The Actuary and ERM (1)

Michael Tripp, FIA, FASI

This is the first of two articles about 'Enterprise Risk Management'. It focuses on the background to and application of the subject. The second article will focus more on technical actuarial aspects.

The term Enterprise Risk Management, or 'ERM', has been around for a long time. I'm sure I first encountered it in the early 1980s, but I would not be surprised to be told that is was also mentioned one, or even two or more, hundred years before that! However like so many management theories and consultancy initiatives reference to its use waned, and during the 1990s other more exciting and newer phrases and concepts came to the fore. Not that ERM ever really died or that the concept was flawed in any way – just one of those things that happen as human beings strive for advancement.

One definition of risk that appeals to me is an event (or events, possibly linked) of an unplanned or unpredictable nature that leads to a variation in outcome or result from that planned, budgeted or expected. This definition admits of risks that can be small or large, of risks that can happen frequently or seldom, of risks that can happen regularly or irregularly, of risks that can occur anywhere in any organisation or enterprise and of risks that can be categorised in many and various ways by many and various people. In some sense Enterprise Risk is the global set of all such possible risks that can affect an enterprise; and Enterprise Risk Management is the study of actions and considerations around the management of these risks.

The rationale for identifying and managing every possible aspect of risk that could affect an organisation has a very sound logic to it, and an appeal to most senior people. Not that every senior person would have the same view – people are all motivated in different ways and some may be so motivated by entrepreneurial achievement that they have little time to consider risk, let alone spend valuable resource in managing it when they would naturally believe that resource could be better used elsewhere. Nevertheless several robust studies into the economics of successful enterprises suggest that an enterprise that is managed well in every aspect of its business tends to prosper better and more consistently than an enterprise that focuses solely on just one dimension of success – no matter how important that dimension may be. This observation leads one to realise that risk management is one of the many dimensions vital to high quality management.

Michael Tripp
Partner, UK Financial Services
Ernst & Young LLP
mtripp@uk.ey.com

Coming from another angle, over the years most countries have from time to time seen the collapse of companies – some small, but some great – that have shaken their self belief. This has again often led to a variety of initiatives aimed at reducing the risk of collapse, including those to do with governance, regulation and financial management.

There will be an inevitable trade off between the likelihood and impact of a risk compared to the cost and effort in controlling it. In some sense there will be a view taken on the proportionality of effort to control a risk compared with its consequences. This view will be informed by an informed and transparent discussion about an organisations circumstances and its appetite to take such risks.

The observant reader will see that thus far the text could apply to any organisation operating in any market. We will now narrow our comments down to the financial world – the world of banks, insurers and investment management firms.

The banking world has typically been amongst the most global of these industries, and The Basel Accord, under the Bank of International Settlement has been at the centre of banking regulation. Not that every country subscribes to its guidelines, but for the sake of this article we can make the working assumption that its work and pronouncements are highly relevant. Maybe its work in the 1990s, which commented on relatively specific aspects of risk, was one reason why ERM waned?

Certainly the concept of risk based governance and regulation became more widely discussed in the 1990s – across all parts of the globe from Australia to USA, from China to Brazil, from India to Scandinavia – and Basel picked up this theme on its first accord. It set a framework that became the basis for many linked discussions – credit risk, market risk, liquidity risk, operational risk, group risk. Curiously enough though not enterprise risk – may be this was a reaction against the slightly jaundiced use of buzz words? The colloquial overuse of phrases (such as enterprise risk management) can hide the real meaning and obscure the value of real use deep under the surface. Such shallow fads need to be challenged!

Turning now, even more narrowly, to insurance. Risk based thinking, has been finding its feet through country based discussions, eg in Japan, Australia, UK – and now becoming regional with 'Solvency II' in Europe and more general discussion over the Americas. These discussions often take Basel as their reference point. Nowadays, a typical comprehensive risk framework for insurance would now be taken to cover:

- Insurance risks – to do with the setting of premiums, underwriting and policy conditions – the prediction of claims, reserving, pricing, price monitoring anything that generally affects the prediction of loss ratios. Reinsurance programme design might be an aspect of this risk as would management of exposure and accumulation or catastrophe coverage
- Market related risks – usually, but not always relating to the economic markets, the risk of uncertain economic developments and growth, interest rates and the market value of securities. In the widest sense this might also encompass aspects of political, social and technological development affecting the market in which the enterprise operates

- Credit risks – the possible non-payment of an assumed debt, typically reinsurance or agents balances for most insurers, but other debtors would be in scope
- Liquidity risks – the risk that insufficient liquid assets (cash) would be available to pay customers, staff, shareholders or any other creditor with a legitimate claim. In the past this has been very closely tied up with the topic of Asset Liability Management where cash flows are modelled and uncertainties assessed
- Operational Risks – the risks arising from possible unexpected behaviour or failure of systems, processes, people – and external events. This would typically encompass Business Continuity Planning. It may sometimes be taken to cover legal risk – arising from dispute over any legal contract
- Group Risk – the coming together of the above, but particularly where there is reliance on another part of the same group
- Strategic Risk – which not only includes the taking and aspects of implementing strategic decisions, but may be defined as including general strategy to say pricing and hence management of any underwriting cycle
- Reputational Risk – more generically things that can go wrong affecting an organisations brand and reputation.

This wide set of risk categories leads to the need to understand the different forms for managing risk. At one extreme an organisation might decide to live with the risk – having firstly clearly established its risk appetite. Then it may consider mitigation via reinsurance or the use of controls. A control framework is vital and brings with it the concept of gross/inherent risk (no controls), the effect of introducing controls and the explicit risk of their failure, and then the net or residual risk. Controls themselves should be independently tested eg by control risk self assessments, or targeted internal and external audits. Such a framework would further include internal peer group reviews, eg claims or underwriting reviews.

A typical risk management cycle might include the following elements

- Setting the context – what is the purpose/objective of the activity, what scope
- Identification – describing risks, maybe in light of organisation process map, reporting, eg through a risk register, challenging and allocating ownership
- Understanding and Quantifying – assessing, standing back, then measuring and estimating – normally modelling, in context of views on likelihood/impact – distributions and capital management/planning
- Determining what to do – mitigation/exploitation/funding/ignoring, all in context of defined risk appetite – considering systems of controls and management role
- Embedding – senior management and others role in identifying, owning and using for decisions, key risk and other indicators, use on management decisions and planning, reviewing/refreshing and reporting
- Reviewing the effectiveness of the risk management cycle – standing back and determining improvements

The actuary's role comes to the fore in the modelling and quantifying of risk. The initial focus may be on insurance and market risk because they appear the more significant and often have more easily available data, but before long the full enterprise should come into scope. Most people can see that each risk will have an associated (probability based) distribution of outcomes – maybe skewed – around the expected position. Understanding and modelling such distributions are the actuary's stock in trade – whether considering the difference between mean, median and mode or talking about different percentiles of the distribution, or considering various definitions of ruin probability or levels such as the 1 on 200 chance of failure (sometime taken to be the same as the 99.5th percentile).

This role brings significant challenges which we will discuss in the next article. Such challenges include:

- Data – internal and external : what is available and how useful is it?
- How to deal with the really heterogeneous nature of some risks – is the past really a guide to the future? How to deal with the so called 'survivor bias'?
- Linking risk quantification to capital and business planning
- What degree of granularity – by class of business, by type/size of claim, by channel
- Dealing with the correlations and diversification between risks
- What measures to use – Value at Risk, Tail Value at Risk, other?
- What methods to use – stress and scenario approaches? If so, how to combine them? Or full stochastic models (monte carlo techniques) – and if so, how to avoid the black box
- What timeline to use? One, three or five years? Should risks be run-off to ultimate?
- How to deal with gaps and overlaps – how to categorise risks
- Issues in the 'tail' – at the high risk end of distributions what shape of tail and how correlated
- Understanding the difference between model, parameter and process risk – all assuming that the data is meaningful
- Becoming familiar with the difference between actuarial and management best estimates (say for claims reserves in general insurance)
- Linking different/conflicting accounting frameworks – such as the global IFRS compared with Country based GAAPs – some forbidding hidden margins eg in reserves, some requiring fair values (maybe discounting with explicit risk margins)
- How to communicate the meaning of analyses without either sounding unclear/uncertain or overly precise

In studies about what causes organisations to fail, there has nearly always reference to the role of senior management. A complete organisational collapse nearly always involves senior management in some unexpected way. For the actuary this is a difficult area. Can the behaviours of senior people (and their unpredictable but often linked consequences) truly be modelled? At best, even with the most

sophisticated current models in the world, only a small insight may be gained into such issues. My personal view is that for now, while actuarial models are helpful in giving insights into most of the probability distribution say up to the 95th or even 99th percentile, they are less useful at very high percentiles, or the extremes of the tail. Here perhaps more qualitative judgements, characterised by indices/ ratings maybe useful.

At this point the issue is really to do with organisational risk (including HR, key person, organisational effectiveness, roles and responsibilities, incentive compensation plans, governance, degree of change, experience and teamwork of the executive, role of the Board).

So in this first article I hope to have set the scene within which the actuary works. The encouragement is to think widely, read around the subject and be imaginative in deciding how to carry out probability based modelling in conjunction with other disciplines and experts who may find mathematics hard to grasp, obscure or too analytic.

(Second part in April 2006 issue)

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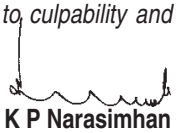
appeared in The Actuary not very long ago, where he had written about material evidence that had remained to be brought up before the Law Lords that put Equitable Life and the actuarial profession in a poorer light. The Actuary had also carried a report on the case in court filed by the present management of Equitable Life against former Directors and Auditors.

In what could seem a denouement – or perhaps not quite one considering the disciplinary proceedings that Ranson and Headdon are still facing in the profession – the January/February 2006 issue of The Actuary carries a report, from the Financial Times of 3rd December 2005, on the settlement with costs reached by the Society, to terminate further proceedings in Court –

> "The long-running and highly controversial litigation brought by Equitable Life against its former directors and auditors finally shuddered to halt yesterday as the society agreed to pay legal costs incurred by nine of its former board members.
>
> Equitable first filed the multi-billion pound claimed against Earnst & Young, its former auditors, and 15 former directors in April 2002. Last night, it had nothing to show for its efforts but a bill for legal costs totaling £45m.
>
> The last two to settle were Jennie Page ..... a former non-executive director..... and Chris Headdon, the society's former chief-executive and appointed actuary.
>
> Even so, Ms. Page was clear that given how far matters had progressed, she would have preferred to have seen a final judgement in the case and even in the final stages tried to negotiate for a statement in court at the very least. 'I'd have preferred that policyholders had had the opportunity of Mr. Justice Langley saying something to mark the end of these proceedings, but the society refused to allow a hearing'.
>
> These views were generally echoed by Mr. Headdon, who still faces the prospect of professional disciplinary proceedings. He, too says he would have welcomed a final judgement, objectively weighing up the evidence. 'It is regrettable that policyholders have not had the benefit of hearing Mr. Justice Langley's views', he commented.....
>
> Of the society's final bill of £45m, about £35m represents its own costs. Add the legal expenses shouldered by other parties and the entire litigation has costs more than £70m; all to know avail, beyond grief on all sides."

An extract from a letter written by Equitable Life to its policyholders on 2nd December 2005 forms an interesting conclusion –

> *"In his reports in to the near collapse of Equitable Life, Lord Penrose said that the Society was 'the author of its own misfortune'. His lordship concluded that decisions were made by the previous Board which resulted in due financial consequences for policyholders for the Society as a whole; decisions that nearly put the society out of business.*
>
> *Lord Penrose reached clear and forceful conclusion as to the downfall of the Society. However, we must accept that it is a different matter to satisfy a Court that the role of the former directors constitutes a responsibility that leads in law to culpability and redress."*



K P Narasimhan

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The Actuary And ERM - II

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Michael Tripp, FIA, FASI

Our first article on Enterprise Risk Management discussed the general approach to defining, identifying and managing risk across the whole (insurance) enterprise. This second article will discuss some of the more technical data and modelling issues.

Can risk, as widely defined as enterprise risk, be quantified?

Over the years my view has evolved: in some senses yes, in some senses no! It has been said that quantifying, or attempting to quantify, is the start of any scientific understanding. In the case of enterprise risk management even the most ardent 'quants expert' needs to be able to relate to the possibility that events in the future may not in anyway be related to those in the past – reflecting as they so the myriad of human behaviours and unexpected large events which seem to occur in the most unexpected combinations and circumstances. Even so, use of numeric data helps inform decision makers and improves judgement.

Data, Heterogeneity, sources of error and survivor bias

Rising to the quantification challenge, the first hurdle is obtaining useful information, or data. Thinking back to the types of risk described before (insurance, market, credit, liquidity, operational, group strategic and reputational) data availability varies. Any basic framework should give measures of exposure and of the number/type/size of events that are to be quantified related against this. Taking stock of data availability and future collection is most actuaries' vital first step. Motivating an organisation to capture all required information may prove tricky. This said, most world class insurance companies are now systematically capturing meaningful data under each risk heading.

Clearly risks are highly heterogeneous, and any initial work should start by understanding this – investigating sources of overlap, correlation and the underlying drivers of risk. Insurance and market data may be readily available, whilst operational risk may be scarce. Establishing systems to capture risk incidents, categorising them and over time forming a useful data base is not trivial. Human nature being what it is, the data is almost bound to contain error, and some form of audit trail or independent sample based verification may be wise. Such databases should capture so called near losses, and have external comparisons to help form a view on their survivor bias. (Survivor bias means that any event which did not occur in the captured data, but could have, will be omitted from the analysis. To this extent the analysis is biased). Before using any data set careful consideration as to its meaning, reliability, scope and relevance is vital. Reconciliation with accounts, comparison with external data sources and general probing are wise activities.

Michael Tripp
Partner, UK Financial Services
Ernst & Young LLP
mtripp@uk.ey.com

Measures of risk and appropriate metrics

Assuming some meaningful data has been captured as well as deciding what model to use, we need to consider how to describe the results to others – what metrics will convey useful summaries of our analyses? In part this will depend on the recipients' state of understanding and analytic view; in part on the reason for the work; eg is it to:

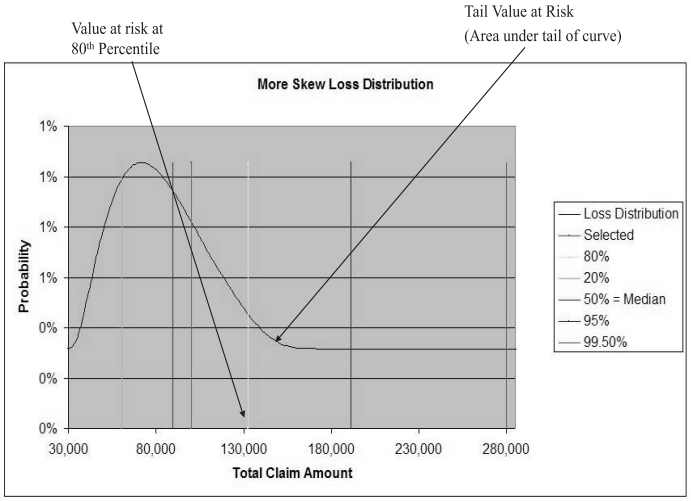
- Quantify capital requirements for economic management
- Predict possible outcomes for planning purposes
- Prioritise actions for management
- Help determine best reinsurance strategies
- Help risk managers relate to staff and regulators.....

the list is endless!

How do you communicate something about probability distributions to non mathematicians.? Even straight forward issues such as the distribution of outcomes not being symmetrical, or the difference between a median, a mean (and a mode) are not trivial and as for the idea of 'tails'!

These days we typically talk about the value of the 'nth' percentile (e.g. 99.5th over one year) from a modelled distribution – this is sometimes known as the 'Value at Risk' approach. This metric inadequately describes what can happen even further up the distribution curve. To overcome this, the 'Tail Value at Risk' concept has become accepted – that is the expected value of outcomes (i.e. amount of outcome multiplied by probability of occurrence), given that the outcome is known to exceed a given trigger point.

Fig 1: see separate file



In the economic capital world, the 'Cost of Capital' approach is finding favour. Figures are discussed in present value terms, with the discount rate being adjusted to allow for different risk levels and capital requirements. In this framework, explicit margins for uncertain outcomes may also be included.

There are many other metrics, but in this short article there is only space left to mention one further concept, that is 'Key Risk Indicators', or KRIs. These are intended to provide a monitoring or early warning system of high or increased risk. They may be:

- Exposure related – that is showing an increase in the volume of an activity or the throughput of a process with a potential risk attaching; an example might be the number of claims notified
- Loss related – that is a measure that increases when something is going wrong; an example perhaps being the number of customer complaints
- Cause related – that is a leading indicator of process breakdown; these are harder to define and a typical example might be staff turnover.

Stress and scenario methods

The first family of methods may be described as scenario or stress tests. Confusingly, these words get used in different ways by different people. Typically a scenario may be defined as a plausible combination of events, causing a given outcome, and described in words. For example a large weather catastrophe, with a particular reinsurer failing and the loss of a key (claims operation) office. This sort of scenario can be quantified, possibly by asking experts to consider what they think the most likely outcome would be.

Stress tests may be thought of as the more arbitrary but systematic stressing of all or selected assumptions – e.g. a loss ratio, a growth rate, a premium rate change or some economic assumption and so on. A given combination of a set of stress tests can also be called a scenario.

The advantage of stress tests and scenarios is that they are relatively easy to construct, understand and communicate. A key disadvantage is their lack of objectivity in measuring the degree of uncertainty, or position on the distribution curve

Analytic methods

A second family of methods is the analytic, or pure statistical. Analytic mathematics is used to form equations which can be solved for the required metrics. For instance, using past data to calculate means standard deviations and skewness of say loss ratios. These can be combined through analytic correlation matrices, or time series to develop mathematical equations describing the risks faced and quantifying the range of and probability of deviations from the mean or expected outcome.

Whilst attractive to the mathematician, such approaches almost inevitably fail to capture anything like the reality of risk faced in total. They may help inform aspects or component modules of risk models, but still fail to be other than theoretic in their use. Regulators often aspire to these approaches in the hope of reaching a simple formula – eg the Australian, American, Japanese or German models.

Monte Carlo/Dynamic Financial Analysis (DFA) methods

These days most quantification attempts eventually reach the need for a simulation model. The concept of using random number generators to seed simulations of outcomes that match different probability distributions is well known. The power of computers now makes this relatively easy. Analytic thought is still vital – all too often people rush to simulate what they think is reality when a little time thinking things through would help make models more usable and useful.

The idea of simulating each item in a P & L account and balance sheet, with sensible links between items, has an intuitive appeal. For instance the use of:

- time series and/or games theory to simulate markets and hence average premium rates, rating movements or economic variables;
- poission or negative binomial to simulate frequency events;
- Lognormal, gamma, pareto or increasing generalised pareto to simulate severity events.

Naturally models start to become more and more complex. There may be hundreds or thousands of variables each with its own simulation all combined to produce a full enterprise model. There may be rules reflecting management behaviour or decisions under certain circumstances. Typically such models will be built in specialised software – and classes of business, types of loss, cash flows and so on will each receive careful thought.

The more complex a model, the less easy it is to understand how 'accurate' its results will be. Like modelling economies though, in the fullness of time it is likely they will become more and more insightful. For the moment simple tests such as ensuring the modelled mean outcome and the corporate plan are similar may be sufficient and indeed a very useful discussion point!

Understanding sources of uncertainty is still developing. For example given a data set, what certainty is there in the selected model or the selected parameter levels? These can be dealt with mathematically and in today's world any discussion should explicitly allow for these sources of uncertainty as well as the underlying process uncertainty.

Typical issues arising

Use of models has thrown up a number of debates and issues; some of the more interesting:

- Modelling insurance risk is likely to include premium adequacy, reserve adequacy and exposure to catastrophes. One of the

traps is whether to model business written in a given time to ultimate run-off, or just to some intervening period – eg through one calendar year. Taking the view that capital can always be raised has lead some people to consider modelling reserve adequacy over one calendar year – that is the underlying assumptions are based on past data showing reserve movements a year at a time. Clearly this is a dangerous limitation

- There are usually benefits within groups from risks being diversified. The modelling assumptions though are difficult and still often relatively arbitrary. A range of approaches is found including use of correlation matrices (using e.g. judgement to assess how correlated the results of different classes may be) and the use of risk drivers (e.g. claims inflation may be based on salary inflation which in turn may be based on economic growth and interest rates)
- Some of the higher profile insurance company collapses have been caused by unexpected combinations of events, often down to the behaviour of senior management. In statistical terms these are sometimes 'tail events' – that is modelled at the extreme ends of the assumed distributions. Dealing with tail correlations is still a challenge
- Calibrating models is another difficult area. In many countries regulators have talked about living with a 1 in 200 chance of company insolvency. This leads to assessing risk and capital needs at the 99.5th Percentile over 1 year (with claims run-off to ultimate) – or perhaps 97.5th Percentile over 5 years. Comparing this with credit ratings (e.g. of AAA which is say around the 99.3rd to 99.8th Percentile depending on term and lower levels AA A B C and so on) suggests there is still room for discussion
- Use of copulaes to drive modelled correlation is finding favour because it is a relatively straight forward way of simulating probability distributions with some form of linkage in their outcomes – i.e. when one event happens the likelihood of another event occurring changes in a positive (or negative) fashion.

Accounting framework, economic and margins

All the forgoing is highly dependent on which set of accounting conventions define the numbers being used. The new IFRS is supposed to help move us to global consistency, but in truth there is still a long way to go. Reserves may be of variable strength – meaning that hidden margins exist. Discounting may or may not be allowed. Use of margins and assumptions about future claims/ other inflation all remain discrepancies to be resolved.

Other approaches – Delphi, Bayesian nets, engineering models

In the UK, there are a number of new risk professions springing up – PRMIA, The Institute of Operational Risk, the Institute of Risk Management are three good examples. Each has its contribution to make to ERM. Each brings different ideas

For my money the interesting ones include:

- How to incorporate human behaviour – the use of psychometric analyses and measures of how change in an organisation affects its risk profile
- The use of the 'Delphi Method' for capturing the views of experts where no (useful) data exists – or to supplement scarce data. That is asking a number of experts for their individual views including quantification; collecting and playing back these views (anonymously); then asking for revised views in light of the extra information
- The use of Bayesian Belief Networks – where each process or risk is related to other processes or risks in a tree of dependencies using prior assumptions and conditional probabilities – and this model is 'trained' using real life data
- The development of engineering models to represent companies together with cause and effect feedback models

The future

So these two short articles are coming to an end. There has only been space to hint at some aspects of what current best practice is – and how it is developing. I have always been an optimist and can see so much still to be done. In 1988 I recall presenting an elementary paper to my then insurance company executive team. After some discussion the merits of taking a holistic view to risk and capital allocation were accepted. But then everyday management challenges got in the way of full implementation. Since then computers have become more powerful, skills deployed in companies deeper and general management more sophisticated. It seems to me that while good progress has been made with insurance, some aspects of credit, liquidity and market risks much remains to be done around process linkages, the effect of human behaviours, operational risk and hence ERM in total. Managing ERM will drive improved company value. It is an area where we can learn from other industries and concepts, be that for example process management (total quality management, or 6 Sigma) or engineering process models with empirically linked processes being simulated as a physical system.

The hope is that these short articles have given enough insights so that newcomers to ERM are enticed to seek further learning; so that relatively experienced practitioners are encouraged to ponder one or two thoughts they hadn't explored before; and who knows so that a real expert will see something controversial or just downright wrong persuading them to write a letter or even another article!

I believe the actuarial contribution to ERM is in its infancy. We need to develop skills and techniques – even to extend our professional syllabus. This is an area where there is a real difference to be made.