RISK PERCEPTION & RISK ASSESSMENT VERSUS HAZARD REDUCTION
INSURANCE - BIOTECHNOLOGY – ENGINEERING - TRANSPORT

MEETING OF THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE ON MONDAY 25TH OCTOBER 2004

Risks and hazards are objective factors with potential impacts that are amenable to scientific evaluation and their controlled reduction. The perception of risk on the other hand is subjective and reflects a fear of risk that varies between individuals. Government is a risky business, but how can the objective and subjective aspects of risk be managed together in order to benefit from our past mistakes "so that they never happen again"?

Alastair Evans describes how London underpins the world's economy by managing financial aspects of risk. Phil Dale has extensive experience as a research scientist of risk assessment applied to GM crops and contributes his experience with biosafety issues. Chris Elliott combines practical engineering skills with those of a barrister having experience of advising Government on risk with a particular interest in transportation by rail.

London: the Insurance Capital of the World?

Alastair Evans, Head of Government Affairs, Lloyd's

The London Market

The UK insurance industry is the third largest in the world, following the US and Japan. It writes about £160 billion premium income annually[1]. The risks insured and reinsured range from life insurance to motor and household risks and extend to complex commercial and multinational risks.

The London Market is an integral part of the UK insurance industry. It comprises Lloyd's, insurance and reinsurance companies, marine Protection and Indemnity Clubs and insurance brokers, almost all of which are located in the City of London. It provides a wealth of concentrated insurance expertise and an economic cluster of interrelated services.

It is the world's leading market for internationally traded non-life insurance and reinsurance. The risks written by the market are diverse and typically include marine, aviation and transport risks, major property and complex liability risks as well as coverage of catastrophes. London provides a marketplace for high exposure and complex risks which local markets are unable to absorb.

The London Market writes more than £25 billion[2] of non-life business annually and is particularly significant in certain areas of business where its expertise helps to secure substantial percentages of the world's insurance business as indicated below:

- 60%+ of offshore oil and gas risks
- 39% of the world's aviation business
- 19% of the world's marine business
- 15% of worldwide reinsurance, and
- 10-15% of large industrial insurance business worldwide.[3]

London faces strong competition in the general insurance and reinsurance markets. However, it remains our belief that London can accurately be described as the insurance capital of the world. We recognise that London's ability to retain this position is conditional on demonstrating innovation, with an appetite for risk, highly efficient business processes and competitively priced products.

Lloyd's

Lloyd's is the world's leading specialist insurance/reinsurance market. It is home to 44 Managing Agents who run 62 separate underwriting businesses known as syndicates who write almost £14 billion[4] worth of premiums with an unrivalled concentration of underwriting expertise and talent. It is also a global trader and writes business from over 100 countries[5]. The risks underwritten are therefore geographically diverse. The major markets are the US, UK and EU. Lloyd's has a reputation as an innovative market trusted to insure the world's toughest and most complex risks. It is financially strong and secure and has an unrivalled track record for paying valid claims. It is the second largest commercial lines insurer and the sixth largest reinsurer in the world[6].

The market has changed from one backed wholly by private capital to a much more diversely financed market and from a self-regulated market to being regulated by the FSA. Annual accounting has replaced three year accounting. Co-operative programmes have been launched to address business issues

such as faster production of policies, quicker movement of monies and greater contract certainty at inception. A new governance structure has also been created around a franchise concept to improve market performance and brand leverage.

As a result Lloyd's rating has increased when many others have declined. The market has returned to profitable trading post 11 September. Lloyd's delivered strong financial results in 2002 and 2003, generating profits of £834m and of £1,829m respectively on a pro-forma annual accounted basis. This has strengthened the market's capital base. Its net resources (the Lloyd's equivalent of shareholder funds/stockholder equity) totalled £10.1bn at year end 2003, a 35% increase on 2002[7]. Lloyd's central assets have also grown following a recent £500 million subordinated debt issue. Lloyd's has now achieved its target of central assets exceeding $1bn, which was set after September 11[8] and it can be said with confidence that Lloyd's has become a success story again.

Insurance and Risk

Insurance offers an intangible product, a promise to pay in the event of occurrence of an event specified within the insurance contract that causes loss. Risk can range from the more mundane, though important, everyday risks to individuals' property and wellbeing, to catastrophic risks, which can be both natural and man-made. Insurance provides a risk transfer mechanism through which an individual or company can protect itself against future misfortune by transferring the financial downside inherent in risk and uncertainty to a professional insurer.

Insurance works on mathematical principles. Insurers build up statistical records on the severity and frequency of particular risks which assist them in setting an appropriate price. They pool the insurance premiums of the many to pay the losses of the few. To be insurable, risks need to satisfy certain criteria: they must be fortuitous (ie not certain to happen), be financially measurable, satisfy a test of insurable interest, and be compatible with public policy.

The acceptance of risk can expose the insurance industry to severe financial claims. Whilst the cost to the whole industry of the recent East Coast US hurricanes is still being calculated, Lloyd's estimates its own exposure as being of the order of £1.3 billion[9]. Following the 11 September attacks, the number of insurance and reinsurance policies triggered worldwide ranged from aviation through to property, life and business interruption. Lloyd's underwriters are meeting claims to the value of approximately £2 billion for that day.

Because insurers accept risk, they have to ensure that this exposure is within their financial forecasts and financial capacity. Doomsday scenarios have to be anticipated and reflected in financial modelling. At the core of Lloyd's own risk management process lie certain Realistic Disaster Scenarios that are designed to enable Lloyd's to forecast what the market's potential financial exposure to catastrophic events might be, in the aggregate and at individual business level.

There are 17 scenarios on which Lloyd's syndicates are required to report. Some of these envisage total losses to the insurance industry of up to $70billion[10]. These include:

- US windstorms
- Marine events
- Loss of a major complex in the North Sea
- Aviation collisions
- Liability risks
- Political risks
- Earthquakes in the US and Japan
- Terrorism events

The results are used in business planning, as input to Lloyd's risk based capital modelling and to enable syndicates to benchmark themselves against their market peers. It is all part of prudent planning.

Long-tail risks pose particular challenges to insurers. Exposure by individuals to certain environments (eg noise, asbestos etc) can cause latent problems which do not manifest themselves, perhaps for decades. Victims seek legal recourse against those who owed them a duty of care and were negligent. The underwriting of long-tail liability risks has to cope with such challenges. Insurers accept and price risks against a known legal and scientific background but may face claims, which dwarf the level of premiums received, decades later in a very changed legal and scientific environment. This is not said as a complaint. It is a fact of underwriting life which the industry accepts and copes with.

The challenge for insurers in assessing and pricing risk becomes yet more complex in the case of new and emerging risks. Insurers need to try to keep themselves abreast of scientific developments if they are to avoid underwriting misjudgements with potentially expensive consequences.

These judgments have to be exercised against an evolving claims background which some commentators have described as a growing "compensation culture". Opinions differ as to whether a compensation culture really exists or whether it is simply a media-led campaign. For insurers, the key is not newspaper headlines but whether the frequency and severity of claims is or is not increasing or may increase in the future, since the cost of claims has to be reflected in prices. Actuaries have said that the compensation culture is costing UK plc about £10 billion a year – and rising at 15% per annum[11]. The average cost of an employers' liability claim has increased by over 100% over the last five years[12]. Clinical negligence which cost the NHS £6 million in 1975, cost nearly half a billion by 2002[13]. Compensation and legal costs have risen to £100 million in the Ministry of Defence[14]. Society (whether via Parliament or the courts) has, and should have, the right to decide that compensation should be awarded in a particular set of risk circumstances and those costs have to be sourced. Insurance provides a crucial mechanism in modern society for helping to ensure that victims are properly compensated.

Conclusion

We believe that London remains the insurance capital of the world. This belief is not advanced with any sense of hubris. Competition is fierce in the global insurance and reinsurance industry and that position will only be maintained by continual modernisation and being at the top of our game. The challenge which London faces is to continue to provide cost-effective, innovative solutions to the world's voracious demand for risk transfer.

[1] IFSL, City Business Series, 2004, Insurance (p3)
[2] IFSL, City Business Series, 2004, Insurance (p15)
[3] All percentages from: IFSL, City Business Series, 2004, Insurance (p19)
[4] Lloyd's Worldwide Markets, 2004
[5] Lloyd's Worldwide Markets, 2004
[6] S&P Global reinsurance Highlights, 2004
[7] Lloyd's Finance Department, April 2004
[8] Lloyd's Finance Department, April 2004
[9] Lloyd's Risk Management, 2004
[10] Lloyd's Loss Modelling, 2004.
[11] Actuaries' Working Party report "The Cost of Compensation Culture", reported on www.thenetrisk.com 17/12/02
[12] Association of British Insurers, "Liability Insurance", August 2002
[13] "Making Amends", Chief Medical Officer, June 2003
[14] NAO Report "Ministry of Defence- Compensation Claims",18 July 2003

Biosafety of GM Crops: How the biotechnology community handles risk and its perception

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Introduction

Over the past 20 years it has become possible for plant biologists to isolate genetic material (DNA) from a range of organisms to genetically modify (GM) crops. GM methods provide plant biologists with opportunities to modify crops in novel ways. It is important, for instance, that we find sustainable crop based substitutes for our diminishing oil and mineral reserves, and explore ways to produce crops adapted to changing climatic conditions. GM crops are cultivated in 18 countries by 7 million farmers and worldwide cover over twice the land area of the UK (67.7 million hectares in 2003).

Highly developed methods of risk assessment have evolved in recent years to assess the safety of GM crops, and this is one of the few areas of scientific innovation where the process of risk assessment is carried out proactively, rather than reactively. Proactive risk assessment has many merits, but it does tend to focus disproportionate attention on risk, and frequently ignores benefit.

I shall discuss three topics associated with risk: its assessment, acceptability and perception. I shall conclude with thoughts on other dimensions of risk.

Risk Assessment

In assessing risk we address a series of questions. In some cases sufficient scientific knowledge and experience is available to answer them. In others, new scientific data has to be generated. Some key questions in risk assessment are:

- How does the introduced gene modify the crop?
- Are there changes in toxicity or allergenicity?
- Is the crop more invasive or persistent (weedy)?
- Are there effects on friendly organisms (eg ladybirds)?
- What is the likelihood and consequence of pollination?

The general consensus within the scientific community is that there is no generic difference between the risks of growing GM and non-GM crops. Each GM crop must be evaluated case by case.

Risk acceptability

What "yardstick" do we use to determine whether an impact is acceptable or not? A view out of an aeroplane window confirms that agriculture has a dramatic impact on our rural landscape, compared with how it must have looked a hundred or even twenty years ago. Over 70% of the UK land area is farmed in some way, so agriculture largely defines our landscape and rural environment.

In assessing the risk of GM crops, the EU regulatory process requires a comparison with similar non-GM crops. The difficulty with this is that different crops (oilseed rape, maize, sugar beet) themselves can have fundamentally different impacts, as was illustrated by the four year Farm Scale Evaluations (FSEs).

The aim of the FSEs was to assess the impact on farmland wildlife of three GM crops (oilseed rape, maize, sugar beet), each made tolerant to one particular herbicide to improve crop weed control. The comparator of impact (or the "yardstick" of acceptability) for each GM crop was a non-GM variety of the same crop. The results of the paired comparisons were that the GM maize was found to be associated with more wildlife compared with the non-GM variety, and the GM oilseed rape (spring sown) and sugar beet were found to be associated with a reduction in wildlife compared with the non-GM varieties. Decisions on commercialisation were based largely on these direct comparisons.

A fundamental weakness of comparisons of this type is that they fail properly to take a holistic view of the impact of agriculture on wildlife. The FSEs established that there were significant variations between crops (whether GM or non-GM) on wildlife. Oilseed rape is generally better for wildlife than maize. There were also significant differences in wildlife between locations and seasons. The outcome of the decision made on commercialisation was that there was no regulatory mechanism to limit the continuous cultivation of non-GM maize (damaging to wildlife) but it would prevent the cultivation of a GM oilseed rape break-crop (beneficial to wildlife). The results also fail adequately to emphasise that any method of efficient weed control in crops (hoe, flame thrower, mechanical cultivation) is also likely to have a significant negative impact on wildlife in agriculture because weeds often provide nourishment for wildlife food chains.

This emphasises the need to refine the precise objective of risk assessment. Its ultimate aim is surely to minimise any adverse impacts of GM crops on the environment. But this only makes sense when it is done in concert with (ie against a common yardstick) comparable judgments applied to damaging non-GM crops and existing farming practices.

A further anomaly is that certain crop modifications are possible by GM and non-GM methods (eg glyphosate herbicide tolerant ryegrass). A GM glyphosate tolerant ryegrass would be unlikely to be approved by the current GM regulatory process; whereas a non-GM herbicide tolerant ryegrass, with closely comparable environmental impacts, would proceed into agricultural use without comparable regulation.

Risk perception

It is fair to say that the biotechnology community finds the area of risk perception to be difficult territory. This is because the rules of engagement between the various interest groups are very different.

The biotechnology community largely uses scientific evidence and reasoning to reach a conclusion in risk assessment. Where there is inadequate knowledge, they explore ways of managing risk. This is not to say that value judgements are not part of this process, but they are usually within a particular scientific and agricultural context.

The campaigning groups, and sections of the campaigning press, typically use a different currency. In basic terms, their concerns focus around who has power over food and the environment. The GM Nation report acknowledges that GM crops have become an icon for a range of concerns. Issues raised in the debates included: globalisation, the influence of big business, industrialisation of agriculture, trust in government and a range of environmental issues. Discussions that begin with GM crops often move rapidly to broader issues of power.

A particular difficulty with risk perception is that people rarely weigh information symmetrically. A grain of doubt can far outweigh a mountain of reassuring evidence. This is so even when there is no scientific evidence to support a concern. During recent years there have been extensive campaigns against GM crops by sections of the press and activist groups. Once a campaign is adopted it seems that balance and integrity of information is often a casualty. While mistakes have undoubtedly been made in GM crop commercialisation, biotechnology companies face litigation if they make false claims for their products, whereas false allegations of risk carry no such penalty.

Other dimensions of risk

The biotechnology community faces ongoing demands for greater public transparency of their risk assessments. As a consequence, the activist groups are provided with the information they need to destroy GM field plots. Largely as a result of GM crop destruction, the number of GM field trials in the UK has reduced to almost zero in recent years.

As the UK aspires to have an innovative science and technology based economy, the consequences to research of crop vandalism are serious and could be devastating in the longer term for the following reasons.

(a) An important role of field research with GM plants is to provide an analytical tool to understand important crop characters (eg environmental stress tolerance; pest & disease resistance; oil, starch and protein production). Basic knowledge in plant biology is relevant to all methods of crop improvement.

(b) The major crop biotechnology companies have decided to move their GM research and development programmes out of the UK eg Bayer Crop Science, Syngenta. One Chief Executive told me that if biotechnology companies have to move their field crop evaluation out of the UK, it is logical to move their research programmes abroad also (mostly to the USA). Biotechnology companies take with them an extensive knowledge base and infrastructure for all aspects of crop biology.

The ability to do GM field research is of enormous significance to our crop research capability in the UK, and has parallels with the importance of stem cell research in medical science. If strategic and applied research involving GM field evaluation is denied, the UK is destined to become a backwater in innovative crop biology.

The management of system risk: Safety and environmental risk in engineering and transport

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What is risk?

Ever since a caveman decided to bring fire into the cave, we've been living with risk. That caveman knew that fire was dangerous, but he decided that the benefits of a warm home and cooked food more than compensated for the risk that his home might catch fire. Since then, it is hard to think of any beneficial innovation, social or technical, that didn't bring with it the possibility of harm.

It is helpful to distinguish hazard (anything that can cause harm) and risk (the chance that a hazard will cause harm, and the extent of that harm). The objective is then to manage the risk, not to eliminate the hazard. The caveman knew that fire was a hazard, but he realised that, if he kept it in the hearth and made his children stand back, the risk was low enough to be worth taking in order to have a warm cave.

A serious ethical challenge arises where individuals cannot decide for themselves whether to take a risk, either because they do not have sufficient information or because they do not have sufficient control. This is made even harder when the benefits and potential harm do not fall to the same people, especially if the benefits occur now and the potential harm is to future generations.

Many engineering and transport risks are like that – I want to explore how a responsible and ethical engineer meets social demands when he knows, at least statistically, that what he is doing will injure or kill people or harm the environment.

The legal and ethical duty

There are two principles:

- *risk is the responsibility of the person who creates it* - "…it shall be the duty of every employer…", Health and Safety at Work Act 1974, Polluter Pays Principle, Art 130R(2) EC Treaty
- *risk cannot be eliminated* - "As Low As is Reasonably Practicable" (ALARP), "Best Available Technology Not Entailing Excessive Cost" (BATNEEC).

But what does "reasonable" mean? It's a common word in our law. You may use reasonable force in self-defence or to evict a trespasser, and you are not negligent if you use reasonable skill. What is reasonable at any time is what society believes to be reasonable, but there are very few rulings by Courts that provide much guidance on where to draw the line between reasonable and unreasonable.

One way of expressing society's view of what is reasonable is to estimate how much it is willing to pay to avoid a risk. When deciding whether to adopt a safety measure or to permit an activity, we work out how much it will cost or save and how much risk it will cause or remove. We can then estimate the cost-effectiveness – how much safety we will buy per pound that we spend. The National Institute for Clinical Excellence does this for medical treatments and ranks them in order of cost-effectiveness. The budget for the NHS then determines how far we can go down this list before the money runs out. The Department for Transport publishes an annual figure for the Value of Preventing a Fatality (VPF). We can compare this with the cost of a safety measure in terms of Cost per Fatality Avoided (CPF).

This hard-nosed economic approach puts an important demand on engineers. We have no right to plead that a safety measure is not cost-effective unless we are confident that our costs are under control. We should not rule out a safety measure as too expensive if its high cost is a result of our incompetence.

But we don't let this hard-nosed economic approach be the only thing that determines what we will permit or forbid. We recognise that society cares more about some kinds of risk than others, and that

we must reflect what public opinion demands. That then begs the question – how do we determine what public opinion demands?

Where do we find representative public opinion? Certainly not in the news media. Even the broadsheet newspapers present at best an incomplete view of risk, and in many cases they actively distort the truth to print an eye-catching story. Railways have been grossly misrepresented – the number of fatal train accidents and the number of passengers killed were both fewer after privatisation than before. The nuclear power industry struggles against a perception that it is more dangerous than "safe" coal or gas power, and parents wrestle with the belief that paedophiles lurk around every corner.

As a result, people simultaneously hold two views. They believe that the train or food is safe enough and nothing more should be spent on safety, but that it is outrageous that accidents are allowed to occur and the Directors of the companies responsible should be punished. What should the responsible engineer do now? Should he lower an already low risk because people are outraged, taking resources away from other more serious causes of harm, or should he deal directly with the feeling of outrage? The second approach brings him into the territory of Corporate Social Responsibility.

The traditional view of social responsibility was that people vote for Parliament and Parliament, through legislation and Ministerial oversight, reflects their views. That is no longer enough. Civil society embodies a wide range of interest, pressure groups and extra-parliamentary political processes and the responsible engineer has to engage with all of them to gain and retain his informal licence to operate. If he does that, he can do what society demands, which is to provide the proper balance of safety, cost and performance

Back to systems

My definition of a system is *"a set of parts that, when brought together, exhibit properties that were not present in the parts alone"*. Those properties, including risk or safety, cannot be managed by managing the parts alone; you have to manage them as a system. This raises two important risk management issues: how to apportion risk between the parts and what about risk that emerges from the interactions of the parts?

We can apportion risk – the total risk arising from a system can be shared out, so that each part has to present no more than its share of the total. A proper risk-based process can lead to the conclusion that it is not necessary to take any further action to mitigate the risk. The hazard is still there, but the risk is properly controlled. That sort of process is the most robust defence against against knee-jerk reactions and misrepresentation.

But what happens when the risk arises solely from the interaction of the parts of the system. You can't then apportion the risk to each part – it makes no more sense than to try to describe the sound of one hand clapping. Instead, we try to define what each part will do rigorously so that their interactions are wholly predictable. In practice, of course, specifications are rarely perfect (especially when there's software involved). This is the area where engineers' approaches to risk are weakest, and where caution and hazard management may take precedence over risk assessment.

System risk is compounded when the different parts of the system are under different ownership or management, such as in transport. The fundamental principle of holding the risk's creator responsible means nothing, because no one person did create it. If the interface specification is not perfect, we may find that some risk has two owners, who may not agree on how to manage it, and there may be orphan risk with no owner. Who then is responsible?

In conclusion

We have a well-defined approach to managing safety and environmental risks, but two challenges remain. The first is to find a clearer way to judge what society demands of duty holders, in a climate of rational debate. The second concerns fragmented systems, where concepts like duty holding and the Polluter Pays Principle start to break down. Then the companies that make up an industry must work together to find solutions that address the whole problem and produce the optimum outcome for the industry as a whole.

Safety-critical industries can rise to these challenges – they do not want the alternative of more State intervention – but they need a constructive dialogue with Government, Parliament, Regulators and wider civil society.

In discussion the following points were made:

How does the London insurance market keep ahead of science? This is appraised in a variety of different ways by insurers and scientists, however it is the assessment of premiums that matters when considering the likelihood and severity of claims. This is complicated by new and emerging risks such as ecological damage, for example, where there is no jurisprudence at present, requiring a guarded approach. There is a problem trying to weigh up different types of evidence when assessing risk. Science is very complex and although consensus may be obtained, there is constant risk of disputes and outrage fuelled by the media who need to learn how science works. Hence there is also a risk of accusing the media of causing a problem, when this is actually due to mismanagement, requiring better self regulation. Outrage arises from lack of early public interaction on decisions perceived to carry risk. Factors for consideration include the identification of any beneficiaries of risk, if taken; the extent of risk to workers and the public, the identification of those responsible, and risk-benefit analysis. Is there any benefit from GM crops for example to the customer in the supermarket? There needs to be a clear benefit that the consumer or a "representative person" could identify with if the risk is to be considered acceptable. This need also arises when training engineers to understand the public where emotion may predominate over rational discussion, resulting in an ongoing requirement to bridge the gap between CP Snow's two cultures. Would the motorcar ever have been developed if the risks had been properly assessed?