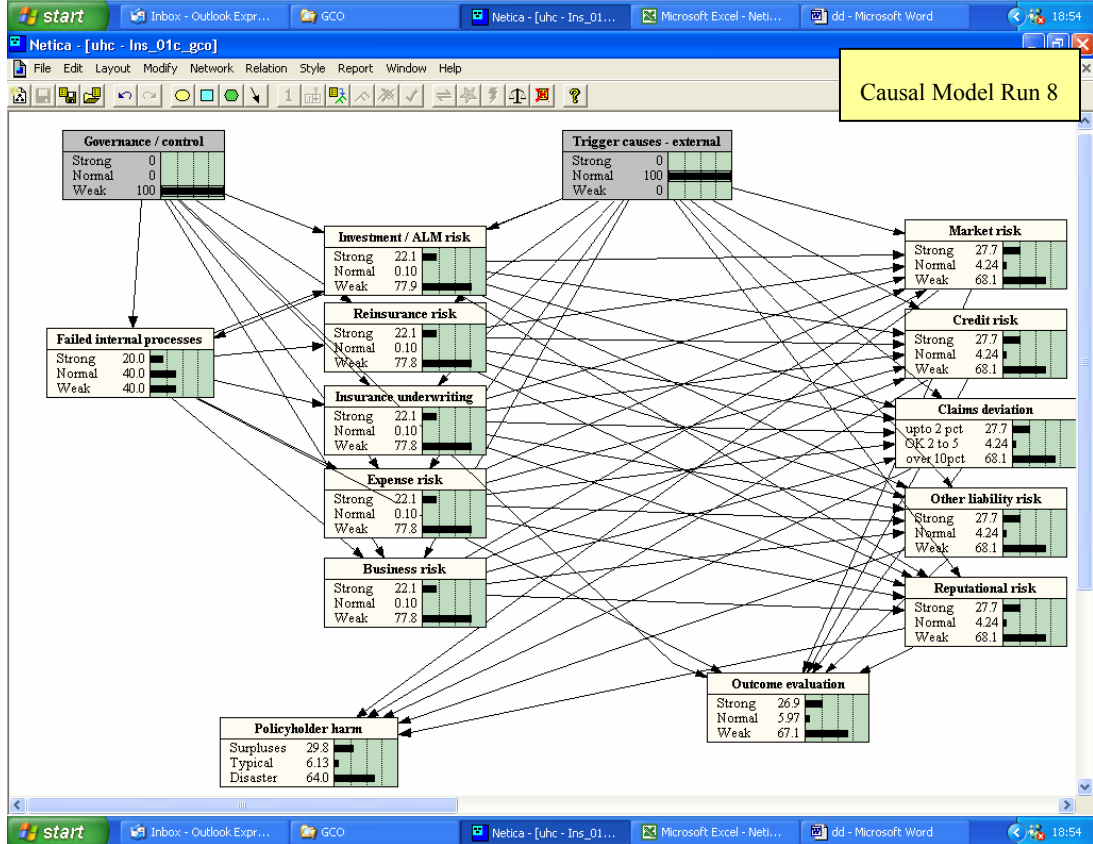
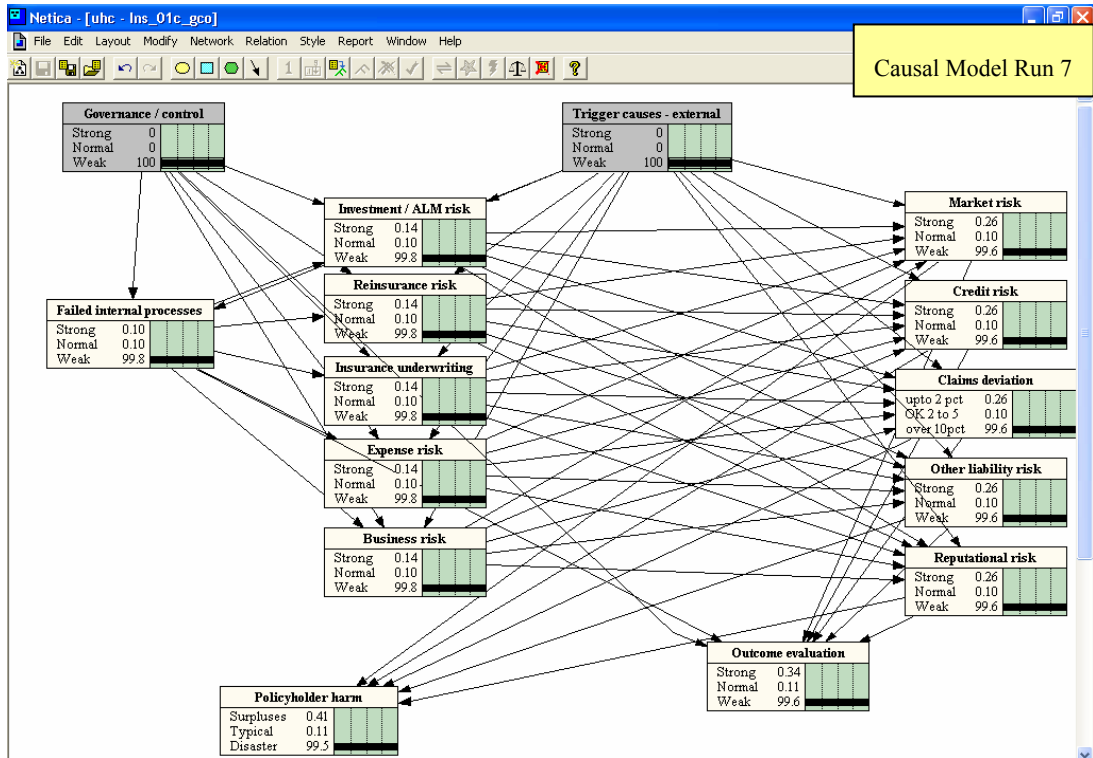
Selected Causal Model Runs - enterprise wide risks management

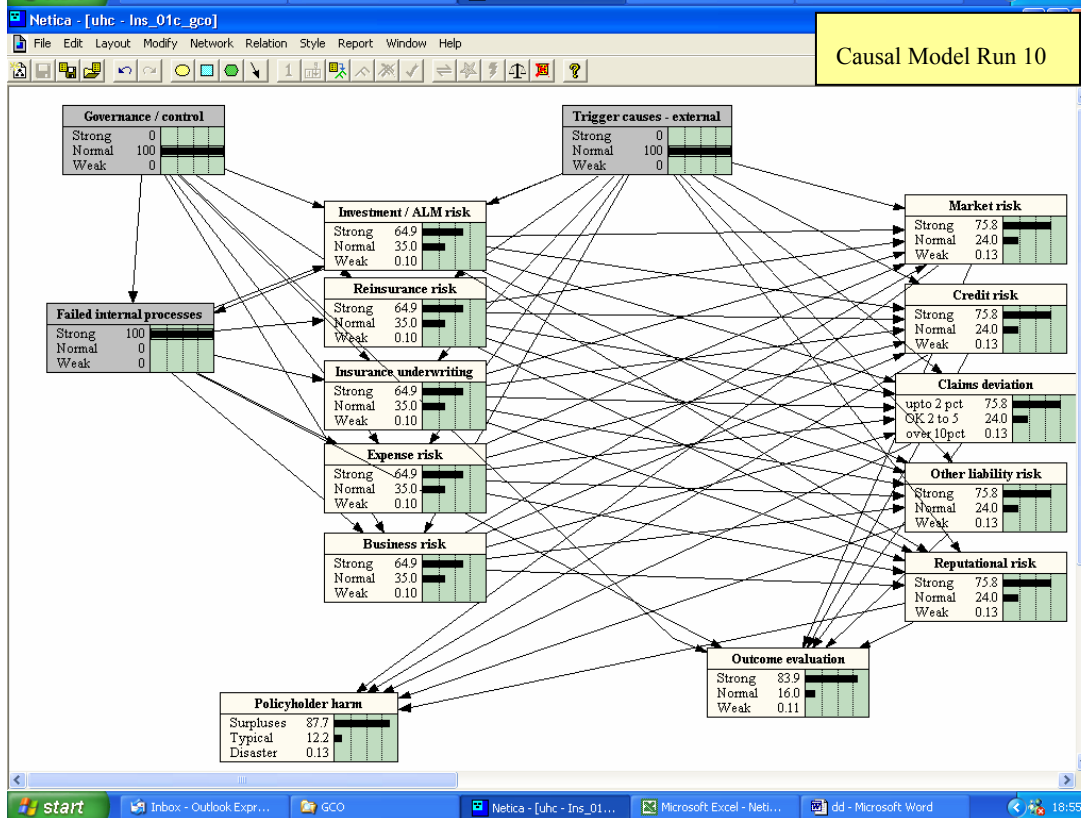
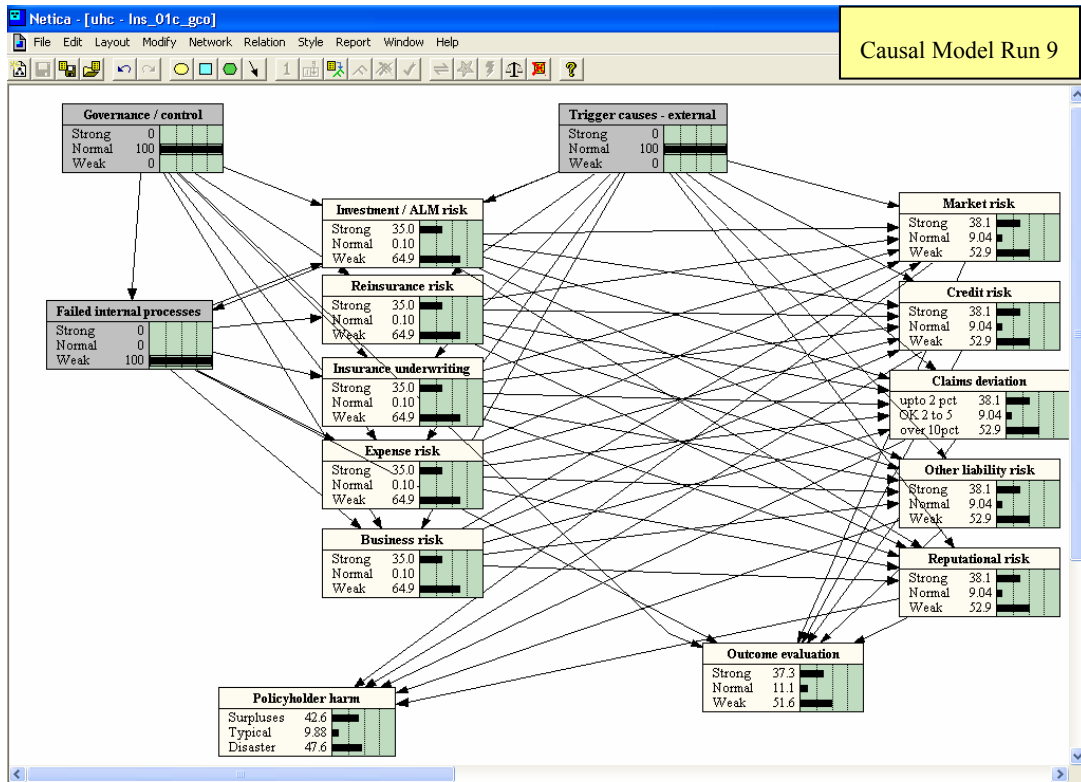
1. Untrained default model, without any strong beliefs
2. Model with “strong” Governance Control
3. Model with “weak” Governance Control
4. Model with “strong” Governance Control and “strong” External Trigger Causes
5. Model with “strong” Governance Control and “weak” External Trigger Causes
6. Model with “weak” Governance Control and “strong” External Trigger Causes
7. Model with “weak” Governance Control and “normal” External Trigger Causes
8. Model with “weak” Governance Control and “weak” External Trigger Causes
9. “Normal” Governance Control, “normal” External Trigger Causes and “strong” Failed Internal Processes
10. “Normal” Governance Control, “normal” External Trigger Causes and “weak” Failed Internal Processes









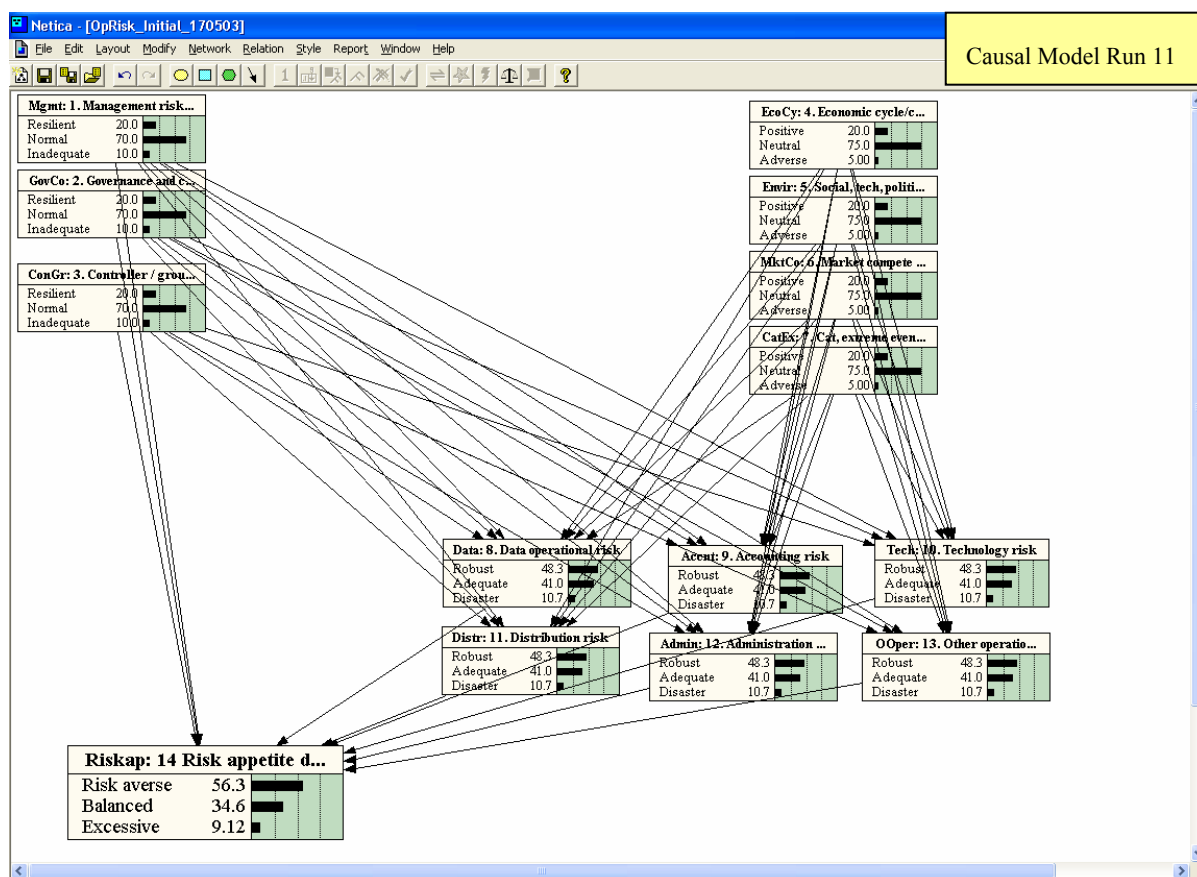


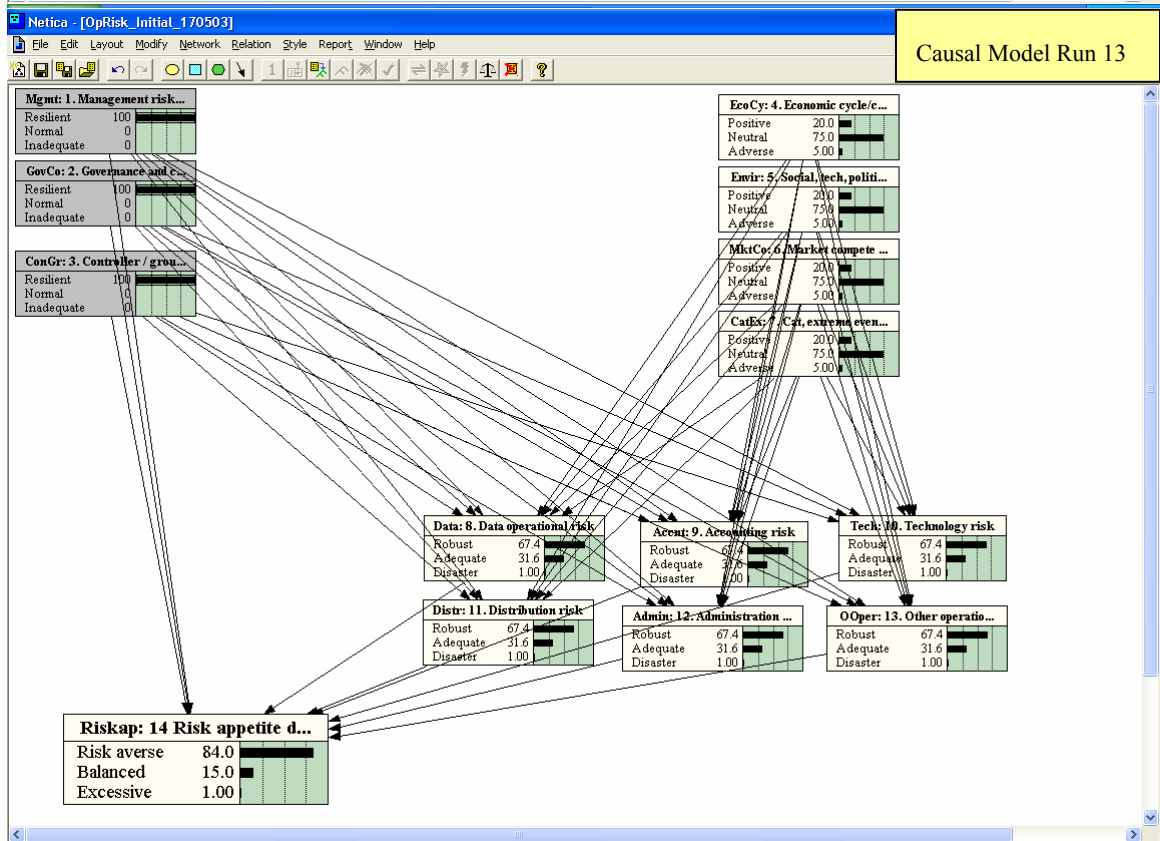
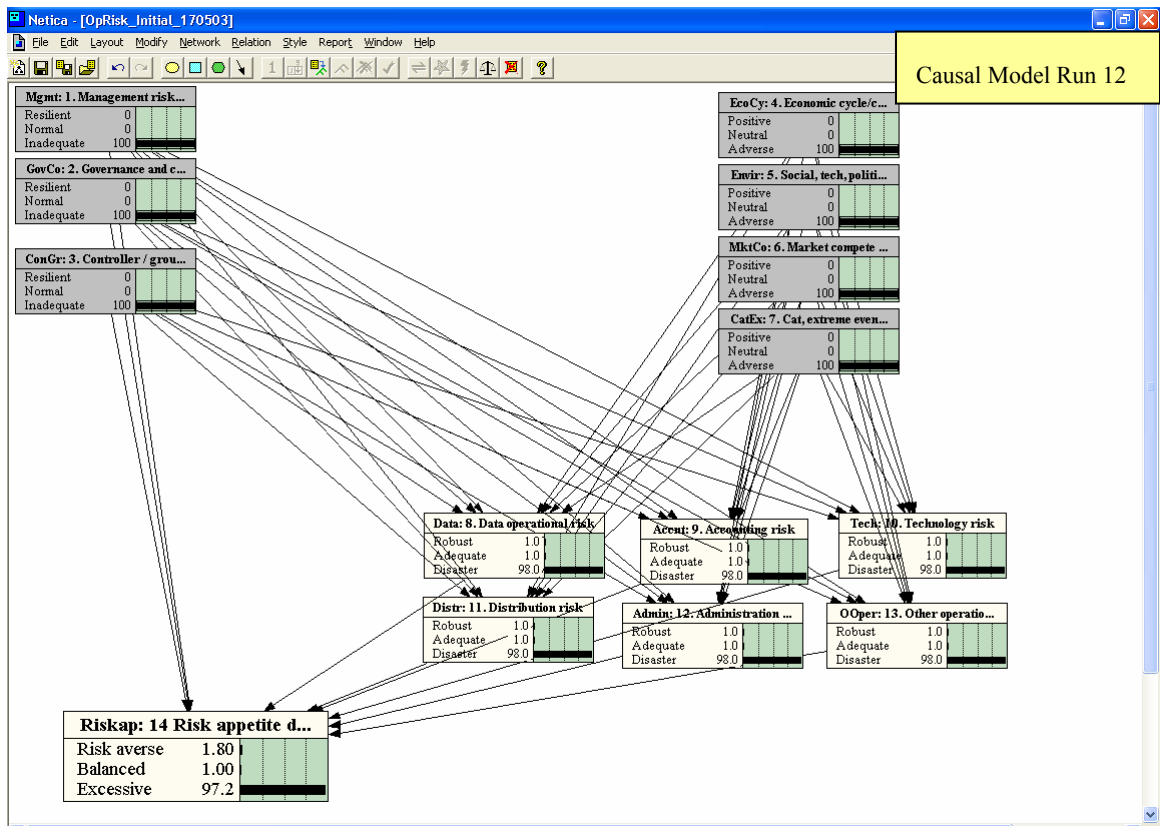
Selected Images - Causal Model (operational risks management)

- 7.55 In practice, several cause-effect risk maps and causal models may be required to help the top management team to achieve effective enterprise wide risk management. Each can form a useful strategic window on the organisation and the inherent risks. For example, it may be useful to focus on operational risks to model and measure the likely **Risk Appetite Decision** under a range of possible business and industry scenarios. For example, we have prepared an illustrative causal model for operational risks management, where the key modelling output is a measure of the **Risk Appetite Decision**. The causal model for operational risks is illustrated below.
- 7.56 As with the enterprise wide risk management causal model, it is outside the scope of this paper to show the development and nurturing of a trained causal model. However, the initial research in this area has already shown promising developments.

Selected Causal Model Runs - operational risks management

11. Untrained default model, without any strong beliefs
12. Model with “resilient” Management risk, Governance Control and Controller/Group risk
13. Model with “inadequate” and/or “adverse” internal and external inputs





Delphi method

Description of method

- 7.57 The approach is a very simple one, designed to use the views of a variety of experts to develop a hypothesis.
- 7.58 A selected number of "experts" are individually asked for their response to a given question. They respond without referring to each other.
- 7.59 These responses are then collated and distributed to the experts (anonymously) so each now has the benefit of being able to place their response in the perspective of the (wider) views of other experts.
- 7.60 Each "expert" now provides a refined, or edited response in the light of the consensus view from the earlier exercise. The overall intention is one of consensus building for the whole group.
- 7.61 These second responses form the basis for a combined hypothesis or view.

Illustration

- 7.62 The case study incorporates claims fraud. Over the years, MELG had completed a number of investigations into claims fraud and claims "enhancements" (misrepresentations) by policyholders.
- 7.63 Clearly external claims fraud and associated deliberate or naïve "bidding up" of claims by policyholders is a source of considerable cost to MELG. There was however no clearly agreed view of the scale of the problem.
- 7.64 In liaison with the Director of Claims, the risk manager selected 12 staff widely regarded as the internal claims experts, and also two external experts - the auditors and the management consultants assisting with redesign of the claims process.
- 7.65 Two questions were posed - "how many events occur in a year where either deliberate external fraud or policyholder exaggeration lead to overpayment (or leakage) of claims?", and "what is the total cost of these events in a year?"
- 7.66 A summary of the investigations was provided to help the experts develop their views.

- 7.67 The 14 responses were collated and distributed. A second round of responses was collected. Based on this a median view was developed - excluding one outlier. This view was used as the basis for the quantification in the refined dynamic financial analysis.

Observations

- 7.68 The method is a way of developing a common view where the chance of consensus in open forum is low. It relies on expert input.
- 7.69 It is easy to apply and avoids extremes of outcome.
- 7.70 The application of this method is particularly useful with very low probability/high value events, or where data is sparse, or non-existent.

Stress and scenario testing

Description of method

- 7.71 For each risk category, a realistic scenario is described, including circumstances and quantification.
- 7.72 A (possibly brainstormed) set of plausible scenes can then be developed and the associated losses quantified. It is assumed that the very worst case of everything going wrong is too penal. Typically the combination of 2 major problems and one minor problem might be regarded as sufficient.
- 7.73 An alternative is to carry out such calculations without trying to construct plausible scenarios, but to investigate the ability of the company to withstand combinations under different stresses.

Illustration

- 7.74 In the case of MELG, using the 3 operational risk loss types described, we might assume:
- 7.75 The risk of a strategic loss is approximately one in every year, with a mean loss of £40 million, or a 80 percentile loss of £80 million:
- The claims fraud figure might be a total annual loss of £25 million - arguable on a declining trend
 - The systems development loss averages £2.2 million. It is known that a big project is already in hand and has problems. It might be that a sensible allowance is for a £10 million overspend, £5 million this year and £5 million next.

- 7.76 As well as these losses, there might be consequences for other aspects of the Profit and Loss account. A delayed system implementation could result in planned savings not materialising, or materialising later than assumed. It might be prudent to allow an extra £10 million for the consequences of systems delays.
- 7.77 Combining these in a sensible manner is not easy. One approach would be to assume a large strategic incident of say £60 million, a slightly reduced "fraud" figure of say £20 million and a systems based loss of £15 million. In total a plausible possible loss of £95 million.
- 7.78 Some aspects of this may already be implicitly budgeted. Suppose current solvency is [50]%, ie £1.2 billion, then an assumed maximum drop in asset values, a possible underwriting loss, a decline in reserving position and an operational loss of £95 million might be a reasonable additive stress test. In this context it can be seen that the operational loss is significant, but not the most important source of "concern".
- 7.79 We believe the illustration of £95 million on a premium base of £2.5 billion (ie around 4%) is not unreasonable. A stress test at 7.5% or even 10% would be worth considering.

Observations

- 7.80 This is a relatively simple and straightforward method. It is a practical and empirical approach. If used in the context of a well developed risk register and a systematic analysis of possible loss sources it could be regarded as a useful "back of the envelope" method.
- 7.81 Clearly it can be put into the context of the company's current position. Knowledge about management actions, process improvements/changes, staffing matters and consequences of change can be considered.
- 7.82 Another way of looking at it would be to consider what "net assets" would be left after a given underwriting loss, a given market value movement and a given reserving adjustment. This could then be seen as the "maximum" operational risk loss that the company could stand.

8 Case study - outline report to Risk Committee

- 8.1 As with section 7, the outline report to the Risk Committee is still work in progress. In particular in many places in the report we have illustrated the type of examples that might be discussed rather than the actual examples based on our case study. We have included items in italics, in brackets, to indicate some of our thinking behind elements in the outline report.
- 8.2 The methodologies so far are all very well but at this point the actuary is faced with the familiar problem of how to assimilate and present the results of a technically detailed exercise to a reader, for example a member of the board, who does not really want to know how it works. The reader just wants to know what it means for their business.
- 8.3 In this section we have created a short example report with some mechanisms for portraying the results of an operational risk review. We also set out a checklist for elements that an actuary working on operational risk may want to consider incorporating into a report.

Example report - Introduction

- 8.4 This report has been produced for the group risk committee for the purposes of considering the capital requirements of the Company in respect of operational losses. In reaching this conclusion the report also comments upon: -
- The profile of operational losses within the Company to help the committee understand the nature of operational risk run in the Company's everyday business
 - Areas where the operational risk is such that risk mitigation measures could be considered as a means of reducing the overall capital requirement
 - An allocation of operational risk across functional areas and business lines in order to assist the committee with a view on the risk adjusted rate of return on capital of each area of the business with a view to considering incentive schemes to help manage the level of operational loss.
- 8.5 This report should be read as a whole as individual parts read in isolation could be misleading. This report is intended for a reader with some awareness of operational risk, the ways in which it can arise and its implications for an organisation. The reader should refer to the authors with any queries.

- 8.6 The exercise which forms the basis for this report is the first such exercise carried out within the Company. As such the work has concentrated on the major risks for which data suitable for analysis was available. We have relied upon the data provided despite this data being incomplete in some areas. Any improvements subsequently made to the data appropriate to an exercise of this type may produce results substantially different from those presented here.
- 8.7 We have considered only operational risks defined as “losses arising from people, processes, systems and external events”. We have not considered how these risks integrate with other risks faced by the organisation at this stage.
- 8.8 This report has been (or will eventually be) produced in accordance with Guidance Note 12 issued by the Institute of Actuaries with regard to the format and content of non-life reports.

Example report - Executive summary

- 8.9 Our analysis has identified the following as key operational risks for the company: -
- Conflict of group and local objectives
 - Lack of internal controls allowing external fraudulent activity to go unchecked
 - Poor control over third party supplier transactions.
- 8.10 *[The key purpose of the exercise was to identify capital requirements for operational risk to the two business lines, Personal and Commercial.] Capital requirement per £1,000 of premium are as follows: -*
- | | |
|------------|----|
| Commercial | £X |
| Personal | £Y |
- 8.11 We note therefore that on a view of return on capital adjusted for operational risk, the Commercial business is providing stronger performance.
- 8.12 *[One of the biggest benefits of performing an exercise of this type, given it may well be the first time that the area will have received so much attention, is to document the learning points that have arisen throughout.] The key learning points identified during the exercise are as follows: -*
- There are areas where risk management controls are inadequate and a small investment in tightening these up could realise significant benefits in terms of reduced operational loss outgo
 - System M is proving considerably more reliable than System N and we recommend System M is used as the preferred platform going forward

- Current fraud related loss is at an unacceptably high level and mitigation measures are needed.
- 8.13 *[Data and methodology sections will be fairly self explanatory as per GN12 guidance so we have not included an example here.]*

Example report - Results and recommendations

- 8.14 *[Some graphical presentations of results would aid a presentation to the Risk Committee.]*
- 8.15 According to this review, the capital that should be set aside in respect of operational losses is £Z million. This is allocated down to functional areas and business lines as follows for the purposes of monitoring risk adjusted return on capital within the Company. *[It is allocated with due regard for the current state of management systems and controls]*
- 8.16 It is also displayed by risk type in descending order to focus attention on those risks where mitigation measures may have the most significant benefit.
- 8.17 Figure 1 displays the risks according to the Frequency with which they occur and the amount or severity of the loss when an event occurs.
- The bottom left quadrant contains green blobs and represents low frequency, low severity losses that are not of significant cost to the organisation. By their nature the costs of further risk mitigation in most cases outweigh the losses caused. These elements make up a "background noise" level of operating loss that should be expected. The expected losses are not the ones that capital needs to be set aside for
 - The top left quadrant has orange blobs that represent operational loss that are still relatively small in amount (severity) but are more frequent. These losses will represent a greater level of loss to the organisation than the previous quadrant because of the sheer number of losses that are being reported. This is an area where we would recommend a review of risk mitigation controls to reduce the frequency of losses from these sources. The cost of additional controls in this case may well be returned in the saving made in these losses can be moved into the bottom left quadrant. These losses will also contribute to an expected level of operational loss but fluctuations in the number that actually occur could lead to variation in this level of loss and, as such, capital should be set aside to protect against fluctuations in the number of losses being reported
 - The bottom right quadrant also has orange blobs as these also represent risks of which the company should take note. These risks result in a loss on an infrequent basis, but when a loss occurs, it tends to be a big one. These

losses can be difficult to control against because they happen infrequently but the amounts involved mean that it is worth considering risk mitigation measures that reduce the likelihood of them happening, or in particular, catch them early to bring down the eventual cost. They are also the losses that are likely to introduce the most volatility to the operational loss experienced in a period and, as such, it will be important to consider the capital that should be set aside to protect against an level of unexpected loss from this source

- The top right hand quadrant needs to be empty for a healthy business. We have identified one red risk area edging into this category. The size of these losses and the frequency with which they occur means that they are the single biggest cause of operational loss within the organisation costing on average £W million per year. We would recommend that controls are put in place to mitigate the loss from this risk area as a matter of priority.

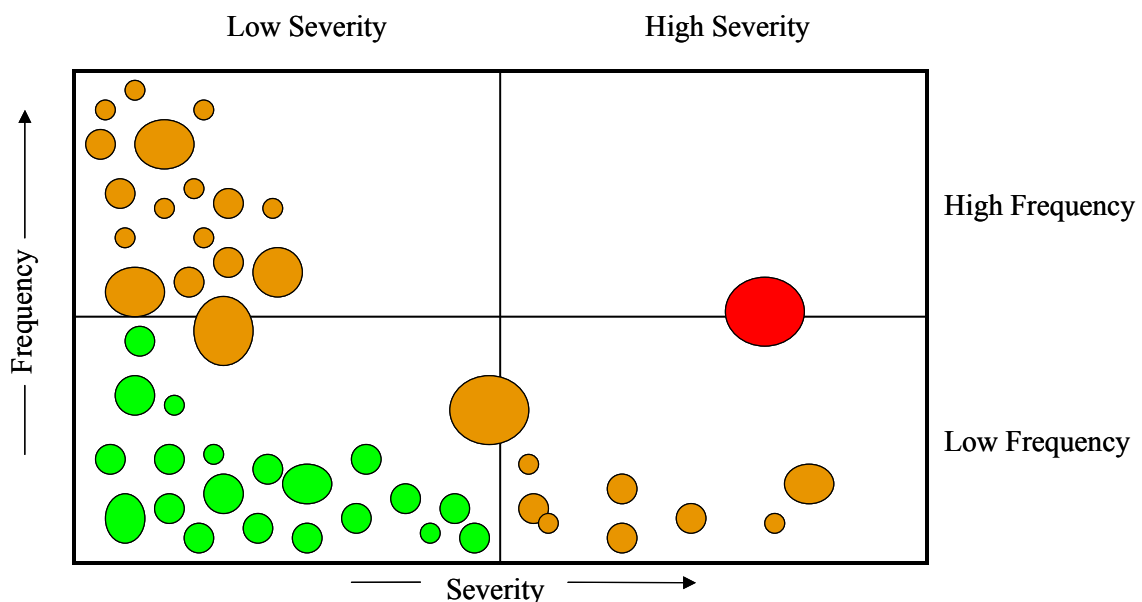


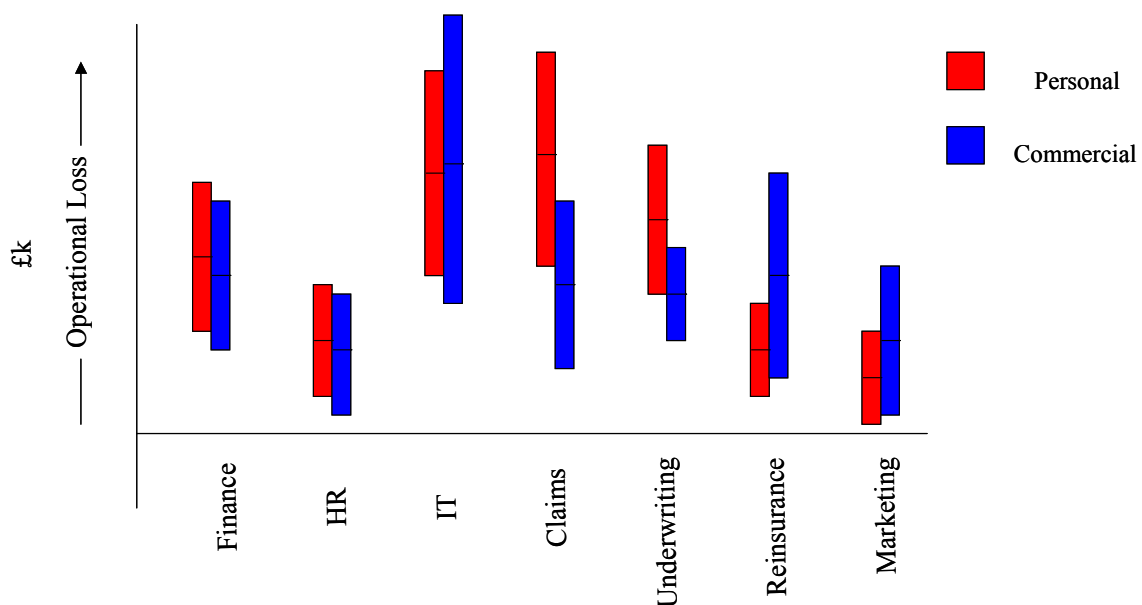
Figure 1 - Frequency vs severity of operational losses

- 8.18 Figure 2, below, illustrates loss variability by functional area and business line. Each bar represents the spread of operational losses that may arise from a particular functional area and class. The bar is not intended to cover every possible loss exhaustively but represents the majority of possible outcomes (approximately 90% of losses).
- 8.19 The marker roughly in the middle of each bar represents the average level of loss that should be expected from the corresponding functional area and class. We note that this average level simply represents the current outgo in terms of operational loss that is occurring in the organisation. It is not an indication of

the capital required to withstand an unexpected level of loss. The unexpected level of loss is represented better by a point towards the top of each bar. The ideal is for a short bar (little variability) that lies close to the axis (limited average loss).

- 8.20 It should be noted, however, that our overall assessment of capital required does not assume a level of unexpected loss at the top of each of these bars. It is very unlikely that a worst outcome scenario would happen in all functional areas for each class at the same time. It is useful, however, to draw comparisons as to the average and potential levels of loss in the different areas.
- 8.21 For example, we note from the claims and underwriting areas that the personal class is generating a significantly higher level of average loss, as well as a higher variability of loss than the commercial class. This may be due to the greater number of transactions that occur in the personal business line but these figures suggest a review of the risk mitigation controls for personal underwriting and claims should be considered. On the other hand, we note that the position for reinsurance and marketing is reversed. For these functional areas, it is the commercial business line that should be investigated to see if they can learn anything from the processes on the personal side.
- 8.22 We note further that both the high level of loss and the high variability exhibited for both business classes in the IT area is unacceptable and should be investigated further. The IT area is generating significant operational capital requirements and a considerable amount of money could be spent and be justified if this area can be brought under control.

Figure 2 - distribution of operational loss by functional area and business line



Other thoughts (based on FSA's London Working Group Reports)

- 8.23 When catastrophic losses occurred, the company found they had insufficient reinsurance. The company had failed to assess the risks and its exposures correctly. Reasons potentially included flawed assumptions, incomplete data on potential aggregations among risks accepted, failure to model realistically and over-reliance on historical data and failure to appreciate changing risk characteristics (e.g. evolving weather patterns). Another problem that occurred was purchase of reinsurance with additional contractual arrangements in side letters which have a material effect on how the reinsurance will perform but are not disclosed to auditors and supervisors.
- 8.24 Conflict with group objectives and loss of autonomy arose gradually, making them harder to detect and act on. Regulatory reporting identified some issues, but the Group Internal Audit team identified the real operational management problems mainly through onsite inspections. Group Internal Audit concluded that a regular assessment should take place of the UK firm's autonomy, combined with tighter Group rules on appropriate types of investment and asset-liability matching.
- 8.25 Senior management should explicitly monitor the key assumptions being made in determining the extent of the reinsurance cover needed by the firm. Firms should also model realistic disaster scenarios and assess the maximum likely gross losses and then map these against the reinsurance programme to estimate the likely net position. They should regularly reassess the maximum possible loss, and report this as a key assumption. Undisclosed side-letters are hard to detect. Group Internal Audit concluded that the most appropriate solution would be preventative measures such as obtaining explicit disclosure in writing of all such arrangements, supported by effective personal sanctions against management who misrepresent such matters, and by safe whistle-blowing routes.

Other comments

- 8.26 Appendix E has a checklist of items that should be considered in producing a suitable actuarial report.
- 8.27 Clearly any report should discuss any problems observed, or limits on the scope of the work undertaken. Further any issues concerning integration of operational risk with other major categories of risk should be stated. In due course it would be expected that there should be some comment on the implications for capital management and allocation - both by business unit and by business line.

8.28 Professional matters may need discussing. At this stage this would mean referring to guidance note 12, but arguably further more specific guidance should be considered.

9 Soft Issues

- 9.1 The FSA quote the Basel Committee on Banking Supervision who define operational risk as "the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events". One possible definition of soft issues is the people element of this definition. CP 142 says:

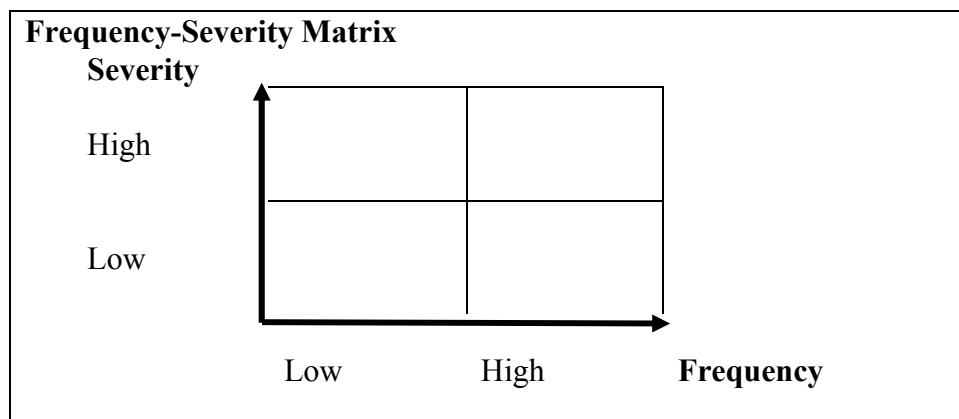
"The way in which a firm manages its employees can be a major source of operational risk. Poorly trained or overworked employees may inadvertently expose a firm to operational risk (for example by processing errors). In addition, a firm may find the availability of its employees, or its ability to replace them, can influence its ability to recover from interruptions to the continuity of its operations."

- 9.2 Operational risk has a different application for each company, depending upon its own particular circumstances. The FSA's draft guidance suggests:

"A firm should try to understand the types of operational risk that are relevant to its particular circumstances and the impact that these risks may have on the incidence of financial crime, the fair treatment of its customers and its own solvency. This might include, but is not limited to, the following issues:

- (1) the inappropriate management of a firm's people is an important source of operational risk (people refers to the employees of a firm and all the other human resources that are involved in its operations);*
- (2) both IT and manual systems and their related processes are a source of operational risk;*
- (3) operational losses may occur as a direct or indirect result of operational risk events*
- (4) operational risk events may have immediate tangible effects that can be easily quantified (eg monetary) and intangible and possibly delayed effects that cannot be easily quantified (eg reputational damage)*
- (5) the extent to which outsourced processes, people and systems remain a source of operational risk*
- (6) which external events represent sources of operational risk".*

- 9.3 The accuracy of risk measurement methods crucially depends on the soundness of the risk model and the availability of data. Proper risk modelling requires a thorough understanding of recurrent patterns that underlie the risk under consideration. The appropriateness of the risk models is inherently linked to data availability and thus the occurrence of events. Incidents help provide better understanding of underlying risk structures and also provide the basis for statistical testing of risk models. Furthermore, the accuracy of risk models depends upon the measurability of outcomes and thus goes hand in hand with sound definition and understanding of effects.
- 9.4 Operational risk encompasses events with very different frequencies and possible patterns of occurrence and severities. In an article in the Journal of Bank Finance, Muermann and Oktem, professors at Wharton Business School, suggest that a first step in determining the applicability of statistical analysis, the potential incidents should be categorised into a frequency /severity matrix based on experience and expert opinion.



- 9.5 The highest attention will obviously be paid to the high frequency high severity risks, which threaten the very existence of the operation. Relatively little attention will be paid to low frequency low severity risk risks. A lot of effort is often spent on the low frequency high severity events, but by definition these have very few data points and the estimation of probabilities and loss distributions thus produce highly unreliable results. Other approaches are therefore needed.
- 9.6 By contrast, high frequency low severity events on the other hand hold out the possibility of creating large databases to which statistical analysis can be accurately applied. Historical data, if based on a through definition of outcomes related to operational losses, can be used to estimate the loss distribution, ie the probabilities of such events and subsequent losses within certain time periods. However, because we are still in the early stages of the

evolution of operational risk management in the industry, these databases are not yet available and will take a period of years to build up. In the meantime, we are compelled to use more crude and subjective methods.

- 9.7 This approach is advocated by the FSA, who say in CP142

"A key issue is operational risk measurement. Due to both data limitations and lack of high-powered analysis tools, a number of operational risks cannot be measured accurately in a quantitative manner at the present time. So we use the term risk assessment in place of measurement, to encompass more qualitative processes, including for example the scoring of risks as "high", "medium" and "low". However, we would still encourage firms to collect data on their operational risks and to use measurement tools where this is possible and appropriate. We believe that using a combination of both quantitative and qualitative tools is the best approach to understanding the significance of a firm's operational risks."

- 9.8 The nature of soft issues is such that they are difficult to make explicit. They include factors such as morale and organisational culture, and other factors which impact on culture such as top leadership values and behaviour, communication and performance orientation.
- 9.9 A British Bankers Association survey suggests that there are a number of factors that reflect or influence the company's culture, including the style of decision-making, the level of formal processes and the attributes of the core processes. All of the components are important and they complement one another. The BBA suggest an enterprise-wide operational risk framework that pulls the pieces into an integrated whole.

Enterprise-wide Operational Risk Management Framework



- ***Strategy*** - risk management starts with the overall strategies and objectives of the organisation and the goals for the individual business units, products or managers, followed by identification of the associated inherent risks in the strategy and objectives.
- ***Risk policies*** - strategy is complemented by operational risk management policies, which are a formal communication to the organisation as a whole on the approach to, and importance of, operational risk management.
- ***Risk management Processes*** - these will encompass controls, assessment, measurement and reporting
- ***Risk mitigation*** - specific controls or programmes designed to reduce the exposure, frequency or severity of an event or the impact of an event or eliminate or transfer an element of operational risk.
- ***Operations Management*** - the day-to-day processes, both front office and back office, involved in doing business
- ***Organisational culture*** -includes communication, the "tone at the top" clear ownership of each objective, training, performance measurement and knowledge-sharing.

9.10 Robert Simons, a professor at Harvard Business School, looked at cultural factors in articles in the Harvard Business review in 1999. He highlights how an aggressive can-do culture often arises when a company's sales and profits soar and leads to bold initiatives and satisfied clients but also can end up silencing any messenger carrying bad news a company's practices. Simons has developed a tool he calls the *risk exposure calculator*, which shows the pressure points present in every organisation that lead to increased risk and are a function of the company's circumstances and management style. There are three dimensions to this tool:

- **Growth** - this looks at the pressures for performance within the organisation, the rate of expansion of the business and the level of inexperience in key employees
- **Culture** - this covers the rewards the organisations gives for entrepreneurial risk-taking, the level of executive resistance to bad news and the amount of internal competition
- **Information management** - this focuses on the complexity and velocity of transactions in the business, the amount of gaps in diagnostic performance measures and the degree to which decision-making is decentralised.

9.11 Though the scores from the tool are purely subjective, they are intended to raise awareness of the issues and indicate whether the organisation is fundamentally safe, needs to be careful or is at risk and needs to take action to address the level of risk.

9.12 Simons concludes his article by suggesting five questions which each organisation needs to ask itself:

1. *Belief systems* - Have senior managers communicated the core values of the business in a way that people understand and embrace?
2. *Boundary systems* - Have managers in the organisation clearly identified the specific actions and behaviours that are off-limits?
3. *Diagnostic control systems* - Are the diagnostic control systems adequate at monitoring critical performance variables?
4. *Interactive control systems* - Are the control systems interactive and designed to stimulate learning?
5. *Internal controls* - Is sufficient attention paid to traditional internal controls?

- 9.13 This philosophy is clearly similar to that of the FSA, who in their draft guidance say:

"A firm should ensure that all employees are aware of their responsibility and role in operational risk management, and are suitable and capable of performing these responsibilities, through the establishment and maintenance of:

- (1) appropriate segregation of duties and supervision of employees in the performance of their responsibilities*
- (2) appropriate recruitment and, as necessary, subsequent review processes to consider the fitness and propriety of employees, including their honesty, integrity and reputation, competence and capability and financial soundness;*
- (3) appropriate systems and procedures manuals that employees may refer to as required;*
- (4) training processes that enable employees to attain and maintain appropriate competence;*
- (5) appropriate disciplinary and termination of employment policies and procedures that are enforced.*

When controlling the impact that employees may have on its susceptibility to operational losses, a firm should pay particular attention to approved persons and other positions of high personal trust (for example, security administration, payment and settlement functions). There are specific rules and guidelines for approved persons and for the apportionment of senior management responsibilities."

- 9.14 It is clear that the people side of the organisation is of fundamental importance in looking at operational risk. Does the organisation have the ability to admit mistakes? Does it suffer from "key person syndrome"? To what extent is, and should, maverick behaviour be tolerated or encouraged. The recruitment selection process will influence how those in the organisation behave, as will the approach to training and development.

- 9.15 Modern organisational development theory has a lot to say about the composition of teams, especially top teams, and their impact on organisational effectiveness. Perhaps the best known indicator in this field is the ***Myers-Briggs Type Indicator (MBTI)***. This is an instrument that has been exhaustively researched over fifty years and seeks to make Carl Jung's theory of psychological types understandable and useful in a business environment. It examines differences in preferences in individuals that result from
- Whether they prefer to focus externally or internally (extraversion/introversion)
 - The way they prefer to take in information
 - How they prefer to make decisions
 - How they orient themselves to the external world.
- 9.16 From this is categorises respondents into one of 16 types. Jung's theory suggests that differences in behaviour result from people's inborn tendencies to use their minds in different ways. As people act on these tendencies, they develop patterns of behaviour. The 16 types reflect the different patterns of behaviour that are observed.
- 9.17 A team that works well together is not a chance event. When teams understand their own styles and those of others, they are more likely to be effective. Research has shown that the more similar the psychological types in a team, the sooner the team members will understand each other. However, while groups with high similarity may reach decisions more quickly, they are more likely to make errors owing to inadequate representation of all viewpoints. Groups with many different types will reach decisions more slowly and painfully but may reach better decisions because more viewpoints are considered.
- 9.18 Another well-known approach to enhancing team performance is ***Belbin's team role theory***. This has been developed through rigorous analysis of a wide range of teams over an extended period which has led to the identification of different clusters of behaviour that underlie the success of teams. This has been formulated in nine team roles:
- Action-oriented roles - Shaper, Implementer and Completer-Finisher
 - People-oriented roles - Co-ordinator, Team worker and Resource-Investigator
 - Cerebral roles - Plant, Monitor-Evaluator and Specialist.

9.19 Belbin's research showed that there are a finite number of behaviours or team roles which comprise certain patterns of behaviour which can be adopted naturally by the various personality types found among people at work. It is argued that the accurate delineation of these team roles is critical to understanding the dynamics of any management or work team.

9.20 Clearly, these two approaches share some similarities. Indeed, research has been done to demonstrate the correlations between the MBTI types and the Belbin team roles. The key point from an operational risk perspective is that the balance of a team, however measured, can significantly influence its risk profile.

9.21 People risks interact with other risks. The most obvious example of this is that people are always involved with computer systems, both in their design and development, and in their operation. As the FSA say in CP 142:

"The automation of processes and systems may reduce a firm's susceptibility to some "people risks" (for example, by reducing human errors or controlling access rights to enable the segregation of duties and information security) but will increase a firm's dependency on the reliability of its IT systems."

9.22 This is a key point, which raises other issues such as:

- System design - active involvement of users to make it work more effectively for them and so avoid errors or misunderstandings
- Use of drop down lists/avoidance of manual typing
- Built in data entry checks to minimise poor data entry
- Do data entry staff understand the importance of entering the correct items and the possible results of poor data entry
- It is human nature to be lazy - do the first items on the drop down lists or the default values appear more often that seems reasonable, are there useful data fields that are optional and so not being filled in etc etc
- If staff raise issues with the system or if particular errors are cropping up regularly, is anything actually done about it? If not staff will stop bothering to report problems or to monitor errors - as well as get the impression that what they think does not matter.

9.23 The level of change will have a major impact on the level of people risk. Major re-engineering and downsizing projects can lead to a significant loss of experience by the organisation. A recent A M Best survey showed that one of the major causes of insurance company failure was excessive growth. Major expansion often leads to problems, particularly when it is unplanned.

- 9.24 The FSA highlights the fact that major change will result in an alteration of a firm's risk profile. Their draft guidance is as follows:

"Before during and after a significant change to its organisation, infrastructure or business operating environment, a firm should assess and monitor how this change will affect its risk profile. In particular, there may be an increase in operational risk from

- (1) untrained or de-motivated employees or an expected significant loss of employees during a period of change or subsequently*
- (2) inadequate human resources or inexperienced employees carrying out routine business activities owing to the prioritisation of resources to the programme or project*
- (3) process or system instability and poor management information due to failures in integration or increased demand*
- (4) inadequate or inappropriate processes following business re-engineering."*

- 9.25 Relationships are at the root of the soft issues. Personal relationships with those inside and outside the organisation can have a disproportionate influence on decisions made by senior executives. Given the central role of personal relationships, the development of appropriate measurements may have to come from a source such as occupational psychology models.

- 9.26 The future of any business depends upon its customer relationships, so processes like complaint management and service level monitoring are critical. Those businesses that have the Government as a customer are exposed to significant political risk, as the recent experience of BAe Systems has demonstrated.

- 9.27 The interaction between the people risks and other risks is well illustrated in the recent Occasional Paper published by FSA entitled *Managing Risk: Practical Lessons from recent "Failures" of EU Insurers*. The study identified about 50 generic risks that had led to or threatened to lead to solvency problems at insurers in the last six years. In attempting to refine and classify these into a useful framework, it was recognised that the risks were linked in causal chains. For instance, the risk of adverse claims development may arise from poor risk selection (underwriting risk), which may in turn arise from poor underwriting policy or controls (underwriting systems and controls risk), which may itself be due to lack of experience (management risk). This led to the development of the cause-effect risk-map as a practical tool distinguish the root cause of a firm's problems from among all the issues that presented themselves.

9.28 The FSA risk map provided our starting point for the causal modelling work outlined above (see 7.36 to 7.56). The causal models illustrated that, although the manifestation of a loss may be simple enough to identify, the cause is likely to be considerably more complex, being a causal chain that involves both soft and ‘non-soft’ factors. Modelling it, even assuming the data is available, is therefore a non-trivial task.

10 Measurement or Bust? - concluding thoughts

- 10.1 When the working party first met in October 2002, as the title of the paper suggests, members felt that the priority was to quantify operational risk. However as time and discussion has progressed and, in particular, as the survey was carried out our views have changed.
- 10.2 Now, the working party members believe that before any meaningful quantification can take place, it is necessary for an organisation to work out how and why they can experience operational risk events. Only then can the quantification begin, otherwise the results will carry a serious risk of being misleading and, more importantly, the understanding needed to manage operational risk will not have been developed.
- 10.3 Even if this is done, the early quantifications of operational risk will need to be treated with care. To start with the results are, perhaps, best viewed as indicative of the scale of loss likely/capital required and over time used to determine whether this is increasing or decreasing. There are simply too many uncertainties and this will not change materially for some time.
- 10.4 From the survey we carried out, it appears that few general insurers are beyond the preliminary stages of developing the understanding of what drives operational risk events in their business. At best they seem to be at the stage of creating a basic high/medium /low frequency-severity risk map. Many have not even achieved this. The bank and asset management industries are much further ahead - and they are concerned that they are not making enough progress. General insurers are in danger of falling well behind.
- 10.5 The working party has looked at how you might go about quantifying operational risk but has had to create the data that might be needed. This also indicates how far the general insurance community is from where it needs to be.
- 10.6 In addition, CP190 clearly indicates that the FSA will increase capital requirements for insurers who they believe do not have the right mindset and who are approaching regulatory requirements with a reactive, "box ticking" mentality. It is not enough to have the risk map and the process - the FSA have to be convinced that you actually use it in a way that will provide some control over the operational risks faced.
- 10.7 The working party would therefore strongly recommend that general insurers give urgent attention to the following issues, if they are not to find themselves behind the game and financially penalised as a result.

- Complete a detailed risk mapping process (at least)
- Implement an operational risk database (see paragraph 10.8)
- Reach agreement internally on what loss types fall into insurance risk, market risk, credit risk, operational risk to minimise the risk of double counting or missing items completely (see paragraph 10.9).

10.8 An operational risk loss database should capture information such as:

- Loss type
- Loss size (financial impact on bottom line) and currency
- The date the loss was realised (ie recognised in external or internal accounts)
- The data the loss was incurred (eg when the project causing the expense overrun was signed off, when the incorrectly priced rates went live etc)
- Line of business, business unit/branch etc.

10.9 There are some operational loss events that may be difficult to isolate completely and which may be partially or wholly recognised in the modelling of other risks. For example, external fraud is an example of a type of operational loss. However the results of this may already be built in to the modelling of claims sizes and frequency in the insurance risk element of an insurer's capital model. Equally, an organisation would want to avoid a type of loss falling between two categories because those responsible for the modelling each believed that the other was including it.

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Interviews

Survey participants

We interviewed people from the following companies and organisations:

Allianz Cornhill Insurance plc

Association of British Insurers

Association of Insurance and Risk Managers

Association of Local Authority Risk Managers

Axa Insurance

BNP Paribas

Financial Services Authority

Groupama UK

Heath Lambert Risk Management

Institute of Risk Management

PRI Group

Prudential Corporation

Royal Sun Alliance

Schroders plc

Wellington Underwriting plc

Zurich Financial Services UK

Survey questionnaire

GIRO working party on operational risk

Date:

Interviewer:

The principal factor that will affect the course of the interview is whether the person being interviewed is from a trade association/professional body, or whether they are from a company. Some questions may be irrelevant in either case.

Purpose of interview:

I am here on behalf of the working party on operational risk set up by the General Insurance Research Organisation of the Institute and Faculty of Actuaries. We are trying to map out the approaches to managing and measuring operational risk used in various financial services industries and organisations. I will ask you a few questions about your views on what goes on in your industry (and your organisation/member organisations). The interview should take no longer than 45 minutes.

Scene setting:

Who is being interviewed? Name, organisation, job title.

What kind of organisation? Bank (which kind) insurance company (which kind) etc? Quoted or not? Part of large group (if so which?) Or: trade association (who are the members), professional body, etc.

What direct or indirect responsibility does the interviewee have for managing operational risk?

General operational risk:

How do you define operational risk? Do you use different definitions for different purposes? If so, what?

Can you tell me some of the events that might give rise to operational losses in your organisation? In your industry?

What is the general level of awareness of operational risk issues in your organisation? In your industry? At what levels? (Board, senior management, specialist risk management, etc)

What are the regulatory issues that affect the approach to operational risk in your industry?

What professions might you consider getting advice from on operational risk management?

Techniques and methods:

What techniques do you use to manage operational risk?

What information or data relating to operational risk do you collect? Which do you find most useful and why?

How explicitly do you separate out operational losses from credit, market, or other losses?

How do you expect your data collection to change in the future?

What risk indicators do you use?

What types of quantitative analysis do you do now? What types do you expect to do in the future?

What reporting of operational risk takes place in your organisation? (by whom, to whom and how often)

What are the strengths and weaknesses of your current approach to operational risk?

The future:

What do you think are the important issues in operational risk today?

What do you think will have changed in five years time?

C

Case study details – Illustrative

HISTORIC ACCOUNTS

Profit and loss account

	1995	1996	1997	1998	1999	2000	2001	2002
Gross earned premium								
- Household	1,001,279	1,204,217	1,297,381	1,305,716	1,409,887	1,597,714	1,709,698	1,908,575
- Employers liability	77,811	112,448	139,051	167,639	199,575	240,776	298,716	497,949
Gross earned premium	1,079,090	1,316,665	1,436,432	1,473,355	1,609,462	1,838,490	2,008,414	2,406,524
Reinsurance ceded	41,710	52,994	59,779	64,317	72,233	84,048	96,098	131,950
Net earned premium	1,037,380	1,263,671	1,376,653	1,409,038	1,537,229	1,754,442	1,912,315	2,274,575
Gross claims paid								
- Household	297,677	403,825	541,348	614,424	754,855	892,202	1,104,455	1,251,266
- Employers liability	36,139	54,469	87,780	124,560	207,845	323,791	317,801	372,285
Sub total 1	333,816	458,293	629,128	738,984	962,700	1,215,993	1,422,256	1,623,551
Claim deterioration								
- Household	0	0	27,067	0	37,743	26,766	0	0
- Employers liability	0	0	4,389	0	10,392	9,714	0	0
Sub total 2	0	0	31,456	0	48,135	36,480	0	0
Catastrophe	0	0	0	0	0	100,000	0	0
Gross claims paid	333,816	458,293	660,584	738,984	1,010,835	1,352,473	1,422,256	1,623,551
Reinsurance recoveries								
- Household	8,930	12,115	17,052	18,433	23,778	27,569	33,134	37,538
- Employers liability	5,421	8,170	13,825	18,684	32,736	50,026	47,670	55,843
- Catastrophe	0	0	0	0	0	81,000	0	0
Reinsurance recoveries	14,351	20,285	30,878	37,117	56,514	158,595	80,804	93,381

	1995	1996	1997	1998	1999	2000	2001	2002
Claims handling expenses								
- Household	20,522	23,960	38,824	34,383	52,105	62,131	70,531	62,665
- Employers liability	3,164	4,962	3,723	12,837	12,660	10,289	14,477	24,761
Claims handling expenses	23,687	28,922	42,547	47,220	64,765	72,420	85,009	87,426
Net paid claims	343,152	466,930	672,254	749,087	1,019,087	1,266,298	1,426,461	1,617,596
Increase in gross claims reserve								
- Household	93,900	7,890	49,448	-7,116	22,490	121,496	-98,192	-30,102
- Employers liability	21,726	20,494	6,991	48,763	-272	-16,897	10,018	186,490
- Prior year adjustment (EL)								50,000
- Deterioration	0	0	2,822	0	1,111	3,138	0	0
Increase in gross claims reserve	115,625	28,384	59,261	41,648	23,329	107,737	-88,174	206,388
Increase in reins recoveries reserve								
- Household	11,417	1,144	6,747	-959	3,394	22,092	-18,370	-8,475
- Employers liability	3,813	1,711	843	7,309	-76	-6,072	2,427	38,345
- Deterioration	0	0	379	0	166	481	0	0
Net incurred claims	443,547	492,459	723,546	784,385	1,038,932	1,357,533	1,354,230	1,794,115
	42.8%	39.0%	52.6%	55.7%	67.6%	77.4%	70.8%	78.9%
Commissions	191,359	227,163	248,275	243,379	279,735	336,051	342,691	407,417
Other acquisition expenses	72,783	97,288	115,027	112,067	106,047	101,807	118,510	116,379
Administrative expenses	46,162	48,847	63,797	73,152	108,699	126,489	129,518	121,567
Extra expenses	10,000	10,000	25,000	25,000				
Reinsurance commissions	24,537	33,422	38,360	34,906	36,055	42,557	37,375	88,613
Net incurred expenses	295,767	349,876	413,738	418,693	458,425	521,790	553,344	556,750

	1995	1996	1997	1998	1999	2000	2001	2002
Underwriting profit	298,067	421,336	239,369	205,960	39,872	-124,881	4,741	-76,290
Allocated investment income	73,425	88,110	141,794	108,559	153,755	4,015	-51,179	-103,861
Increase in unexpired risk reserve	2,875	-494	18,505	1,484	2,778	6,439	-2,853	3,135
Insurance profit	368,617	509,941	362,657	313,035	190,849	-127,305	-43,585	-183,285
Investment income / charge	121,256	145,507	282,789	246,203	391,203	11,068	-126,869	-245,452
Other income / charge								
Pre-tax profit	489,873	655,448	645,446	559,238	582,052	-116,237	-170,453	-428,737
Acc loss	489,873	655,448	645,446	559,238	582,052	-116,237	-286,690	-715,427
Tax	171,456	229,407	225,906	195,733	203,718	0	0	0
Post-tax profit	318,418	426,041	419,540	363,505	378,334	-116,237	-170,453	-428,737
Dividend	6,368	6,496	6,626	6,758	6,893	0	0	0
Retained profit	312,049	419,545	412,914	356,747	371,440	-116,237	-170,453	-428,737

Balance sheet

	1995	1996	1997	1998	1999	2000	2001	2002
Assets								
Equities	1,071,943	1,362,597	1,655,746	1,846,727	2,079,674	2,210,245	2,109,609	2,254,158
bonds	1,310,152	1,665,397	2,023,689	2,257,111	2,541,823	2,701,410	2,578,411	2,755,082
Non-earning	71,463	90,840	110,383	123,115	138,645	147,350	140,641	150,277
	2,453,558	3,118,834	3,789,818	4,226,953	4,760,142	5,059,005	4,828,660	5,159,517
Liabilities								
Gross UPR + URR	434,511	526,172	593,078	590,826	646,562	741,835	800,512	965,744
Gross OS claims reserves	500,035	528,419	587,680	629,328	652,657	760,394	672,220	878,607
RI share of UPR + URR	16,795	21,178	24,682	25,792	29,018	33,914	38,303	52,952
RI share of OS claims reserve	19,328	22,183	30,152	36,502	39,986	56,487	40,544	70,413
Net UPR	417,716	504,994	568,396	565,034	617,545	707,922	762,210	912,793
Net OS claims reserve	480,707	506,236	557,528	592,826	612,671	703,906	631,676	808,194
Others	44,921	50,562	56,296	57,893	61,511	70,591	69,694	86,049
	1,914,013	2,159,743	2,417,813	2,498,202	2,659,950	3,075,049	3,015,158	3,774,753
Shareholders fund	539,545	959,091	1,372,005	1,728,752	2,100,192	1,983,955	1,813,502	1,384,765
Solvency margin	50%	73%	96%	117%	130%	108%	90%	58%

PROJECTED FIGURES

Profit and loss account	2001	2002	2003	2004	2005	2006	2007	2008
Gross earned premium								
- Household	1,709,698	1,908,575	2,004,004	2,099,433	2,194,862	2,290,290	2,481,148	2,710,177
- Employers liability	298,716	497,949	697,129	1,045,693	1,145,283	1,219,975	1,294,667	1,369,360
Gross earned premium	2,008,414	2,406,524	2,701,133	3,145,126	3,340,144	3,510,265	3,775,815	4,079,537
Reinsurance ceded	96,098	131,950	164,689	219,837	237,638	251,705	268,635	286,709
Net earned premium	1,912,315	2,274,575	2,536,443	2,925,289	3,102,506	3,258,560	3,507,181	3,792,827
Gross claims paid								
- Household	1,104,455	1,251,266	1,165,969	1,186,591	1,185,798	1,332,536	1,546,693	1,802,096
- Employers liability	317,801	372,285	462,542	673,990	705,613	809,449	920,365	1,038,361
Sub total 1	1,422,256	1,623,551	1,628,511	1,860,582	1,891,411	2,141,985	2,467,058	2,840,457
Claim deterioration								
- Household	0	0	0	0	0	0	0	0
- Employers liability	0	0	0	0	0	0	0	0
Sub total 2	0	0	0	0	0	0	0	0
Catastrophe	0	0	0	0	0	0	0	0
Gross claims paid	1,422,256	1,623,551	1,628,511	1,860,582	1,891,411	2,141,985	2,467,058	2,840,457
Reinsurance recoveries								
- Household	33,134	37,538	34,979	35,598	35,574	39,976	46,401	54,063
- Employers liability	47,670	55,843	69,381	101,099	105,842	121,417	138,055	155,754
- Catastrophe	0	0	0	0	0	0	0	0
Reinsurance recoveries	80,804	93,381	104,360	136,696	141,416	161,393	184,456	209,817

	2001	2002	2003	2004	2005	2006	2007	2008
Claims handling expenses								
- Household	70,531	62,665	72,873	74,162	74,112	83,283	96,668	112,631
- Employers liability	14,477	24,761	30,065	43,809	45,865	52,614	59,824	67,493
Claims handling expenses	85,009	87,426	102,938	117,971	119,977	135,898	156,492	180,124
Net paid claims	1,426,461	1,617,596	1,627,089	1,841,857	1,869,973	2,116,489	2,439,095	2,810,764
Increase in gross claims reserve								
- Household	-98,192	-30,102	90,000	50000	80000	90000	60000	100000
- Employers liability	10,018	186,490	80,000	100000	70000	80000	150000	110000
- Prior year adjustment (EL)		50,000	0	0	0	0	0	0
- Deterioration	0	0	0	0	0	0	0	0
Increase in gross claims reserve	-88,174	206,388	170,000	150,000	150,000	170,000	210,000	210,000
Increase in reins recoveries reserve								
- Household	-18,370	-8,475	2,700	1,500	2,400	2,700	1,800	3,000
- Employers liability	2,427	38,345	12,000	15,000	10,500	12,000	22,500	16,500
- Deterioration	0	0	0	0	0	0	0	0
Net incurred claims	1,354,230	1,794,115	1,782,389	1,975,357	2,007,073	2,271,789	2,624,795	3,001,264
	70.8%	78.9%	70.3%	67.5%	64.7%	69.7%	74.8%	79.1%
Commissions	342,691	407,417	456,307	524,753	550,990	578,540	624,823	677,933
Other acquisition expenses	118,510	116,379	130,345	149,897	157,392	165,261	178,482	193,653
Administrative expenses	129,518	121,567	136,155	156,578	164,407	172,627	186,437	202,284
Extra expenses								
Reinsurance commissions	37,375	88,613	99,246	114,133	119,840	125,832	135,898	147,450
Net incurred expenses	553,344	556,750	623,560	717,094	752,949	790,596	853,844	926,421

	2001	2002	2003	2004	2005	2006	2007	2008
Underwriting profit	4,741	-76,290	130,494	232,838	342,485	196,175	28,542	-134,857
Allocated investment income	-51,179	-103,861	101,538	116,706	133,759	146,031	158,876	175,700
Increase in unexpired risk reserve	-2,853	3,135	0	0	0	0	0	0
Insurance profit	-43,585	-183,285	232,032	349,544	476,244	342,206	187,418	40,843
Investment income / charge	-126,869	-245,452	194,007	236,169	284,648	326,979	366,491	406,872
Other income / charge								
Pre-tax profit	-170,453	-428,737	426,039	585,713	760,892	669,185	553,909	447,715
Acc loss	-286,690	-715,427	-289,388	296,325	760,892	669,185	553,909	447,715
Tax	0	0	0	103,714	266,312	234,215	193,868	156,700
Post-tax profit	-170,453	-428,737	426,039	481,999	494,580	434,970	360,041	291,015
Dividend	0	0	7,462	7,611	7,763	7,918	8,077	8,238
Retained profit	-170,453	-428,737	418,578	474,389	486,817	427,052	351,965	282,777

	2001	2002	2003	2004	2005	2006	2007	2008
Balance sheet								
Assets								
Equities	2,109,609	2,254,158	2,691,422	3,191,243	3,607,704	4,007,039	4,443,348	4,863,199
bonds	2,578,411	2,755,082	3,289,516	3,900,409	4,409,416	4,897,493	5,430,759	5,943,909
Non-earning	140,641	150,277	179,428	212,750	240,514	267,136	296,223	324,213
	4,828,660	5,159,517	6,160,367	7,304,402	8,257,633	9,171,668	10,170,330	11,131,321
Liabilities								
Gross UPR + URR	800,512	965,744	1,080,453	1,258,050	1,336,058	1,404,106	1,510,326	1,631,815
Gross OS claims reserves	672,220	878,607	1,048,607	1,198,607	1,348,607	1,518,607	1,728,607	1,938,607
RI share of UPR + URR	38,303	52,952	65,876	87,935	95,055	100,682	107,454	114,684
RI share of OS claims reserve	40,544	70,413	85,113	101,613	114,513	129,213	153,513	173,013
Net UPR	762,210	912,793	1,014,577	1,170,116	1,241,002	1,303,424	1,402,872	1,517,131
Net OS claims reserve	631,676	808,194	963,494	1,096,994	1,234,094	1,389,394	1,575,094	1,765,594
Others	69,694	86,049	98,904	113,355	123,755	134,641	148,898	164,136
	3,015,158	3,774,753	4,357,024	5,026,670	5,493,085	5,980,068	6,626,765	7,304,980
Shareholders fund	1,813,502	1,384,765	1,803,343	2,277,731	2,764,548	3,191,600	3,543,565	3,826,341
Solvency margin	90%	58%	67%	72%	83%	91%	94%	94%

An illustrative Risk Matrix

Event Business Type Matrix using Annex 2 of “Working Paper on the Regulatory Treatment of Operational Risk”

In this table we categorise by perceived level of risk to bottom line results for a UK domiciled operation.

Event Type (Category 1)	Event sub Type (category 2)	Direct Commercial Lines	Broker Commercial Lines	Investment Income
Internal Fraud	Unauthorised activity	Low (or is there an accumulation problem?)	Moderate - bigger ticket items?	Low (depends on whether investment in house or externally managed)
	Theft and Fraud	Low	Moderate	Low
External Fraud	Theft and Fraud	Low	Moderate	Moderate (if outsource, low if not)
	Systems security	Moderate	Moderate	Low (None? (if outsourced)
Employment practices/workplace safety	Employee relations	Low	Low	Low (none if outsourced)
	Safe environment	Low	Low	Low (none if outsourced)
	Diversity and discrimination	Low	Low	Low (none if outsourced)
Clients, Products & Business practices	Suitability, disclosure & fiduciary	Moderate (FSA?)	Moderate (FSA?)	Low (none if outsourced)
	Improper business/market practice	Moderate	Moderate	Low (none if outsourced)
	Product flaws	High (mispricing, bad wordings - if wording wrong for one, wrong for all)	High (mispricing, bad wordings - wordings can be more tailored esp Lloyd's & London mkt so may be more limited impact)	Low (none if outsourced)
	Selection, sponsorship & exposure	Not relevant	Not relevant (brokers job)	Low (none if outsourced)
	Advisory activities	Low (could be perceived as advising if don't get disclaimers etc in but company not individual)	None (that's the broker)	Low (none if outsourced)
Damage to physical assets	Disasters and other events	Moderate to high (more direct contact at the right time dependent)	Moderate (brokers can carry on with some activity in the meantime)	Low (esp if outsourced)
	Systems	Moderate to high (more dependent than broker equiv)	Moderate	Low (none? if outsourced)
Execution, delivery & process	Transaction capture, execution &	High (garbage in, garbage out)	High (GIGO plus complexity of data	Moderate - if misunderstanding between

Event Type (Category 1)	Event sub Type (category 2)	Direct Commercial Lines	Broker Commercial Lines	Investment Income
management	maintenance		capture)	fund managers and yourselves or internally if fund manage your own investments
	Monitoring and reporting	High (if miss reg deadlines then you get penalised, can't write business, D&O if misreport to markets) Does Inadequate reserving fit here?	High (same issues - possibly higher risk of inadequate reserving due to higher complexity of covers and legal issues - direct commercial will be simpler product lines)	Low (none? if outsourced)
	Customer intake and documentation	High (bad wordings - overlap with product?)	Moderate to high	Not relevant
	Customer/client account mgt	Not relevant	Not relevant	Not relevant
	Trade counterparties	??	??	
	Vendors & suppliers	Moderate to high - claims cost control via supplier links	High (del auth!)	Moderate to high if outsourced - depends on line of business High - longer tailed assets, higher reserves held for longer so more investment income more important to profits.

Differences when compared with a persona lines business include

- Not really any client account mgt issues. little no advisory role or selection/sponsorship type issues.
- Where does aggregation go?
- What about territorial differences - proportion of UK/non UK business may make a difference as may territories you do business in and how. Cultural differences in business practices (plus distance from HO!) may lead to errors of judgement and improper practices being followed.
- Where does an internally managed investment fund getting its investment strategy wrong fit? Ie deliberate mismatching risk

- Regulators are increasingly focussing on it - note that most company failures are caused by or exacerbated by operational problems eg fraud (Independent?), failure of internal control processes (Allied Irish Bank, Barings). No regulator wants the embarrassment of large corporate failures or frauds.
- Events such as the Barings, AIB etc losses cause at best major reputation/image problems for the companies concerned and at worst the company's collapse. Directors could be sued by shareholders for mismanagement/negligence, employees lose jobs and some may find their employment prospects damaged by past association with the company. It is in directors' and employees' interests to ensure that operational risks are appropriately monitored and controlled.
- Identifying potential areas of operational risk, understanding them, measuring them and controlling them will help prevent some sources of shock losses to company earnings and performance. This acts to reduce the volatility in shareholder profits and so can make the stock more attractive to shareholders (and to other sources of capital)

Check list for Actuarial Report on Operational Risks

Introduction

- Scope
- Report produced for
- Purposes
- Read as a whole
- Intended for knowledgeable reader.
- Problems/limitations
- Integration with other risks
- Professional matters.

Executive summary

- Key findings.

Terms of reference/aims

- Company risk committee required/annual/one-off review of operational risk
- Purpose: to satisfy regulatory requirements and shareholder needs
- To identify in systematic manner
- To understand/assess - to categorise
- To quantify improvements
- To incorporate work by compliance, internal audit, Special Investigations (or Fraud) Unit, claims review teams and other relevant bodies
- To ensure consistent with other risk assessment/capital assessment work
- Capital/risk management.

Background

- Company: ownership/corporate structure
- Lines of business
- Results
- Overview of strategy
- Management structure.

Current position and preamble

- Existence of annual cycle; if so describe
- Work previously completed (eg risk register)
- Existing process definitions
- Existing systems of control

- Roles and responsibilities/culture
- Regulatory comments (project arrow visits)
- Future timetable requirements/changes in regulations
- Defining operational risk:
 - other risk categories
 - catch all
 - strategic - in/out.
 - reputational - in/out
 - legal - in/out.
- Operational risk already in PL
 - exceptions:
 - asset management
 - strategic management failure
 - final salary pension schemes.

General approach:

- Agree risk definitions
- Complete identification exercise
- Complete (other) data capture
- Model operational risk explicitly
- Adjust historic data for explicit operational risk
- Consider background/soft issues
- Consider impact of existing and proposed systems and controls
- Develop explicit capital assessments.

Work completed, methods and data

- There is/is not an existing risk management process
 - stages:
 - identification/mapping
 - assessing/quantifying
 - actions/mitigation
 - reviewing.
 - timetable.
- Our approach included:
 - defining top down process map

- conducting risk review workshops
- listing key risks, with clear owners/responsibilities
- undertaking interviews
- desk research into industry circumstances
- discussion with external parties.
- Incorporating the views and findings of:
 - compliance
 - internal audit
 - external audit
 - fraud investigations unit.
 - Head office claims
 - Head office underwriting
 - Board
 - Company legal/secretariat.
 - understanding the impact of key risks
 - collecting appropriate data/quantification measures
 - completing a top down assessment
 - providing an independent challenge
 - verifying/checking collected data
 - agreeing methods.
- Methods adopted
 - scenario/stress test
 - statistical
 - experts
 - causal modelling
 - data collected and collated:
 - etc
 - we undertook limited data reviews
 - etc
 - departments asked to confirm validity of data and our use of information.

Identifying risks

- We list below all risks identified
- We identify operational risks
- We have categorised operational risk at three levels:
 - level 1 - based on the FSA definitions in CP or Basel
 - level 2 - based on Basel
 - level 3 - our own categories.
- We have adopted [110] level 3 definitions
- for each risk:
 - identify category
 - identify owner
 - identify impact
 - identify current measures
 - identify plans to manage/mitigate
 - identify how to refresh.
- We have set these out in the form of a risk map showing the relative importance of each risk now, and how it is believed this may change over the next 12 months.

Review of soft issues and change climate

- Risks are often inter-related and behave in complex manner
- External drivers of change
- Internal drivers of change
- Existing systems of control, roles and responsibilities
- Recent management change
- Strategic imperatives and possible consequences
- Existing understanding of risk appetite
- Existing capital and ability to withstand risk
- Discontinuities:
 - people/staff
 - systems
 - processes
 - organisations.

Analyses - 1

- Stress and scenario tests
- Drivers
- Scenarios
- Conclusions.

Analyses - 2

- Statistical models
- Attritional, working, extreme values
- Results
- Observations
- Conclusions.

Analyses - 3

- Identified specific risks
- Outlines initial causal claims
- Assumptions
- Results
- Observations
- Conclusions.

Synthesis

- Based on quantification models:
 - overall view
 - etc.
- effect of systems and controls:
 - etc.

Conclusions

- Implications for internal capital assessment
- Etc.

Review of process, proposed future work/improvements

- Cost benefit analysis:
 - capital
 - impact on P & L
 - P & L volatility.
- Other relevant comments

Reliances and limitations