INSTITUTE OF ACTUARIES
GENERAL INSURANCE STUDY GROUP

COMMERCIAL FIRE UNDERWRITING WORKING PARTY REPORT

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"The author has no doubt .....that the time is approaching when..... the present loose and almost undefined method of estimating (Fire Insurance) premiums will give place to one of a more scientific and definite nature."

Preface to "The Theory and Practice of Assurance" (1847) by W E Hillman FIA.

SECTION 1

SCOPE AND OBJECTIVES

The working party feel that the level of knowledge of commercial fire insurance is relatively low within GISG. This may be a relevant factor contributing to the recent decline in numbers of specialist general insurance actuaries within the larger composite companies. Actuaries may have entered the arena with some worthwhile ideas on reserving, statistical analysis and motor rating. However, while their ideas in these areas have been refined over the years, they have never made the important transition into the centre of the general insurance stage within the direct writing companies. This would involve contributing ideas within the commercial insurance field and considerable contact with underwriters. The members of the working party feel that actuaries have a lot to offer in this area. Others may agree when they see the wide diversity of thinking between actuaries and underwriters that is portrayed in the paper.

In many ways this is a "chicken and egg" situation. Actuaries cannot be helpful to commercial underwriters until they are involved in and understand the business; yet they are unlikely to be involved in the business unless they can be helpful to underwriters. It is hoped that this paper will be a start in helping to break the vicious circle.

With the above thoughts in mind the working party has produced this basic educational paper on commercial fire underwriting - a class of business which covers any property except domestic dwellings. Such business produces nearly £1 billion worth of premium in the UK alone. Although the paper does give background information, particular emphasis is given to areas where actuarial ideas could be most profitably employed. These could perhaps be developed in later papers. Similar work could also be usefully done in other areas of commercial insurance business.

Finally it is hoped that this paper could be simply modified to make it appropriate as educational material for the B3 general insurance exam. At present the lack of suitable reading for commercial fire insurance is a real problem to the students. The CII course dwells rather too much on strict underwriting considerations and gives too little information on rating and other financial matters to be of much use to actuarial students.

SECTION 2

BACKGROUND TO FIRE INSURANCE

2.1 An Underwriter's Perspective

What is the view which a Fire Underwriter has of his work and how does he guide his course in business life? It is worth spending a little time on this question, since the perspective of the underwriter may differ significantly from that of the actuary. For effective communication, one needs to understand the other man's point of view.

(a) Influence of the Tariff

The first point is a clear one. Like actuarial work, fire underwriting is a discipline with a strong tradition. Because of the long history of the FOC (Fire Offices' Committee), and the 120-odd years of the tariff, there is a coherence to fire underwriting thought which runs virtually across the industry. The unity is much greater than one would find, say, in Liability Insurance or Pecuniary Loss, and the principle applies even to those offices which were non-Tariff, since they were strongly influenced by its existence. Although proclaiming independence, many would follow the same rating structure, and might even be in possession of under-the-counter copies of the Tariff itself!

The rating methods of the Tariff are described more fully in Section 3.3. But, in brief, the Tariff comprised a set of basic rates, on a trade or industry basis. To these, various adjustments were prescribed according to the particular features of a risk, and the warranties which an insured was prepared to undertake. The schedules were based more on underwriting 'feel' than exact science, but nevertheless incorporated many years of business experience. As a result, at the overall level, the Tariff was successful in prescribing premium rates that gave offices a very adequate level of profitability. But it was not always so satisfactory in terms of fine tuning, and some problems were experienced with the system as the 20th Century progressed into its later years.

These problems related mainly to the lack of flexibility of the Tariff. The industrial scene was changing, and the effort of incorporating whole new industries into the structure proved too great, and the commercial market was changing with such rapidity that there was no hope of keeping the Tariff rates up to date, other than by a crude system of overall adjustments. Most important of all, Commercial Fire became a very competitive business. Offices would have to fight at each renewal to retain their custom. Even those which were FOC-diehards had to permit exceptions to Tariff ratings, or lose substantial premium income.

Hence there were good commerical reasons, as well as political ones, for the eventual disbanding of the FOC in 1985. But though the formally agreed rating structure may have gone, there is a continuing legacy from the Tariff era. The way of thinking that lay behind it will remain a strong influence for many years to come.

(b) The Underwriting Cycle

The second main point relates to markets and competitive pressure, which are a reality for the Fire Underwriter. Their expression in practice is through the underwriting cycle, a phenomenon which can be described in classic economic terms. For example, in the early 1970's, there was a hardening market, reaching its peak in 1972/73. Premium rates were relatively high, and good underwriting profits could be made. New companies were attracted to enter the market and established ones increased their capacity for business. Soon the market was overprovided, competition intensified and premium rates began to fall. This led to a protracted soft market in the later 1970's and early 1980's. By the end of the period many companies were suffering substantial losses. Some reduced their capacity, while others left the market altogether. This led to the opposite aspect of the cycle, and in 1984/85 the hard market reasserted itself. Premium rates were restored to higher levels relative to risk, and those companies left in the market returned towards a position of underwriting profit.

A significant aspect of the recent hardening of the market has been the drastic reduction in reinsurance capacity. This feature has particularly hit the smaller companies, and largely destroyed their ability to undercut the bigger, better established offices. Thus, in the soft market, a small company could write large tranches of business far beyond its own capacity, simply by reinsuring the greater part away - in some cases 95% and more! But the option is no longer open today.

There is a corollary to be drawn from the underwriting cycle. It is that, in the soft years, an office may deliberately take or retain business, knowing that the rate set is not a profitable one. This is because it has a feel for the cycle, and wishes to keep the business on its books for the hard years which are likely to follow. The aim is to make a good profit in the longer term, and not just for the current year in isolation. (Even so, the sensible underwriter will have some lower limit in mind, below which he will not be prepared to go in the competitive scramble).

(c) Underwriting vs Insurance Profit

This is an issue on which actuaries and underwriters may well express differing opinions. The actuary, with his knowledge of investment principles and discounting will be inclined to favour the concept of "Insurance Profit" (ie. including investment returns) over that of "Underwriting Profit" alone. But to the underwriter there may be good reasons for taking the latter as the main goal. For example, in a large organisation with many branches involved in underwriting, clear instructions have to be given to the staff. To them, the term "Underwriting Profit" will have a direct and simple meaning, and will help to guide the course of their work. But the staff would not fully understand the concept of "Insurance Profit", nor how it is arrived at by the actuary. Hence direction and momentum will be lost, and with them, perhaps the chance of making any profit at all.

A further point is that, if premium income can be expected to cover claims, expenses and a margin for profit, then investment income may be used for building up the reserves. This strengthening is particularly desirable under modern conditions, so that solvency margins can be maintained at an adequate level as the business grows. Also, as time goes by, the individual risks tend to become much larger in size, so that a stronger capital base is needed in order to give the proper cover.

(d) Trends in Risks

The trend towards larger risks is an easily observable one. There are nowadays more 'ostrich eggs' in the nest, in comparison with the ducks and chickens of yesteryear. The effect comes simply from the industrial trend towards larger units with greater concentrations of valuable equipment - computers, aircraft, chemical plant and so on. A modern shopping complex would be another example.

The losses which occur in such cases can be extremely large, eg. Donnington ordinance depot, Cricklewood warehouse fire, BAC at Weybridge, etc. It seems that there is a functional relationship between increase in square footage and increase in estimated maximum loss, (EMI, of which a more detailed definition follows on page 13), and that the function is more geometric than arithmetic in character.

A second significant trend is towards greater moral hazard - damage resulting from arson and other wilful types of vandalism, together with lax standards of discipline, security and management control. Poor housekeeping is on the increase, and appears to have been a contributory factor, eg. to the Bradford Football Club disaster of 1985.

(e) Claims & Rating: The Classic Approach

How does the underwriter feed back the claims experience into his rate-making decisions? Under the classic theory, when the Tariff was in its heyday, he would adopt a 3-tiered approach to losses.

Small losses should be borne by the individual case. With large or medium policies, there would be no problem, but a small policy might well not pay for itself. Such a policy should either be declined at the next renewal date, or its rate should be increased to an economic level.

Medium sized losses should be borne, not case by case, but funded out of the total class premium. That is, each trade or industry, considered on its own, should be self-supporting. If the experience for a given trade were in debt, then the rates should be increased, say by 5 or 10%, or some appropriate margin.

Large losses (or, at least the excess of large over medium) should be borne by the whole of the portfolio. Thus, the Commercial Fire business in toto should be profitable, although given trades might not be, on account of exceptional larger losses during the period in question. A deficiency in the portfolio from large losses would need to be corrected by an overall increase in the rates.

(f) Claims and Rating: Modern Statistical Approach

In an office with a modern data system, the underwriter may take a more detailed and objective approach. Thus, every risk will be classified, and the results collated over the years, until at least a 10 year run of exposures, premiums and claims is available. From these figures, such information as the claims incidence per 100 policies and the

average size of claims can be obtained, together with their trend over the years. In addition, a statistically based set of burning rates can be derived, giving in effect the pure risk premium for each class of business in the Fire portfolio.

A number of fixed markers are thus established for the underwriter, giving him a firm base. His next step will be to predict the future mix of business which the company may expect to obtain. The pure risk rates can then be converted to a range, in order to cover the business mix expected within each class. It is at this stage that the factors making for heterogeneity, such as physical construction, management and housekeeping, fire protection systems, etc. can be brought into the account. As a third step, the rates are converted to working rates by adding margins for expenses, profit, catastrophe losses, inflation and other factors. Inflation has its place, since there is bound to be delay between the writing of a risk and the settlement of any subsequent claims. But the factor is not nearly so significant in fire insurance as it is, say, in liability.

The final result of the process is a rating scale for each trade, in many ways akin to the earlier Tariff version. The differences are:

- That trends in the statistics can quickly be recognised and applied at the next rating review,

- That there is more evidence available for analysing the effect, say, of a change in the mix of business, or of a given underwriting factor,

- There is no need to wait scrupulously on other offices of the FOC, and hence particular opportunities in the market can be more quickly taken up,

- The rating base is more accurately set, in terms of its structure as well as its overall level.

(g) Treatment of Substandard Risks

Here is a further area where actuary and underwriter may not always see eye to eye. A Life Office may decide, as marketing policy, to seek substandard lives at aptly higher rates of premium. But the tactic is not really employed in Commercial Fire. The underwriter's aim is certainly to take on risks, but only those he would regard as reasonable. When a proposal comes in, he will look for any bad features present, and place each on a scale of ascending severity. If the features are minor ones, he may ignore them, or introduce a small loading to the premium, and so on up the scale as the severity increases.

But eventually he will reach a point where the hazard is so great as to make the risk not commercially viable to his company. By the law of averages, ultimately, there will be a loss which is far greater than the premiums paid.

To put the point in figures, if there is a 100% chance of a total loss within 10 years, or a 10% chance of such a loss in any one year, then the risk is quite beyond the pale. In fact, no insurer wants to charge more than 2% as a premium in the property market.

A risk, then, may not be reasonable as it stands. The question is, can it be changed? If so, then terms may be offered, and a contract negotiated. The classic answer is to have sprinklers put in, and then reduce the effective rate by 50% or more. But there are aspects of risk more difficult to deal with - Management and Housekeeping being a prime example. There is an underwriters' adage that if you have a bad insured, it does not matter how good the property, you always have a bad risk. As an example, consider a clothing factory with unrestricted smoking by the work force and a lack of management concern about the safe extinguishing of smoking materials. That is evidence of a management attitude so lax that without a complete change the risk will not be worth taking on. As the text books say, you can never rate adequately for moral hazard.

As a means of control on poor risks that are acceptable, the underwriter will frequently impose a lower acceptable limit than normal. That is, he will restrict the amount of cover given. Consequently, a poor risk is more likely to need co-insurance, with a number of companies each underwriting a proportion only of the sum insured. In such cases, the influence of a competent broker with good market contacts may be essential to the placement of the risk. The key, perhaps, lies in the proposer's attitudes - if these are acceptable, then attempts will be made to take part of the risk by the underwriters concerned.

(h) Independence of Underwriting Factors

Generally speaking, the underwriter will take the various factors such as Physical Construction, Trade Processes, Heating Systems, etc as being independent in their effect on the level of risk. This is the traditional way of working, with all the advantages of convenience and continuity. But it is not the only way of proceeding, and such distinctions as the inception and the spread of fire could well be useful. As a particular example, consider two similar warehouses, one

containing reeled paper and the other pig iron. The fire inception risk might be identical, but the spread hazard is clearly very different. So smoking regulations and other management points have a quite different significance in the two cases. But conclusions in this area, while amenable to common sense, are more difffcult to tackle from a statistical point of view.

In conclusion the most important point of all is that, while there is one truth to be found in statistics, there is another to be found in the market place. It is a fact that market conditions heavily influence General Insurance rates, and the underwriter disregards this imperative at his peril. The time when the annual renewal of business would be a matter of course has gone, and he must fight to retain and expand his portfolio of business.

That said, actuarial and statistical methods are far from being irrelevant. The passing of the Tariff, and the advent of modern methods, does give offices a firmer base and better opportunity for fine-tuning their mix of business. By 1986, the better prepared offices will have available 10 years' worth of detailed statistics on their Commercial Fire portfolios, although they may not be in an ideal actuarial format. These can be ananlysed in many ways, in particular to show the significant trends in the experience - whether rising or falling - and to distinguish them from the hiccoughs which from time to time disturb the business. Thus the benefits of the scientific approach are not entirely lost on the underwriter, and there may well be better prospects for co-operation with the actuary in future.

2.2 Scope of cover

Basic Cover

Since 1922 most leading insurance companies have adopted a standard form of policy; the smaller companies, however, have tended to follow broker wordings. This has led to a uniformity of cover and limitations and also of conditions and their interpretation. Following dissolution of the Fire Offices Committee (FOC) this uniformity may diminish as new wordings appear although the Association of British Insurers (ABI) is preparing recommended wordings for its members. The standard policy covers the property against:-

i) Fire (whether resulting from explosion or otherwise) not occasioned by or happening through:

   (a) Its own spontaneous fermentation or heating or its undergoing any process involving the application of heat. [That is to say that the material undergoing such a process is not covered although the damage caused by a resulting fire is]

(b) Earthquake, subterranean fire, riot, civil commotion, war, invasion, act of foreign enemy, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection or military or usurped power.

ii) Lightning

iii) Explosion, not occasioned by or happening through any of the perils specified in i(b) above:

(a) Of boilers used for domestic purposes only.

(b) In a building not being part of any gas works, of gas used for domestic purposes or used for lighting or heating the building.

The conditions of the policy exclude other types of explosion, nuclear risks, property insurable under a marine policy, and unless specifically mentioned, goods in trust or on commission, and items like money, documents, plans etc.

The wording of the Lloyd's Policy is similar but slightly wider.

Fire implies actual ignition and must be accidental in origin from the point of view of the Insured. Damage to the insured property caused by measures taken to put out the fire, and through such associated occurrences as smoke, scorching or falling walls is covered. Arson (or wilful fire raising in Scotland) is also covered, provided it is not committed by, or with consent of, the Insured.

A standard specification identifies the property covered and would list

(a) The building, including landlords' fixtures and fittings

(b) Machinery, plant and all other contents

(c) Stock and materials in trade

Other specific items of property may be added to this list. Memoranda would generally be attached to this specification to define more closely the cover given. Special clauses may be added to the standard policy to cover items like computer systems records, the fees of professionals (eg architects and surveyors), costs of complying with the requirements of public authorities, and property while temporarily removed.

Special Perils

The following additional covers, known as dry perils, may usually be bought:

EXPLOSION

This would extend the very limited explosion cover given under the standard fire policy. Damage from explosions of non-domestic boilers and steam pressure vessels under the Insured's control is excluded but can be covered by an engineering insurance policy. Nuclear explosions and war and riot risks are excluded.

AIRCRAFT

This covers non-fire damage caused by aircraft or by articles dropped from them. War risks and damage by sonic booms are not covered.

RIOT, OTHER SPECIFIED DISTURBANCES AND MALICIOUS DAMAGE

Damage by fire and other causes like wreckage and looting is covered. Under the Riot (Damages) Act 1986 it may be possible for insurers to recoup losses caused by riots from the Police Authorities.

IMPACT

This covers damage by impact of road vehicles, horses or cattle not belonging to or under the control of the Insured. Impact by the insured's own vehicles can be covered on request.

EARTHQUAKE

This can cover fire and shock damage caused by earthquake.

SUBTERRANEAN FIRE

This includes fires in mines and oil wells as well as those of volcanic origin and fires in made-up ground.

SUBSIDENCE OR LANDSLIP

Because of the strong possibility of selection against the insurer this cover is written with caution. It would have a substantial excess.

SPONTANEOUS COMBUSTION

This covers property damaged by its own spontaneous combustion. It would apply to property stored in bulk which may be liable to self-heating but would be subject to stringent requirements about storage conditions.

Cover against the following wet perils may also be bought:

STORM, TEMPEST AND FLOOD

This is common where the premises contain property susceptible to water damage. The cover is subject to an excess, usually £100.

BURSTING OR OVERFLOWING OF WATER TANKS, APPARATUS AND PIPES

Similar Comments as for Storm, Tempest and Flood apply.

HAIL

Damage to farm crops in the open is usually on a short period basis whilst glass in greenhouses is covered by an annual policy.

Sprinkler leakage

This covers the risk of water damage caused by the accidental discharge of sprinkler heads or by accidental damage to supply pipes, valves or any part of the sprinkler installation.

"All Risks" Cover

This offers cover not only against named perils but against accidental loss of or damage to the property insured from any cause other than those individually excluded in the policy wording. There would be the usual exclusions of war and nuclear risks. The list of exclusions can be extensive. Examples of excluded risks are: fraud or dishonesty, mechanical breakdown, explosion of boilers. Those of excluded property are: property in transit, money. There is a facility to 'buy-back' some of these exclusions for an additional premium.

Variations in Cover

Blanket Policies

These show only total sums insured in each of the 3 categories (ie buildings, contents and stock), for firms with works and warehouses spread over more than one fire risk.

Declaration Policies

These cater for businesses where stock values fluctuate. The sum insured chosen is the maximum likely to be at risk during the year and at regular (say monthly) intervals the Insured declares the value at risk. An initial deposit premium is paid and there is an adjustment at the end of the year. The need to amend the sum insured from time to time to accommodate fluctuations in value is thereby obviated.

Consequential Loss

This type of insurance is also known as profits, loss of profits or business interruption insurance. Whereas the fire policy provides protection against destruction of or damage to buildings and contents a CL policy protects the earning capacity of the business. It makes good the loss in profits while the premises are being rebuilt and the machinery and stock replaced. Items may be insured on the basis of gross profits, revenue, income, rent receivable or earnings in any other form. Additional expenditure to reduce the loss of earnings is included in the cover. A range of perils can be covered and it is common for the corresponding Fire policy to have at least that range. The cover is normally for a 12 months indemnity period but covers for 18, 24 and beyond are available. The indemnity period begins with the occurrence of the damage and ends not later than the maximum period selected during which the results of the business are affected by the damage.

This paper does not consider consequential loss policies in any great detail.

'All-In Cover' (Trader's Combined Policies)

These cover the basic risks against which shopkeepers, offices, hotel proprietors and other small traders need cover. One inclusive policy, with a number of sections, might typically cover fire, consequential loss, employers' and public liability, glass, money and theft. There is also a simplified package policy in which the cover is generally standard, there are size limits and the premiums are based on relatively few rating factors.

No further mention of such covers will be made in this paper.

2.3 Bases Of Cover

Indemnity

The measure of the Insurer's liability is the value (after depreciation) of the destroyed property at the time of the loss or the amount of damage if lower. The sum insured should therefore represent the value of the property.

Reinstatement

This is available for buildings and machinery (but not for stock) and the Insured receives new for old without any deduction for depreciation. Destroyed property is rebuilt or replaced by similar property. For damaged property, the damaged portion would be repaired and restored. In neither case would the insurers be liable for any betterment. If therefore, the replacement

machinery or plant is better than that destroyed, the Insured bears the cost of betterment. Thus a destroyed machine will be replaced with a new one of the same quality; any upgrading of the machine will have to be paid by the insured.

First Loss

The sum insured is restricted, with the Insurer's agreement, to a figure less than the full value of the property. It represents the maximum value the Insured considers vulnerable to a single loss. It is used usually where there is no possibility of the building being reinstated (eg stately homes) or for insurances covering water damage.

2.4 General

Aspects of Market Practice

Estimated Maximum Loss (EML)

One definition of EML is: "It is an estimation of the most serious loss from a single occurrence that can reasonably be envisaged (or, is within the realms of probability) from any peril. In the case of fire/explosion, the factors of construction, sub-division of the risk, occupation and hazards pertaining to the risk at the time of examination are considered but sprinkler protection and other automatic prevention or extinguishing arrangements are ignored." The EML helps the underwriter to determine, in the light of reinsurance facilities available, the extent of his acceptance.

EMLs are equal to the sum insured in the case of small buildings but in large modern office blocks may be only 10% of the sum insured.

Collective Policies and Coinsurance

Large commercial risks are often co-insured, the coinsurers contributing to all claims in the proportions of their participation in the insurance. The office with the largest proportion, the leading office, surveys the risk if necessary (see section 3.2), prices the cover, administers the insurance and prepares the documentation. It will issue a collective policy listing the insurers and their shares. If a proportion of the risk is placed at Lloyds then a separate policy would be issued for that.

Long Term Agreements

The insurer offers a 5% discount to the Insured if he agrees to renew his policy for a term of three (or somtimes five) years and signs an agreement to that effect. The Insurer is not bound to accept the offer of insurance at the renewal date. He may want an increased premium in which case the Insured is not obliged to renew.

Aspects of Cover

Average

To encourage full insurance and to ensure as far as possible that each insured pays an equitable premium the condition of average is applied to virtualy every insurance other than first loss covers. It requires the insured to bear losses in proportion to the level of under-insurance. The application of average reduces the amount payable for partial losses, if the sum insured is less than the full value of the property at the time of the loss. With a total loss the sum insured will be paid in full but leaving the insured short of full indemnity. Agricultural produce is subject to a special rule of average which only comes into operation if the sum insured is less than 75 per cent of the value of the produce covered at the time of the fire.

On reinstatement policies, the sum insured at the time of destruction of or damage to the property is compared with 85% of the figure necessary to reinstate the whole of such property at the time of reinstatement. Only if the sum insured is less, does average apply.

Allowance for Inflation

Adequate sums insured must be maintained and it is not only necessary to provide for inflation during the policy period but, in the case of reinstatement policies, also during the period required to reinstate. The 85% rule mentioned above acknowledges the difficulty of predicting future inflation.

Various schemes for inflation provision have been devised and these generally apply to buildings and machinery. A brief description of the main schemes follows:-

Escalator Clause

The declared sum insured increases on a day by day basis according to an agreed annual inflation rate. Cover may be on an indemnity or replacement basis.

Valuation Linked Schemes (VLS)

The declared sum insured is established by a professional valuer, and the policyholder states his required inflation provision. This method is common with property companies. Cover is on a reinstatement basis.

Notional Re-Instatement Value (NRV)

The declared sum insured represents the insured's view of reinstatement value, including an allowance for inflation during the policy year and reinstatement period. Cover is on a reinstatement basis. This method is rarely used now as the Day 1 Basis is more appropriate.

Day 1 Basis

The policyholder gives a notional assessment of his property's value on Day One and is then given an automatic inflation provision of, most commonly, 50%. The premium paid is based on the Day 1 Value plus a 15% loading for the inflation provision. This method can also apply on an adjustable basis in which case the policyholder pays a loading of 7.5% for the inflation provison. At the end of the year, he then pays an adjustment equal to 50% of the difference between the provisional premium and the provisional premium for the ensuing period. Inflation provision at a figure higher than 50% is available if desired. The Day One value is used to decide whether Average will apply and cover is on a reinstatement basis.

Index-Linked

The sum insured on such a policy is declared to increase by amounts not expressed in the policy but the value of which can be determined by reference to an inflation index. Such policies are generally taken up by small businesses. Cover may be on an indemnity or reinstatement basis.

Allowance for Self-Insurance

Besides retaining a proportion of the risk, the Insured may bear part of a loss through:

(a) Compulsory excess. This rarely applies to the fire perils but is invariably imposed for the wet perils and on "all risks" cover.

(b) Voluntary excess or deductible - in this case the Insured is granted a reduction in premium. The deductible can range from £250 to £50,000 and even more and discounts from 5% upwards. With a substantial deductible, sometimes applying to both material damage and consequential loss covers, an aggregate deductible of say 4 times the deductible may be agreed. (An aggregate deductible is one that applies to the total of all claims in a given period).

(c) Franchise - In this case, provided the claim exceeds the franchise amount then the full amount is paid. However, this method is rarely used.

SECTION 3

RATING

3.1 Introduction

Section 3 provides a detailed introduction to the concepts involved in rating Commercial Fire business and puts flesh on the bones outlined in Section 2.

Section 3.2 (Risk Profile) looks at the way and the extent to which the limited information on the proposal form can be expanded. This should lead to a rate being charged that is closer to the underlying risk and can also lead to measures being suggested that will improve the risk or possibly make an unacceptable risk more acceptable.

Section 3.3 looks at the methods of premium rating that were in force prior to the end of the FOC. The working of the FOC is described and a hypothetical tariff is looked at in order to illustrate the processes involved. Although the FOC has now been wound up, this section is of more than historical interest since most companies still follow many of the FOC principles.

Current rating methods are described in Section 3.4. Whilst a lot of the principles of the FOC have been followed, they have been applied in many different ways. To illustrate the considerable variability of the rating structures currently in use, the structures of seven different companies were investigated. In order to make comparison between the companies easier, the rating structures for each of the companies have been set out in the same format.

Section 2 included an underwriter's thoughts and view on rating. Section 3.5 suggests how the rating structure can be quantified and how rational judgements might be made about the suitability of the rating structure. It indicates the areas where an Actuary might be able to use his expertise.

Section 3.6 looks at experience rating of risks both from the viewpoint of what is currently happening and how a more theoretical concept might be used.

Other aspects of rating are discussed in Sections 3.7 and 3.8 where the question of deductibles is assessed and a brief comment on other perils is provided.

The availability of Market Statistics is discussed in Section 3.9. This section looks at the historical position in respect of FOC data. It also looks at the current position and considers the data being collected by the ABI under the Market Fire Statistics Scheme.

Finally section 3.10 deals with computer systems; particular emphasis is given to expert systems.

3.2 Risk Profile

The proposal form can give only a general description of the risk: the type of buildings, the business carried on inside it and its location. In order to get more details, insurers employ specialist fire surveyors. This section examines how the fire surveyors carry out their responsibilities, discusses some by-products of their work and looks at the sort of people they are.

The fire survey report is addressed to the underwriter and typically covers the following aspects of the risk:

1. physical features of the building;

2. the contents;

3. the process being carried out in the building;

4. an assessment of the quality of management of the proposer;

5. recommendations for improving the risk;

6. a check on whether any recommendations of an earlier survey report or any warranties on an existing policy are being observed;

7. recommendations for the underwriters;

8. an assessment of the Expected Maximum Loss (EML)

Each of these items will be examined in turn below. It may be helpful in considering the following sections to bear in mind (see section 3.5) that the fire risk may be looked on as having 3 distinct elements:

1. The "inception hazard": features of the risk likely to start fires.

2. The "contributory hazard": features of the risk that would cause a fire once started to spread.

3. "Special Perils" (essentially weather hazard): often covered under "fire" policies.

In examining the various aspects of a risk the Fire Surveyor will look for aspects affecting each of these hazards.

THE PHYSICAL FEATURES OF THE BUILDING

Here the surveyor is interested in:

- the extent to which the building is itself combustible
- features which would prevent or encourage the spread of a fire
- the extent to which the building would, while not necessarily actually burning, be damaged by a fire

He will therefore be looking at:

1. Locality

   What are the buildings round about like? How close are they? Is the gap filled with combustible material such as old cars?

2. Construction of walls

   At least 9" brick, stone or concrete is needed and the wall must extend right to the roof before it can be classified as a fire break. This may be difficult to ascertain because of plaster coverings etc. The external walls are important especially if they support the roof.

3. Supporting framework of building

   Is it timber (combustible but likely to stay in place in a moderate fire), metal (may expand and buckle causing a total loss in only a moderate fire - unless protected), reinforced concrete etc?

4. Floors

   Fires will spread upwards very quickly unless there are proper concrete floors. The thickness may be difficult to ascertain because of claddings but in modern buildings should be satisfactory because of the building regulations.

5. Roofs

   Is it combustible? What is the framework? Aluminium is particularly bad as it melts at a low temperature, causing collapse.

6. Roof Lights

   If they fail, eg because they are plastic and melt, a chimney effect may result.

7. Communications with other building

What is the risk in these buildings? Are there measures to prevent fire spreading from or to the other buildings?

8. Age of the building

This, together with knowledge of the building regulations, may give an indications of the standard of construction.

9. State of repair

This will help the surveyor to assess the possibility of total loss through the building collapsing or becoming unsafe. It may also help the surveyor to assess the quality of management (see later).

10. Number of storeys, height

As fire tends to spread upwards this is obviously very important. A fire at the bottom of a tall narrow building might cause a total loss, the same fire in a building with the same total floor area but all on the flat could be quite cheap.

11. Methods of space heating

Is it through oil/gas/electric fires, or are there hot water radiators? If the latter, where is the boiler and see item 7. Where is the oil storage tank and is the building properly protected against seepage from leaks? Are there adequate guards round heaters (to prevent goods being placed too near to them). What about portable heaters - they may not be apparent if the survey is done in the summer (they may be moved too near to goods). The surveyor will pay particular attention to watchmen and storemen's cubby holes where there may be unauthorised heaters unknown to the management.

12. Methods of lighting

Not usually a problem with modern electic lighting.

13. General condition of electrical wiring

PVC insulated cables have now been around long enough for the rubber on the previous generation of rubber insulated cabling to have decayed. The surveyor will also look for any signs of overheating of cables or circuits eg through the use of multiple adaptors.

14. Methods of storage

High piles or high racks, can prevent the detection of fire and also render sprinklers ineffective. This is a serious hazard of modern warehouses.

15. Sprinkler Systems

These are very important in preventing small cheap fires becoming disastrous - a total loss may cost as much as 1,000 small fires. The surveyor will check that there are enough sprinkler heads (about one every 10 feet), and that the rate at which water is delivered through the head is sufficient (about a gallon a minute). As it is not possible to turn sprinklers on to test them, the delivery rate has to be calculated from characteristics of the system.

If Special Perils are covered and the building is not heated in winter, the sprinkler system must be capable of being drained (sprinkler heads must point upwards) and be of the "dry" or "alternative" variety. Dry systems are filled with compressed air, which holds a valve shut against water in a tank elsewhere. When a head breaks the air escapes releasing water into the system. Alternative systems are dry in winter and wet in summer.

16. Vertical Openings

The Surveyor will be particularly interested in measures taken to prevent fire spreading through vertical openings such as lifts or stair wells.

17. Horizontal Openings

An opening such as a door in a fire-break must be properly protected otherwise the fire-break will be ineffective.

18. Area with no fire-break

The Surveyor will be wary of large open plan buildings as the likelihood of fire spreading (and the EML) will be greater than for a well partitioned building.

THE CONTENTS OF THE BUILDING

The surveyor will want to know what is or might be kept in the building and the quantity: machinery, process material, waste material, finished goods, packaging. Modern PVC or expanded polyurethane wrappings are particularly hazardous. Warehouses may contain a large amount of valuable goods, as compared with factory buildings which may be largely empty space. Food and pharmaceuticals are a problem because a small fire may cause contamination and total loss. Similarly, electronics may be easily damaged by heat, smoke or water or hydrochloric acid vapour gives off by burning PVC insulation. A small fire may again be very costly.

THE PROCESS

It will generally be obvious from the trade whether the process uses inflammable materials or is one which is likely to start fires. However the degree of hazard may not be apparent. The surveyor will therefore examine the whole process, including the transportation at each stage and the packaging of the final product. He will look out for anything likely to cause heat (chemical reactions, drying processes) inflammable vapours (solvents), dust (many dusts are explosive when mixed with air), sparks (substances being ground will usually contain stray metallic impurities). The surveyor will examine the storage of the process material, waste material and finished goods, bearing in mind their combustibility. He will look for frayed electric cables and any other unsatisfactory features. He will ask what equipment is switched off when work ceases at night, and what procedures are adopted for clearing up and checking that no fires have started before buildings are closed up.

Most fires are caused by human error. The surveyor will therefore want to know the number of "hands" (for this purpose each worker is deemed to have only one hand!). This will also give him a measure of how congested the building is with workers. The surveyor will also want to know the throughput: a warehouse with a constant turnover of goods is much more hazardous than one used for long term storage.

MANAGEMENT

The safety procedures will only be as good as the management is in enforcing them. The surveyor will therefore want to assess the quality of the management and will pay particular attention to matters such as:

1. No-Smoking Rules

   The Surveyor will look out for indications that they are not enforced. It is not unknown for the manager to smoke while showing the surveyor round! It is better to have recognised smoking areas and smoke breaks than a total ban which is impossible to enforce.

2. Safety Regulations

   Again the surveyor will watch for signs that they are not enforced. This applies not just to anti-fire regulations. Are fire doors wedged open?

3. General Housekeeping

   Are floors swept regularly and waste cleared away? Because of arson it is usually safer nowadays for inflammable waste (eg wood shavings) to be stored inside the building in a specially designated area rather than outside as formerly. Is the place tidy? The spread of fire is hindered by tidily stacked goods because of the

exclusion of air. The surveyor will also be on the look out for moral hazard and will ascertain the well-being of the business. If the management confide in him that 2 sets of books are kept, the surveyor will be dubious about the fire risk, never mind the Consequential Loss! The surveyor will take the opportunity to speak to staff to ascertain how much respect they have for the management. By that means he may discover that he is the 5th surveyor that week or that there have been several fires which management had omitted to tell him about.

With arson (or wilful fire raising as it is known in Scotland) forming such a high proportion of fire losses, the assessment of the management and the associated moral risk may be the most important part of the surveyor's report.

RECOMMENDATIONS FOR IMPROVING THE RISK

The surveyor will often be able to make suggstions to the proposer of ways in which he can reduce fire risk. Often if the proposer acts on the recommendations he may save himself some premium. Since the premium rate for an entire building will generally be based on the most hazardous process carried out in it, it may be worth the proposer's while to arrange for the hazardous processes to be grouped and kept separate from the non-hazardous. The surveyor will often also advise on housekeeping. Other examples will be obvious from points discussed in earlier sections. Premium (or in extreme cases cover) may depend on the proposer taking certain actions.

Fire Surveyors over the years have made a considerable impact on building design. Architects will now automatically include fire safety features. Such features are often much more expensive to incorporate after the building is up. The premium saved can be quite substantial.

Fire Surveyors are therefore often used in an advisory role in the planning of new buildings or of major alterations to existing buildings. An example of the latter which is becoming common these days is the splitting up and redevelopment of large redundant industrial buildings.

CHECK-UP

One final aspect of a survey will be to check on whether the recommendations to the proposer in an earlier survey have been carried out. The surveyor will also check whether any warranties under an existing policy with his own company are being observed. If they are not, the rate may be increased at renewal, or in extreme cases cover withdrawn forthwith. Although non-observance of a warranty would give the insurer grounds for rejecting a claim, in practice it would be difficult to prove after a fire has happened.

RECOMMENDATIONS TO UNDERWRITERS

The surveyor will submit to the underwriter a written report, including a scale plan of the site. He will make recommendations as to:-

1. Whether the risk should be accepted or declined.

2. If acceptable, the rate to be charged (this recommendation may be in the form of loadings or discounts to be applied to tabular or Tariff rates).

3. Any conditions or warranties which should or might be applied and their effect on the recommended rate.

ASSESSMENT OF EML

As part of his report the surveyor will estimate the EML. This will follow naturally from many of the points already discussed such as the high likelihood of a building with an unprotected steel framework, or the contents of a pharmaceutical warehouse, becoming a total loss.

A FIRE SURVEYOR

A Fire Surveyor will not generally be a qualified surveyor in the sense that he will not usually be a member of one of the professional surveying organisations. He will nevertheless have a general knowledge of building construction and regulations, and he will have a working knowledge of many chemical processes and their attendant fire hazards.
He will be able to recognize fire-hazardous wiring and the likelihood of sparking or arcing and he will know enough hydraulics to be able to determine from the characteristics of sprinkler pipework, and water pressures, whether the discharge rate will be adequate.
He will have a good knowledge of fire technics, fire detection/prevention and above all a thorough knowledge of the principles and practices of fire insurance.

3.3 Method Used Before FOC Demise

The Fire Offices' Committee was in existence for over 100 years up to 30 June 1985. It consisted of a group of offices who agreed by committee to regulate rating, wordings, commission levels and other practices such as the collection of statistics. Whilst the greater experience generated from the sharing of knowledge by all tariff members had benefits to the individual companies, the purpose was to give stability and uniformity to the market. As the tariff controlled a sizeable proportion of the market this was, in practice, the case. Indeed except for 1984 (when fire wastage was particularly high) profits were very substantial over the years. The reason for the collapse of the FOC in mid 1985 was proposed Government legislation and the effects of high levels of competition undermining the significance of the collected experience.

Companies not in the FOC were not bound by the Committee practices; the more traditional of these companies regarded themselves as independent rather than non-tariff because they employed FOC tariff rating practices as a basis for their underwriting. In some cases the only rating difference would be that they gave an NTD (non-tariff discount). Other non-tariff offices employed completely different methods of rating, different policy wordings and different commission amounts.

Although the FOC tariffs had worked well for many years their rating methods would not be considered actuarially sound. Nonetheless the rating methods used are worth noting. It is relevant to say that, up until last year, a number of people had suggested other possible rating structures. However the very existence of the FOC meant that few of these could be tried out in practice. During last year many companies were effectively forced to think about new rating methods. It will be seen below that most companies kept many of the FOC principles but changed the way in which they were applied. This should probably be seen as a vote of confidence in the FOC practices; alternatively it might show some unoriginality among underwriters!

Recently a number of risk classifications (eg shops and restaurants) were decontrolled (ie taken out of FOC jurisdication); although there were a number of possible reasons for this it is probably true to say that Government pressure was an overriding consideration. Before these moves virtually all commercial fire risks fell within the FOC and something more than 50% of them had a very explicit tariff, while the others had their rates rather more loosely controlled by the minimum rates tariff.

Where an explicit tariff existed it could be very complicated. The basic principle of all property insurance, however, is to apply a rate per cent to the sum insured to give the total premium payable. For the fire risk you started with a base rate which represented what was considered to be the standard rate for a risk of that trade. Then amounts were added or subtracted for unfavourable or favourable aspects of the risk. A very simple hypothetical example of a tariff for a particular trade might be as follows:

Toy Makers' Tariff

Applicable to buildings in which toys are made and any building on the same site used for storage.

Excluding buildings in which more than one third of the employees are involved in packaging toys rather than their manufacture.

Normal rates (per £100 sum insured):	With Warranty 1	With Warranty 2
Factories wholly used for the manufacture of toys	0.06	0.15
Other buildings	0.075	0.10

Additional rates:

If the total area of the non-standard construction in the external walls and roof is	
(1) more than 20% but less than 50%	0.025
(2) more than 50%	0.05
If ground floor area exceeds 3,000 square metres then for each further 3,000 square metre	0.01
For each power operated machine in excess of one	0.025

Discounts:

		Buildings	Contents
Construction -	Standard I	40%	25%
	Standard II	35%	20%
	Standard III	30%	15%
	Standard IV	20%	10%

For approved fire extinguishers a discount in accordance with standard amounts.

Automatic sprinklers -	Standard A	30%
	Standard B	25%

Warranties:

1. Liquids with a flash point below 32°C to be stored in closed tins not exceeding four gallons and kept in a compartment made of brick or concrete.

2. Liquids with a flash point below 32°C to be stored in closed tins.

3. No working in wood by power.

[Warranties are clauses by which the insured must abide or else the policy cover will cease. Either warranty 1 or warranty 2 will be deleted, warranty 3 will apply in all cases.]

This hypothetical tariff is very much simplified. Even the simple tariffs might be three of four times longer than this and some of the complicated tariffs (eg for the manufacture of plastics) were very complex.

Other factors that might typically have been accounted for in a tariff were a full description of the occupancies included within the trade covered, all aspects of the construction of the premises, the heating used in the buildings, the use of any hazardous chemicals, the carrying out of any hazardous processes not normally found in the trade, and the exact discounts to be allowed for different sprinkler installations and other fire extinguishing apparatus. The warranties contained in the policy affected the premium charged.

Although the tariffs were updated and changed from time to time they were not changed every time the experience of a particular trade changed. Instead the FOC published a schedule of percentage adjustments (SOPA). This gave the amount for each trade which should be added (or deducted) from the rate derived from the tariff to give the premium to be charged. The appropriate SOPA for each risk was set periodically by the FOC by considering the aggregate experience of all member offices.

As already mentioned some risks within FOC jurisdiction did not have specific tariffs. For these each office would have its own rating structure. Nonetheless, even for these risks, the FOC did publish SOPAs. In principle each office was supposed to calculate the rate from its own rating structure and then add the SOPA. However, as some SOPAs were very large (sometimes up to a few hundred per cent) and basic premiums within different offices could be very different, the method was not very scientific. Indeed it is thought that in some offices the basic rate was chosen having regard to the amount of SOPA.

Despite all the problems the FOC offices did come reasonably close to all charging the same rate for any particular risk. Even given the complex nature of many risks and the fact that two underwriters might look at the same feature differently there were relatively few cases where different rates from two offices caused any real problems.

3.4 Methods Currently Used

Following the demise of the FOC the participating offices needed to produce their own rating manuals. In practice so did many non-FOC offices who had previously largely followed the FOC rating. In theory offices could have continued to abide by the tariffs; however, in practice, many offices felt they could produce a rather better rating structure. Among other reasons this was because the tariffs were inflexible in operation as they basically charged an average rate. There was no allowance for features such as good housekeeping and superior management; equally some poor features could not be penalised. Thus many offices felt they could do better than the tariff and, with a bit of luck, select against the market.

As already stated the principles underlying many of the new methods are similar to those used by the tariff. Many offices have taken what they consider to be the best aspects of the tariff and brought in a few new ideas to produce their new rating manuals. Although many of the basic ideas and philosophies have thus not changed there have been changes in the way these have been applied. For example the basic idea of having a range of rates (or a given rate) for a particular trade has remained although there are some new ideas about how the rate for any given risk should be chosen within the particular band. Examples of some such methods will be given below. The actuary should perhaps decide whether the basic philosophy is correct and, if so, whether the method of applying it is an optimum one.

Over the past two or three years many offices have thus produced new rating manuals. Although such new rating manuals could have been introduced from 1 July 1985, they were, in practice, phased in slowly; the old tariff rates, or at least some aspects of them, continued to be used by some offices where this was to their advantage. This helped lead to a reasonably stable market following the demise of the FOC, rather than a rate cutting battle which would have helped nobody. However many would say that this stability was only possible because of the prevailing conditions at the time in which companies were losing money. A new mood was beginning to emerge in the market following the withdrawal of the British National and a significant reduction in capacity of other fringe companies; in some areas this was hastened by their inability to renew their reinsurance covers. This, combined with the continuing underwriting losses of all UK fire insurers, did cause hardening of rates and attitudes.

However with reasonable profits now (July 1986) returning to the fire market competition is increasing and a period of rate cutting is likely to follow. This will probably herald the end of the use of FOC tariffs directly and an increasingly important role for the offices' new rating structures. It is therefore worth considering the basis of this new rating. Despite the important input actuaries could have had to the many rating structures described it is almost universally true to say that they had no such input. As most companies consider their new rating methods to be confidential what follows is an outline description of what a number of anonymous companies are doing.

Company A

Rating Basis and Philosophy

This company applies a rate to sum insured. A separate rate is applied to buildings as opposed to contents and stock; under the FOC only some of the tariffs gave different rates for the two different types of cover.

Method of Rating

The appropriate rates are derived from a table of rates which is in the form shown below. The relevant table for the particular trade and for buildings or contents has to be chosen.

Trade

	GOOD	AVERAGE	BAD
Construction			
Housekeeping			
Processes			

It can be seen that each of the three factors of construction, housekeeping and processes will be rated as good, average or bad. Then, given the trade and whether or not buildings or contents are being rated, the appropriate percentage rate is taken from the appropriate table. The good, average or bad rating for each factor is determined by an experienced underwriter having regard to the survey report. Discounts to the base rate are allowed for superior construction or housekeeping, for sprinklers etc.

Underwriting Guidance

The form of the table is such that little discretion is allowed to the underwriter. The rates are centrally controlled.

Special Perils

Standard amounts are added for additional covers within the wet and dry peril categories.

Company B

Rating Basis and Philosophy

This company uses the same percentage rate to apply to buildings, contents and stock. However, as a number of companies do on some other commercial classes, they have given a band of rates that is applicable for each particular trade.

Method of Rating

To determine where a particular risk should lie within the band the underwriter has to consider the risk potential under four headings; these are construction, hazardous processes, heating and housekeeping. For each of the factors he uses his judgement and the guidelines laid down, to determine a points count reflecting the appropriate degree of risk. Essentially the points are added up and, using an addititive model, the actual rate to be charged within the band is determined.

The way the points system works is, however, rather more complicated than a standard motor points system. The number of points allocated to one factor will affect the range of points from which a figure can be chosen for the next factor. In this way an allowance can be made for dependency between rating factors. No formalised method of experience rating is set down. To the basic rate calculated as above for the risk, discounts are allowed for such features as sprinklers and other fire extinguishing apparatus.

Underwriting Guidance

By standardising the way in which a rate is chosen for a particular risk within the trade band, rather less discretion is allowed to the underwriter. Central control is increased and statistical monitoring of how a premium has been made up is more easily carried out.

Special Perils

Appropriate standard amounts are added for additional perils to be covered.

Company C

Rating Basis and Philosophy

Of all the companies considered this one used the most detailed method of rating. Only time will tell whether the increased sophistication in the rating formula will really give a better answer.

Method of Rating

From the broker's presentation and the survey details, the underwriter grades the most important features of the risk on a scale between one and five. For each particular trade a range of rates is given and the underwriter decides where to pitch his basic rate from within this band according to the graded features of the risk. An appropriate discount (from a standard table) is allowed for fire extinguishing apparatus and a loading is made for ground area. This gives the basic stock and contents rate, from which is subtracted a construction discount, depending on the type of building, to give the building rate.

Appropriate loadings or discounts are allowed throughout for inflation schemes, deductibles and stock covered on a declaration basis. Finally a size and experience discount is allowed; this comes from a relatively standard table giving the discount to be allowed for a particular size of premium and a particular five year loss ratio.

Underwriting Guidance

A reasonable amount of discretion is allowed in the way in which the underwriter interprets the survey and the broker's presentation.

Special Perils

A dry peril rate is added which depends on the number and nature of such perils covered. For wet perils a different rate for buildings and contents is used; the susceptibility of contents and stock is graded from one to three and this determines the rate to be added for storm cover (which also depends on the construction of the building), for flood cover (which additionally depends on the number of floors and whether there is a basement) and for burst pipe cover. Standard amounts are charged for other wet perils and a discount is given according to how many, and which wet perils are covered. The total wet perils premium is then discounted by a factor which increases as the total sum insured increases. Finally an amount for any other risks covered is added.

Company D

Rating Bases and Philosophy

This office was non-Tariff and what follows describes the rating method used up to now. A complete review is currently in progress.

Rates are expressed as % of the sum insured. In most cases, the same rate applies to Buildings, Contents and Stock.

The rates are based partly on detailed internal statistical analyses; they have also evolved from the underwriters' judgement over years of experience and from market considerations.

Method of rating

Risks are classified according to the trade of the occupier. Most risks are then rated either by reference to Tariff rates or by reference to internally produced tabular rates. Trades rated by these tabular rates are grouped into about 50 classes. The grouping of trades into classes is according to the underwriters' perception of the similarity of the risk as translated into premium rate terms, rather than similarity of the risks themselves. As a result, many of the members of a class are clearly related (for example manufacturers using the same or similar raw materials). On the other hand many others are completely unrelated (for example manufacturers, retail shops, public buildings).

In addition to the trades rated as above, there are 3 lists of trades which are outside the normal rating system.

1. A list of automatic declinatures.

2. An "accommodation" list of trades which will be accepted only in exceptional circumstances, for example, because the fire insurance may be part of a package. Rating in such cases would be done on the basis of individual consideration by Head Office underwriters.

3. A further list of trades where acceptance is not in doubt but the rate is fixed on the basis of individual consideration by Head Office underwriters.

Underwriting Guidance

The tabular rate for a given class is usually a range, within which a rate has to be selected by the underwriter using his judgement. The range between the minimum and the maximum rate varies between classes. In some classes the range is nil. In others the maximum is usually between 1.25x and 4x the minimum. In an exceptional case (with a low minimum rate) the maximum is 6x the minimum.

There is clearly considerable scope for judgement on the part of the underwriter. In exercising his judgement, the underwriter would take into account the surveyor's report and the past experience.

The basic rate may then be adjusted upwards or downwards, as appropriate, for the following features of the risk. The survey report would play an important part here too.

1. The construction of the building (is it combustible/"fireproof", will it collapse easily in a fire, etc)?

2. Factors contributing to rapid fire spread (undivided roof, etc).

3. Methods of space heating (gas fires or hot water radiators, etc).

4. Management and housekeeping (including "moral risk", although a bad moral risk would normally be unacceptable on any terms).

5. Special storage arrangements (compartmentation, height etc).

6. Presence or absence of sprinklers or other fire extinguishing appliances.

In practice there could be overlap between these adjustments and the selection of the basic rate within the tabular range.

Special Perils

These are rated independently of the Fire risk using tabular rates. A separate rate is provided for each peril to be covered. Tabular rates are also provided for various combinations of perils at less than the sum of the rates for the individual perils in isolation. The rates vary by sum insured: the higher the sum insured, the lower the rate.

Company E

Rating Basis and Philosophy

This note outlines the approach of one office to Fire Underwriting. The office concerned was a non-tariff office and the abolition of the tariff has not fundamentally altered the approach which was to have regard to the tariff amended on a subjective basis. The major change is that the company has now issued its own rating guide which includes these subjective amendments to the tariff. Rates are quoted as a band of rates for particular classes of risk, with discounts for deductibles.

Method of Rating

In determining the rate to apply to a specific risk, the underwriter will have regard to:-

Construction of building
Heating
Fire fighting equipment
Security
Moral hazard
Geographical area
Long term agreement
EML relative to sum insured (the rate should increase with increasing proportion).
Housekeeping standards.

A change in recent years is the increasing emphasis placed on security as a rating factor. Malicious claims account for around 40% of claims by amount.

Experience rating is not used.

Special Perils

Dry Perils (catastrophe in nature) - aircraft, explosion, riot, earthquake and impact

Wet Perils - storm, flood, burst pipes

For dry perils, the rate does not vary with sum insured. For wet perils, the rate decreases as sum insured increases. For rating wet perils, location and claims history over a number of years is vital.

Underwriting Guidance

The underwriter has some discretion on risks within his level of authority. On bigger cases, he will refer to the central controlling department which provides a feedback on the latest thinking as applied to individual risks and augments that given in more general terms by circular.

Company F

Rating Basis & Philosophy

This company classifies risks into trade classes. Each class has a start fire rate, used for both buildings and contents, applicable to the sum insured. There is also a minimum rate.

Method of rating

The start rate can be adjusted, at the underwriter's discretion, for the underwriting features of the risk. Factors like management, housekeeping, hazard variation and construction would be considered. Discounts are applied to this adjusted rate for:

a) the standard of construction for the non-sprinklered risks - this discount only applies to the buildings

b) sprinkler installations conforming to prescribed regulations

c) automatic sprinkler installations and other fire extinguishing appliances and for fire alarms.

The discounted rate arrived at must not breach the laid down minimum rate.

There may also be discounts for size. The form of experience rating used is to give discounts for a low 5 year loss ratio with the level of discount increasing with size of risk.

Underwriting Guidance

Although the start and minimum rates are set at HO, the underwriter has a considerable amount of discretion in where he pitches his rate. There are some trade classes where reference has to be made to HO and some where the rating procedure is more complex than described above.

Special Perils

The rate for each peril is separate but is applied to all trade classes. This rate is for normal risks and is increased for risks presenting greater than normal hazard by applying a loan and/or excess. There is a size discount on one scale for 'dry' perils and on a different scale for 'wet' perils.

Company G

Rating Basis and Philosophy

The calculated fire rate applies to all elements of the risk eg Buildings, Machinery/Plant, Stock and Rent.

The rating structure adopted is fairly complicated but the central aim is to provide, as far as is possible, consistent rating by restricting the discretion allowed to the individual underwriter.

Method of Rating

For each particular trade there is a basic rate which is then adjusted in the light of the particular risks. The following features would attract additional premiums in the form of a flat additional premium per cent.

a) Non-standard construction - FOC definitions are used.
b) Height of building; there is an additional premium for each non-fireproof floor above the lowest level.
c) Conbustible linings/ceilings/partitions where these are not covered with incombustible material.
d) Ground floor area in excess of a basic size.
e) Multitenanted (in excess of 2) properties.
f) Portable heating systems.
g) Packing where this is combustible and is in excess of one day's supply.
h) Storage or indiscriminate use of highly flammable liquids/LPG/Oils.
i) Presence of combustible waste.
j) High piled storage.
k) Spray painting not in accordance with FOC recommendations.
l) Woodworking.
m) Plastics.
n) Distance of risk from nearest Fire Brigade.

Discounts are given for Fire extinguishing/detection systems:

a) Fire extinguishing appliances - the following would attract discounts:-
i) Mobile power pumps.
ii) Hydrants on the premises.
iii) Hydraulic hose reels and internal hydrants with small bore hose attached.
iv) Approved portable extinguishers.
v) Buckets.
vi) Portable manual pumps.

Scales are also set down for various combinations of these appliances which gives a fixed maximum discount.

b) Approved sprinklers: the discount varies according to type and an additional discount is given where there is an automatic alarm to the Fire Brigade.

c) Automatic fire alarms.

Experience rating is performed for larger risks but there is no set definition of what exactly a larger risk is. In practice it is restricted to those cases where there is pressure from the broker.

Underwriting Guidance

Some flexibility is granted to the underwriter in adjusting the rate as a result of consideration of the unique features of the risk where they have not been taken into account in the previous calculations. A reduction of up to 20% may be allowed. The subjective items which are to be taken into account are:-

1) Management of the property.

a) General housekeeping.
b) Security.
c) Electrics.
d) Waste disposal.
e) Heating.
f) Workforce (ie make up, industrial relations).

2) Environment.

a) Buildings,
b) Segregation of hazardous process/materials.
c) Inflammables.
d) Machinery.
e) Storage.
f) Compartmentation.
g) Location.

Special Perils

A dry peril rate is used for all businesses and no discount is used. Where an increased hazard applies these rates would be loaded or a substantial deductible imposed.

For wet peril rates, each trade/occupation has a hazard category which determines the rating table to be used and the basic water damage rate.

Both wet and dry peril rates reduce with size of risk.

3.5 Actuarial Thoughts on Rating

As can be seen from Section 3.4, there is a multitude of methods used for rating, virtually every company will have its own particular unique feature in its rating structure.

Furthermore there are a large number of rating factors that are used. The following list is by no means exhaustive and indeed companies may only use some of the factors but the list does give some idea of the range considered:-

(a) Occupation/trade being carried out
(b) Construction of the buildings
(c) Moral hazard/general standard of management
(d) General standard of housekeeping
(e) Closeness to fire station
(f) Presence of fire-fighting equipment
(g) Presence of sprinklers
(h) Fire alarms and whether automatically linked to fire station
(i) Hazardous processes
(j) Floor area of building
(k) Types of space heating used
(l) Number of floors in building
(m) Multi-tenanted property
(n) Geographical area
(o) Storage of waste and hazardous materials

Few, if any, companies use all of the above rating factors but most use a significant number of them.

The question is what is the aim of such a complicated set of rating factors. In assessing any fire risk, there are two essential elements to consider.

Firstly there is what might be termed the inception hazard ie. what features of the risk will actually cause a fire to start. Of the rating factors considered above, items (a), (c), (d), (i), (k), (m), (n) and (o) are aimed at assessing this part of the risk.

Once a fire has started, there is the question of the risk of spread of the fire to be considered. This can take two forms. How quickly the fire will physically spread to engulf the building (rating factors (b), (j), (l) and (o)) and once started how quickly the fire can be put out (rating factors (e), (f), (g), and (h)).

Looking at the rating factors, it is extremely unlikely that the rating factors used will be independent which means that all sorts of complicated rating systems could be used. Such dependency is very likely to exist because of the distinct elements of the inception risk of a fire and the spread risk of that fire; for example, it would be expected that the fire premium of a dynamite factory which generated many sparks would be very much more than the sum of the premiums of a dynamite factory with no such sparks and a similar factory that produced sparks but only used and stored non-flammable products. The assumption that factors are not independent leads to all sorts of possible rating systems; the complications of these are such that the actuary is ideally qualified to help the underwriter in understanding the full ramifications of his rating method.

It is unlikely that many of the rating structures have been formally tested to check whether they truly represent the underlying risk.

At best companies might have looked at burning costs by trade group and for those where experience was bad, made some subjective adjustments. Thus the complexity of rating structure was built up as greater attempts were made to isolate the "good" risks.

The testing of the relevance of the rating structures would seem to be a fruitful area for Actuarial activity. There would seem to be three main questions to answer:

(a) Are any of the rating factors redundant ie. do not add anything to the assessment of the risk?

(b) Can any of the rating factors be further split into a greater number of levels?

(c) Do the rating structures correctly reflect the interdependency of the rating factors?

However this process is not straightforward. There are a number of problems to be overcome:-

(a) Each rating factor must be capable of being set at discrete levels with increasing risk. This means that purely subjective adjustments cannot be measured.

(b) A sensible rating model has to be postulated.

(c) Data must be collected for each risk under the relevant rating factors. For many companies, because of the wide ranging nature of the types of risk in fire insurance, there will be insufficient data to perform an in-depth investigation. The ultimate solution would appear to be the collection of market statistics and a start in this direction has been made (see Section 3.9).

The above rating structures take into account almost every conceivable aspect of the risks. It is inappropriate to make further adjustments to allow for EML's. These are more appropriate in determining limits to size of risks to be underwritten. The following factors given examples of the major features that might be considered in assessing EML's:-

(a) Relationship of value to volume
(b) Volume of individual items
(c) Accessibility of premises for vehicles
(d) Location of premises
(e) Presence of acceptable automatic alarm
(f) Presence of security organisation
(g) Degree of internal and external physical "protections"
(h) Efficiency/coverage of local police
(i) Construction of premises (weakest part thereof).

Items other than rating factors must be considered in setting a premium rate:-

1) Expenses

These should be analysed into their constituent parts. An important part of the expenses associated with the fire policies will be the cost of the survey. Not all policies will be subject to a survey so consideration may be given as to whether the costs of surveys should be spread over the whole class of fire policies or just to those where surveys are undertaken. However, generally surveys will normally be undertaken for the larger policies and thus the cost of the survey may be taken as related to the premiums.

Expenses will need to be analysed into:-

(i) Those dependant on the premium eg. commission
(ii) Policy related expenses eg. policy issue will tend to be higher for more complicated policies
(iii) Claim expenses
(iv) Fixed Costs.

2) Investment Income

In assessing the office premium to be charged allowance would be made for the interest income received arising from delays between receipt of premium and actual payment of claim. The following factors should be considered:-

a) Pattern of Claim Payments

This pattern will vary from year to year (depending on number of "large" claims) and will also vary from company to company. The following pattern is typical:-

	% Claim Amounts Paid
Within 1 year of incident	60
2	80
3	90
4	95
5	98
6	100

b) Delays in Premium Receipt

Premiums will not be received as soon as the risk is written. Typically there may be a delay of say three months before the premium is received from the broker. Allowance must also be made if the premium is payable in instalments.

c) Reinsurance

Allowance must be made for the features of reinsurance. In particular allowance must be made for the actual timing and amounts of premium that are physically paid to reinsurers. There will also be delays between payment of a claim and receiving recoveries from the reinsurers.

3.6 Experience Rating

As part of the rating process, insurers consider the past experience of the risk. However this is often done in a haphazard way without any attempt at using a method that would be considered actuarially sound. Adjustments may be made to the "tabular" rate depending on the underwriter's perception of whether the experience has been "good" (discount given) or "bad" (loading imposed). In this context the phrase "tabular" rate is used to mean a rate ascertained using all information available other than the experience of the risk itself. As a reminder that the word "tabular" has this special definition it will be included in inverted commas throughout this section.

The "tabular" rate is assumed to apply to the "average" risk given all the rating factors other than the risk's own experience.

Usually the last 5 years' experience is taken into account. Where a risk is being rebroked the holding insurer provides the experience for the competing insurers. A standard form has been proposed between many of the insurers writing Fire business. A copy of the form and some comments on the form from an actuarial viewpoint, are shown at the end of this section, pages 48 and 49.

Large claims are rare, but nevertheless contribute a significant amount to the total losses. As a result, most experiences will be better than average ('good'), a smaller number will be worse than average ('bad') and a very small number will have an appalling experience ('unlucky'). This can lead to more discounting than loading: it would be nonsensical to load the unlucky cases for the full cost of the large claim. The total premium charged on all experience rated cases after the experience rating exercise will therefore be less than the total if all had been charged the "tabular" rate. If the future experience overall is a reflection of the past the future claims cost will be in accordance with the "tabular" rates (by definition) and the total business will be written at a loss. The position is further exacerbated by the fact that the good risks will demand experience rating while the bad ones will not.

There is another problem with large fire losses which arises when experience rating is applied to fire insurance. The very large losses may sometimes be removed completely from the experience used in the experience rating exercise. This could happen because the owner of the destroyed building ceases to trade or at least undergoes a major reorganisation. The combined experience of all experiences being offered for renewal will therefore fall short of the "true" or underlying experience. This will lead to premiums falling even further short of what is required, and hence to even higher underwriting losses.

This would be true even if there were no "tabular" rates and all the business was purely experience rated. It would also be true if an insurer priced its experience-rated business entirely on its own merits without any reference to the "tabular" rates: the total experience being used in the experience-rating exercise will fall short of the "true" experience because of the absence of very large claims.

A parallel can be drawn with life assurance on an individual life. When a policy becomes a claim, it is not offered for renewal. No matter how big the sum insured (and hence the premium) no-one would dream of experience rating life policies using only the previous five years'experience of policies offered for renewal.

The following worked example illustrates the points made in this section.

An insurer has tabular rates which are expected to be correct for its portfolio as a whole. For large cases it makes 2 adjustments to the tabular rates.

The first adjustment is justified on account of the size of the case: for example because expenses are proportionately less than for small cases. Perhaps the insurer believes that burning costs reduce as sums insured increases (others may disagree). This adjustment is independent of the experience of the case being examined so in accordance with the definition used in this section of the paper can be deemed to be part of the "tabular" rating system.

The second adjustment applied depends on the cases's own experience. It is this adjustment which is being considered in this section.

Suppose that the distribution of claims by size is expected to be as follows:

Illustrative Distribution of Fire Losses by Size of Loss

Claims Cost	Percentage of Total by no.	Running Total	Percentage of Total cost	Running Total
£1m-			11.8%	11.8%
£0.5m-£1m	0.1%	0.1%	9.3%	21.1%
£0.25m-£0.5m			10.0%	31.1%
£0.1m-£0.25m	0.2%	0.3%	14.8%	45.9%
£10,000-£0.1m	2.4%	2.7%	30.0%	75.9%
-£10,000	97.3%	100.0%	24.1%	100.0%

About 1/10th of the losses are from 1/10,000th of the claims. Nearly 1/3rd of the losses are from only 1/1000th of the claims. Half the losses are from perhaps 1/150th of the claims.

For the purposes of this illustration, simplify the overall distribution to:

	Total cost
99.9% of claims cost 0.667 units ("normal")	0.667
0.1% of claims cost 333 units ("large")	0.333
Average claim cost	1.000

Assume for simplicity that expenses and commission are proportional to gross premium. An assumption that expenses are independent of premium would alter the figures in the illustration but not the principle being illustrated.

Suppose 40 cases are offered for renewal and each had 25 claims during the experience period examined. Of the 1,000 claims, typically 1 will have been large. This means that 39 of the cases will have experienced 67% of the "expected" claims cost according to the underlying experience. The danger is that they would be classified as "good", meriting a discount.

The other case would have been disastrous, having an experience cost of 1,400% of expected. A considerable surcharge on the tabular premium might well be carriable, but a thirteenfold increase? And if it were, it would hardly be insurance! Even if the discount on the "good" cases were restricted to 20%, the "disastrous" case would need to carry a 780% surcharge to make the books balance. In practice, these cases may not be renewed, so the opportunity to collect even a moderate surcharge may not arise at all.

Thus, although the portfolio is expected as a whole to have an experience in accordance with the tabular rates, the application of experience rating could result in the premium collected as a whole falling seriously short of the total required.

This illustration has been based on an average of 5 claims a year over the 5 years' experience examined. In practice experience rating may be applied with fewer claims than this. The standard experience reporting form (as shown at the end of this section) applies to cases with annual premiums of £1,000 and above: many of these may have had 10 claims or less over the 5 years. The fewer the claims the greater the divergence between the apparently good and the disastrous and the greater the possibilities for more discounting than loading.

The distribution of claims size which forms the basis of this illustration has been obtained from a particular insurer with a reasonable amount of Fire business. It has been provided solely with a view to illustrating this point on experience rating. The authors would caution against it being used in any other way, for example in a claims smoothing exercise. The main reasons for this are:

1. The claim size distribution for any given portfolio will depend on the distribution of sums insured exposed. This will vary considerably between insurers, and for a given insurer, between accounts. Furthermore, the sum insured distribution for the cases which are experience rated will be different from the distribution for a portfolio as a whole. And again, the sum insured of the case being examined, or the distribution of sums insured if the case is a collection of risks, will be different from the sum insured distribution of all cases being experience rated. For example, if the case sum insured were £1m it would be impossible for it to have a claim exceeding £1m, yet the distribution shows 11.8% of total claims cost to be in the "over £1m" band.

   For this reason, the distribution would not be suitable for adjusting experience rated cases for the presence or absence of large claims even by the insurer who provided the data.

2. The distribution includes all claims under the insurer's Fire account, including Special Perils and Consequential Loss. The distribution of exposure between these will also differ between insurers - and between cases being experience rated.

3. There are other imperfections in the data which do not invalidate its use for the purposes of this paper (ie solely for illustration).

There is much to be said for trying through an experience-rating exercise to load those cases which appear from the past to have a greater propensity to claims than is implicit in the "tabular" rate. This may be because of imperfections in the "tabular" rating system. It may also be because slack management at the risk is showing itself in a large amount of claims, although declinature may be preferable to loading in such a case.

The experience rating exercise should not attempt to load or discount for past variations in experience which are due to chance alone. It is difficult to see how the method described can avoid this. Furthermore, the method appears to have a built in bias towards discounting.

The whole question of experience rating and its relationship to the concept here defined as "tabular" rate raises important issues which are outside the scope of this paper.

There would seem to be scope here for significant input from actuaries. This could also involve some of the more theoretical concepts which actuaries learn. For example credibility theory and premium theory seem appropriate.

Credibility theory is concerned with the systematic adjustment of insurance premiums as claims experience is obtained. Data used can be individual data derived from the group of contracts of interest for the particular period or collateral data derived from other similar contracts for the same period. A credibility factor Z is assigned to this data. This will vary between 0 and 1. It is close to one when the individual data are extensive and close to zero when sparse. Parameters can be estimated using both individual data and collateral data and the credibility factor Z can be used to produce a weighted average of the two estimates that can be used for purposes of recalculating premiums.

Such an approach may seem to have affinity with the methods of rating in use for fire insurance in the UK. There is information on classes of properties. It would be possible to adjust rating systems to take account of changing experience paying some regard to individual data and to collateral data.

Continental academic actuaries have developed an extensive theory of premiums. This is concerned with net premiums including contingency loadings but not allowing for investment income. If the amount of claim per policy per year is a random variable X then the premium P is fixed at $P = E(X) + g(X)$ where $E(X)$ is the mean of X and $g(X)$ is a function depending on the distribution of X. On the continent (Belgians and Swiss have been especially active) many Premium Principles have been formulated which guide the construction of the function $g(X)$. These includes the Swiss premium principle, the Esscher Principle, the Variance principle and several others. Though it is felt that the dimensionality of the Variance principle is wrong and some results in this connection achieved by the mathematicians are regarded as negative many mathematical considerations favour the Variance principle. According to the Variance principle $P = E(X) + k\ var(X)$ where $var(X)$ is the variance of X and k is a constant or parameter that can be fixed in relation to the class of business. Thus the idea of the Variance principle is to make the contingency loading proportional to the variance of the total claim size per policy. For Fire Insurance such a principle may be regarded as having some intuitive appeal and it would be possible to pay some regard to the Variance principle because Fire Insurance shows greater variation both in claim size and claim frequency than other kinds of insurance and therefore it is desirable to have higher contingency loadings for Fire Insurance.

Experience Form

The form referred to on page 42 is shown on the next page. The following comments are pertinent:

i) There is no indication of the exposure over the period. Over five years a company's buildings, plant, stock and even the trade carried on may have changed quite considerably. Cover may even have changed. Where more than one trade is carried on the trade mix may have changed. The form asks for the "main" trade, but the main trade from the business point of view may not be the main contributor to the Fire risk. Cover may even have changed: for example the mix between pure Fire cover and Special Perils.

ii) It is not clear whether the claims are those intimated or those occurring in the period. This makes it impossible to know whether to allow for IBNR. Presumably occured is intended as it is really policy years which are being examined.

iii) There is no split of the total claims cost by peril. Even in the absence of information on exposure by insured peril this would have been useful because the variance in the experience varies by peril, being much higher for Fire than for Special Perils.

iv) "Large claim" is not defined. Different offices may therefore interpret it differently.

v) Large claims are identified by "cause" enabling the related perils to be idenified. However, any attempt to make allowance for the presence or absence of large claims would be hampered by the lack of a similar split in the total claims cost. This is because the distribution of losses by size depends on the peril.

vi) It would have been helpful if large claim costs had been split between "paid" and "outstanding" in the same way as for all claims.

MATERIAL DAMAGE CLAIMS EXPERIENCE
(For risks with annual premium of £1,000 and above)

Name of Insured:

Main addresses:

Main ABI Classification:

Perils Insured*:

Renewal Date: LTA Expiry Date:

Date to which experience completed:

Where less than five years' experience, including the current year, is available, name of previous insurer:

Last five years' Losses net of Deductible (if any):-

YEAR	CLAIMS		TOTAL CLAIMS		DEDUCTIBLE APPLICABLE £ (Other than Standard Excesses)
	Amounts Paid £	Amounts Outstanding £	No.	Amount £	
19 /19					
19 /19					
19 /19					
19 /19					
19 /19					
TOTALS					

Each large loss during last five years (included in the above details)

YEAR	CAUSE*	AMOUNT PAID/OUTSTANDING £

F	=	Fire	S	=	Storm
A	=	Aircraft	FL	=	Flood
Exp	=	Explosion	BP	=	Burst Pipes
R&CC	=	Riot & Civil Commotion	I	=	Impact
MD	=	Malicious Damage	IOV	=	Impact Own Vehicles
Eq	=	Earthquake	BOR	=	Balance of Risks
			Others (specify)		

Signed: ..... Date: .....

3.7 Deductibles

Historically deductibles were little used and indeed the FOC initially discouraged deductibles partly because their statistics would become more unreliable if deductibles became common.

The arguments in favour of deductibles are that they involve a degree of self-insurance giving the insured a vested interest in the safety of the property insured.

Deductibles can be used as a rating factor. For example where there is poor housekeeping, a deductible, will impose an element of self-interest and thus may be more effective in improving the risk than the submission of a list of recommendations.

Deductibles may take different forms.

a) Compulsory or voluntary

Small compulsory deductibles are generally imposed for instance in respect of wet perils. This might take the form of say a £100 deductible being applied separately in respect of (a) storm, (b) storm and flood, (c) burst pipes to each and every loss at each separate premises. This has the effect of reducing the number of small claims.

Alternatively voluntary deductibles may be offered in return for a reduction in premium. However the diversity of risks makes it very difficult to cost the effect of deductibles. In theory it should be possible to obtain a claim cost distribution and calculate the reduction in premium directly. However it is doubtful if most companies have sufficient data. Some companies use a version of Lloyd's first loss tables.

An alternative approach might be to try and use data on fires produced by outside bodies however, this may prove too complicated to apply in practice.

Care must be taken in assessing the discount to be given in return for a deductible. The claim cost distribution may itself alter as a result of the application of a deductible ie the insured may just inflate his claim so as to obtain the same cover for a lower premium. Obviously this is less of a problem where a substantial deductible is offered.

b) Aggregate Deductibles

This is where no payments are made by the insurer until the claims in a given period, treated cumulatively, exceed the level of the aggregate deductible.

3.8 Other Perils

The cover and scope offered by other perils is set out in Section 2.2 of this paper.

In determining the premium to be charged for these additional aspects of cover, it is necessary to collect data where the claims are subdivided according to the peril covered.

In practice there is generally an additional premium percent of Sum Insured to cover dry perils and little attempt is made to distinguish between different risks. The rate for dry perils will vary depending on the number of dry perils covered. Normally compulsory deductibles are not imposed. However if cover for impact by the insured's own vehicles is granted, a compulsory deductible may be imposed.

For wet perils, the risk is normally graded according to the susceptibility of the risk. Again the actual rate will depend on the number of perils covered. Normally a compulsory deductible will be imposed.

The wide variety of approaches adopted by different companies can be seen in Section 3.4.

3.9 Market Statistics

As briefly mentioned in Section 3.3, the FOC - until its demise in 1985 - collected statistics from certain of its member companies which, after aggregation, were used to review tariff rates and hence set the amount of each SOPA. In the recent past, this exercise had been computer based with offices supplying input details of individual policy transactions and individual claims on magnetic tapes. In practice, many FOC offices were extremely small and this detailed data input was provided by only about 8 offices although, being the larger ones, they would have held the lion's share of the business.

The claims input was used to maintain a claims master file of individual records and this could be analysed in whatever way was required. The policy input records were on a totally different basis and consisted only of policy transactions by the office since the previous submission was made. This would comprise details of new business, renewals, lapses, cancellations or changes to existing business (eg in sum insured or classification). Transaction records (each of which showed its effective start and end date) were treated in complete independence of each other - that is, no serious attempt was made to link together different transactions from the same policy. The input records were grouped only by the period to which they applied and, by summing over the required period, the appropriate totals could be found.

For example, an input record - perhaps a policy renewal - might have a start date in July 1983 and an end date in July 1984. The relevant proportion of the sum insured and premiums would then be added into the classification totals for 1983 and 1984 respectively. If the policy was subsequently cancelled, a further transaction input record would be received and - whilst the cancellation record would not be physically linked to the original renewal record - it should generate negative contributions to the 1983 and/or 1984 totals which would cancel out the positive contribution of the original record.

The FOC output, in principle, gave both loss ratios and burning costs; the validity of the loss ratios obviously depended upon the observance of the tariff and, given that this was generally so, the figures produced by the FOC were acceptable. The burning cost results,. however, were acknowledged to be inadequate and this stemmed from the policy transaction method of supplying input. It will be clear that for records other than renewals of new business, records on the transaction file must show the incremental or decremental portion of the premium and sum insured. In general, this requirement presented no difficulty for premiums - companies obviously knew the premiums which they were returning or the additional premiums which they require, although splitting this between classifications on a multi-class policy did occasionally present difficulties; the problems were far greater for sum insured, though, and many offices were unable to show the proportionate refund or additional sum insured which was equivalent to the return or additional premium. For this reason, the FOC burning costs statistics were not regarded as being particularly reliable.

By about 1980, many offices correctly believed that the days of the industrial fire tariff were numbered and they foresaw the need to have a central statistics scheme for this class of business which did not primarily depend upon a common system of rating. As a result, and after some exploratory research and soundings, the Market Fire Statistics Scheme was established in 1982 initially under the auspices of the British Insurance Association but subsequently under the Association of British Insurers after the formation of that body in July 1985. The exercise runs on a "voluntary group" basis and at present has 24 member companies, between them having approximately 80% of the company share of this market.

The primary aim of the Market Fire Statistics Scheme is to produce burning cost statistics by trade classifications on a market wide basis and which will assist in the underwriting of commercial and industrial fire risks. Having said this, the scheme intends to build on the experience of the FOC scheme both by allowing alternative forms of input and by collecting data which could allow more extensive analyses in future.

Whilst the transaction style approach outlined earlier is theoretically the most accurate and, as such, is acceptable input from those offices who can provide accurate data in this way, the scheme also allows for policy data to be provided by taking quarterly censuses of the entire in-force file. Although by its very nature this can never be totally accurate, it is believed that it will be substantially better than receiving incorrect transaction records. Whilst the purpose of the scheme is the production of burning cost figures, premium data are also collected and will allow for the calculation of loss ratios if required.

The input files also allow for the provision of other data. In particular, it is hoped that it will be possible to make a more detailed and accurate analysis than in the past of special perils (eg storm, flood, aircraft damage). Information is also being collected on features such as size of deductible and type of policy and cover. The scheme operates in two distinct parts - one for material damage and one for consequential loss insurances. In addition to the factors previously mentioned, the latter analysis also provides for examination of policies by period of indemnity and claims by actual period of interruption.

3.10 Computer systems

As in other classes of insurance computer systems are extensively used to aid the administraton of policies. Typically these were batch systems although increasingly they are being converted to on-line systems or even to on-line real time systems.

A number of companies are now producing computerised quotation systems. This is an interesting development because few such systems exist for commerical insurances where judgement plays an important part in premium rating; such systems are more common in motor and domestic insurance where the premium can be automatically calculated from a set of rating factors. Recently work has also been done on the application of expert systems for fire quotations.

Expert Systems represent a new departure for Commercial Fire underwriting and, indeed, for the insurance and financial sector as a whole. Although in the last 10 years there have been a number of well-documented systems for scientific, medical and engineering applications, little penetration has as yet occurred in the financial world.

But the picture is changing - especially through the Japanese 5th Generation Initiative, and the UK response via the Alvey Programme. In the Insurance Industry itself, pioneering work is being done by a large group of Companies under the banner of the 'Aries Club'. Aries, aided by expert underwriters from 3 major companies, has by now (July 1986) developed a prototype underwriting system for Commerical Fire use.

This prototype system is as yet limited to one particular area - the Clothing Industry - but the indications are that it could soon be developed to cover risks in other industries as well. The benefits to be obtained from such a system are seen as fourfold:

a) Relieving the underwriter of some of the more standard jobs, giving him time to concentrate on the most difficult cases,

b) Making head office expertise more widely available in the branches, and reducing the number of cases referred back to head office,

c) Helping to standardise underwriting practice and criteria throughout the company,

d) As a training tool to assist new entrants, to learn the underwriting trade.

What exactly is an Expert System? Broadly speaking, it is a computer system which can, within limitations, tackle problems which would normally require the services of a human expert. Such a system is not necessarily designed to replace the human expert, but rather to enable him to be more productive at his job. In addition, an expert system can help to make the best expetise more widely available throughout a company, and can be used for training purposes.

Some general characteristics of expert systems are as follows:-

a) Will deal with a particular domain, or sub-domain only, of human expertise - eg. the well-known system Mycin diagnoses infections of the blood, while Xcon configures computing equipment according to specific needs.

b) Contain a special database, known as the 'Knowledge Base', consisting of facts, rules and other knowledge relevant to the given domain. In addition, contain implicit structure which models expert understanding of the domain itself.

c) Possess a means of drawing deductions and reasoning with the knowledge in the knowledge base. This is commonly either 'Forward Chaining', reasoning from known facts to possible conclusions, or 'Backward Chaining', testing desired conclusions against available facts.

d) Have a means of communication with the human user, enabling him to ask questions such as 'How was a particular conclusion reached?" or 'What if the value of a particular input parameter was changed?"

e) Typically use software based on the Artificial Intelligence languages Lisp and Prolog. ('Lisp' is derived from List Processing, and 'Prolog' from Programming in Logic). However, other computer languages can be used for expert systems work, although not so well adapted for the job.

f) Are best at 'narrow but deep' applications. Expert systems are generally not appropriate to broad, shallow areas of knowledge, where common sense is likely to be the best guide.

The Alvey Programme is a large-scale Government sponsored programme of R & D in advanced Information Technology, running over the 5-year period from 1983. It is characterised by collaborative research projects between industry, academia and Government Departments (in particular DTI, MOD and SERC). It has an overall budget of £350m, of which £200m is from Government and £150m from private industry. The work is divided into a number of areas, relating to the enablingtechnologies concerned, ie. VLSI, Software Engineering, Systems Architecture, Communications, Man-Machine Interface and so on. In addition, there are a number of 'Large-Scale Demonstration', designed to increase awareness of the new technology on as wide a front as possible.

One main area within Alvey is called IKBS, standing for 'Intelligent Knowledge-Based Systems', and it is here that the link between Alvey and the Insurance Industry has been made. Under IKBS, a number of 'Community Clubs' have been set up in various industries, including Chemical Engineering, Banking, Water Resources, Engineering Planning, Travel, Quantity Surveying and Data Processing. The Insurance Industry is represented by the Aries Club, standing for 'Alvey Research for Insurance Expert Systems'.

Aries was founded in mid-1985, after lengthy preliminary discussions conducted at the ABI, the DTI and the Insurance Technical Bureau. The Club now has 30 members, which are:

18	Insurance Companies
1	Insurance Broker
2	Consulting Actuaries
3	Management Consultants
4	Universities
1	Professional Institute (I of A).

Since its inception, Aries has collaborated with the computer systems company 'Logica, with the aim of producing 2 prototype expert systems for insurance purposes:

a)	for General Insurance:	Commerical Fire underwriting system
b)	for Life Insurance:	Equity Selection system for the investment portfolio.

The development work began in earnest in September 1985, as a 15-month programme with 5 main phases. The 3rd of these phases (now complete) was to construct the prototype Commercial Fire system. The system was demonstrated in June 1986 at a major Club Meeting at City University with 100 people present. The 3 expert underwriters who had taken part in the project spoke of their experience in it with an evident enthusiasm. They were positive about the usefulness and validity of the system as constructed.

The Aries prototype fulfils the first rule of Expert Systems - it recognises strict limitations in its domain of operation. As constucted, it deals only with risks in a particular industry - the Clothing Trade. However the work involved in extending the system to other indutries would be far less than that of building it in the first place.

To create the system, there were 2 distinct phases of work:

a) Knowledge elicitation from the experts, leading to the 'Paper Model',

b) Translating the Paper Model into a full system on the machine.

The phases of work were carried out by different members of the project team. In the first phase, two Knowledge Engineers conducted lengthy interviews with the underwriters concerned, sketching out the domain of their knowledge, and eliciting further detail by the use of sample cases. The results were expressed on paper, in a diagrammatic form known as the 'Paper Model'. This model was tested with the underwriters themselves to prove its validity before the second phase of the work began.

In the second phase itself, two System Builders implemented the paper model in the Aries computer. This machine chosen after a lengthy study of the available equipment, was a Sperry Explorer, an AI (Artificial Intelligence) workstation of high quality. The software used was a system called KEE (Knowledge Engineering Environment), specifically designed for the creation of expert systems and related applications.

Once built the system was subjected to further vigorous testing, both to establish its inner logical consistency, and to check its validity for the underwriting purposes in hand.

The way the Aries System operates is comparatively straightforward, and mirrors many of the reasoning processes of the underwriters concerned. At the top-level, the domain is broken down into a number of major factors influencing the underwriting decision:

Physical Construction of Building
Heating Systems
Trade Processes
Management and Housekeeping
Fire Protection Systems
Location

Each major factor is then further analysed according to its characteristics. For example, under Physical Construction, information will be needed on the Roof, Floors, External Walls, Interior Partititioning, Staircases, etc and such features as Exposed Metal. Under Management and Housekeeping, the aspects will be Trade Waste, Smoking Regulations, Discipline of Workforce, Level of Security and so on.

When a particular risk comes up for analysis, the underwriter will be prompted by the system for information on these points. His answers will be given from his perusal of the surveyor's report, which he will in effect interpret for the machine. The answers will generally be requested on a qualitative scale with a small number of steps.

Eg. Question: How often is trade waste removed from the premises?

Scale of Answers:

Less than Weekly	Weekly	2 or 3 x Weekly	Daily

The underwriter will select the box which most closely corresponds to the picture revealed by the surveyor's report.

Once the answers have been given, the system will combine them according to a settled reasoning pattern to give an overall 'result' for the factor-area in question. This result will be in terms of another qualitative scale, ie:

Reject Risk	Consider Rejection	Accept with Loading	Accept at Normal Rates	Accept with Discount

After each major factor-area has been examined, the final pattern will be assembled. At this stage, any negative areas will tend to dominate over the positive ones. Eg: if 'Reject Risk' is obtained in any one of the 6 main areas listed, ie: Construction, Heating Systems, Trade Processes, etc, then the system will indicate that the risk as a whole must be rejected.

In the case of an acceptance, however, the system will do further calculations in order to recommend a rate of loading or of discount, as appropriate. (The system will not make any contribution to the setting of a Normal Rate for a given class of risk. It assumes that a standard rate book is available for this purpose).

An important feature of the Aries Commercial Fire system is the 'How' and 'What If' facility. For example, if the system recommends 'Reject Risk', the underwriter can ask how this has come about. The reply will be in the form:

'Reject Risk' because 'Reject' obtained for the Management & Housekeeping factor.

'Reject' on M & H grounds because of risk from unregulated smoking by employees.

The underwriter now knows that in this case the first consideration will be to persuade the employer to introduce a ban on smoking in the factory, or at least a strict control. Supporting this can be achieved, the underwriter may ask the system: 'What if a ban on smoking is brought in?' The reply will then be, say:

'Accept with Loading of 135%'

If the loading is unacceptably high, then further trials of 'How' and 'What If' will show how the loading can be reduced. Eg: if there is a problem with portable heaters, then removal of such heaters may produce a rating at an acceptable level.

Although the Aries prototype is not a fully viable commercial system for Fire Underwriting, it does illustrate in the most graphic way possible the potentiality for expert systems in this area.

For the cases which have been tested in Clothing Risks, the system has achieved up to 70% agreement with results by expert underwriters. Some of the discrepancies have been due to misunderstandings of wording, and in other cases the experts have actually preferred the Areas System's result to their own.

The next stages in the work which are needed are further testing within the Clothing Risks domain, followed by extension of applicability to other industries. The Aries Club itself does not have the resources to pursue these stages, but it is now open to any participating company to take the system further. Indeed, several of the major companies in Aries are known to have a keen interest in the further development of expert systems for underwriting and other insurance purposes. Unfortunately, such developments will take place behind tightly-closed doors, because of their commercial implications.

But the Aries experience has at least provided a platform, a fairly public jumping-off point for Insurers who wish to take advantage of the new technology of expert systems.

SECTION 4

REINSURANCE

4.1 Background

Commercial fire insurance is concerned with the insurance of buildings and stock which can have very high values but with low likelihood of claim of a significant size. However, where a major loss does occur the claim can run into many millions of pounds for the largest buildings. Such risks are beyond the scope of one office to retain entirely for itself. There is also the need to be protected from catastrophes, one event giving rise to a number of claims.

4.2 Individual Risks

Whilst facultative reinsurance can be arranged for very special risks, it is impractical to do this on day to day type business. Companies writing commercial fire business will have protection under a reinsurance treaty. In the past, this has commonly been of the proportional type, surplus and quota share. However, several years of poor results have recently resulted in significant contraction of the proportional market and greater use is now being made of non-proportional reinsurance which had previously been used only by the largest insurers for individual risk protection.

When a company's reinsurance programme is insufficient to fully write a risk then the risk will be co-insured with other direct insurers until sufficient capacity is available to absorb the risk.

4.3 Level of Retentions

The setting of retentions is often based on old and trusted rules of thumb, relating maximum retentions to the size of the retained premium income. Reinsurers have to be consulted in setting the level. Some allowance needs to be made for incorrectly calculated EML's.

Although companies generally relate retentions to premium income they appear to differ in which premium income they choose. Some will use the income of the fire account while others may use the UK general branch premium income. It would be possible for a large composite to even go as far as using the total premium income of the whole group. The size of retention will vary considerably according to which view is taken.

A company may employ several different retentions, the least hazardous risks having the highest and the most hazardous the least, although this is contrary to risk theory.

The retentions are based on EML's.

The level of retention is clearly an area where actuarial expertise could well be employed, using risk theory.

An example may be helpful:-

Insurance Company ABC has a scale of five limits from £250,000 to £500,000. Its own capacity is supplemented by a 10 line surplus treaty.

For a certain risk its limit is £500,000. This risk has a sum insured of £5m, but the EML has been calculated at £3M, (60% of sum insured). Then five lines of the treaty capacity are used and the retained and reinsured risk are, therefore, split:-

		£m	%
Company ABC	EML	0.5	16.67
Treaty R/I	EML	2.5	83.33
	EML	3.0	100.00

The premiums and any claims arising are then split in the same proportions.

Suppose a fire occurs and total loss results ie the EML of 60% of the sum insured is proved to have been incorrect and EML failure is said to have occured.

The claim is shared out:-

	£m	%
Company ABC	0.833	16.67
Treaty R/I	4.167	83.33
	5.000	100.00

Then Company ABC finds that instead of a maximum claim of £500,000 it has received a claim for £833,000.

4.4 Catastrophe Protection

Catastrophe protection is required to protect against a number of claims arising from one event such as storm damage and it is arranged on a non proportional basis to protect the net retained account.

There are various ways in which such protection may be arranged, such as:-

a) Cost of claims arising from a single event, and may be allowed to occur over a period of 72 hours say, in excess of a trigger point which itself needs to be above the maximum net retention.

b) Stop loss type covers are very helpful in protecting an account against an accumulation of many claims arising from say a lengthy period of severe weather. They are, however, difficult to obtain unless good historical data is available to reinsurers and even so only limited cover may be available.

Determining the amount of catastrophe cover required is guesswork but would be based on a catastrophic event such as the damage occurring if the Thames Barrier failed to work and London was flooded. It is necessary to have available geographical data on exposure.

The catastrophe protection cover would probably also protect the household account.

4.5 Accounting

Proportional treaty reinsurance is usually accounted for in the same way as the direct commercial fire account, except that the treaty terms may not fully reflect the company's own accounts. In particular, unearned premiums may be at 35% of written premiums for the 12 months period and outstanding claims at 90% of the company's own reserves. The former adjustment assume business evenly written over the year and incorporates a realistic deduction for commission, at 30%.

The latter adjustment is because insurers own reserves on fire business are usually in aggregate in excess of the ultimate settlement, even though there is no specific IBNR provision.

Rather than running the year's business off to final settlement, portfolio transfers are usually made into the following year's reinsurance, the transfers taking in both unearned premiums and outstanding claims. This makes dealing with reinsurers differing shares of the treaty from one year to the next rather simpler.

An example may clarify the differences:-

A company's fire account has the following results in respect of its proportional reinsured business on its own accounting basis:-

	1984	1985
	£'000	£'000
Written Premiums	10,000	11,000
Unearned premium B/forward	3,525	3,710
Unearned premium C/forward	3,710	4,092
	9,815	10,618
Claims payments	5,300	5,900
Outstanding claims B/forward	4,800	5,400
Outstanding claims C/forward	5,400	6,280
Incurred claims	5,900	6,780
Commission @ 30%	3,000	3,300
U/W Profit	915	538

Earned premiums are based on the twenty-fourths method, with 20% initial deduction.

In presenting results to reinsurers with unearned premiums at 35%, and outstanding claims at 90% of insurers own reserves, the results become:-

	1984	1985
	£'000	£'000
Written Premiums	10,000	11,000
Unearned premium B/forward	3,325	3,500
Unearned premium C/forward	3,500	3,850
	9,825	10,650
Claim payments	5,300	5,900
Outstanding claims B/forward	4,320	4,860
Outstanding claims C/forward	4,860	5,652
Incurred claims	5,840	6,692
Commission @ 30%	3,000	3,300
U/W Profit (before expenses)	985	658

Portfolio transfer from 1984 into 1985 = 3,500 + 4,860 = 8,360

Portfolio transfer from 1985 into 1986 = 3,850 + 5,652 = 9,502

Individual reinsurers would be sent an account reflecting their share of the treaty for the particular year. By this means allowance is simply made if a reinsurer's share changes from one year to the next.

4.6 Security of Reinsurance

There is no point in reinsuring if the reinsurer is not able to meet the claims when they occur. It is fundamentally important to have a system of scrutinising reinsurers for financial soundness. In the past, it was common, under proportional treaties for the insurer to retain part of the reinsured reserves and pay to the reinsurers rates of interest which by modern day standards were derisory. Reinsurers are most reluctant to accept such arrangements any more.

The security of captive reinsurers has been put in doubt by the collapse of one such company where the captive's parent refused to bail out the company despite the parent's obvious financial ability to do so. This situation could also apply to any subsidiary of a parent. Thus you cannot necessarily look at a parents account when determing the security of a subsidiary.

4.7 Co-insurance

Mention has been made in paragraph 4.2 above of the need for co-insurance on very large risks. Premiums and claims are shared out proportionately with each co-insurer being a direct insurer. Then if one of the co-insurers become insolvent, the other coinsurers are still only responsible for their original share on any claims that may arise during that period of insurance.

The Lead Office receives an overriding commission from the other co-insurers for the expenses it incurs in carrying out surveys setting up the policy etc.

4.8 Co-operative Agreement

Under the FOC rules a risk placed on a coinsurance basis had to be placed at least 60% with FOC offices (- the 60/40 rule). Within this rule the broker had discretion as to whom he invited to have a share of the risk. Following the demise of the FOC some of the larger offices agreed among themselves that they would individually write all risks 100% and then to reinsure between themselves. From those large offices point of view this appears, at first sight, to be a good way of maximising their market share; however it has the obvious disadvantage of leaving them very heavily exposed in the (unlikely) event of one of their reinsurers not being able to meet their liabilities.

Understandably the brokers were not happy about such arrangements as they would then be unable to place business with their "friends". Although many do not believe that the system will ever work in practice one could not say at the time of the writing (July 1986) that the system had proved unworkable.

SECTION 5

CLAIMS

5.1 The Basis of Settlement

For a fire claim, the amount payable will depend upon the basis of cover (see section 2.3), and will be limited by the sum insured. Nowadays, the 'average' rule is nearly always applied.

If there is more than one insurer, costs are shared, essentially in proportion to sums insured at risk. Detailed rules deal with cases where the cover provided by the various insurers is not identical, for example as to excess and whether average applies.

In practice, because reinstatement will take some time during which the policyholder may not be able to carry on his business, the insurer will usually negotiate a cash settlement so that the policyholder can buy another building without delay (and minimise the Consequential Loss). This is especially likely to happen if the reinstatement cost exceeds the market value to any great extent.

5.2 Claims Handling Procedures

The insurer will usually employ specialist loss adjusters to advise on the claim. Loss adjusters are members of the Chartered Institute of Loss Adjusters, entry to which is by examination together with an experience qualification.

The loss adjuster is nominally independent of the insurer and tries for a settlement that is fair to both sides, but as his fee is paid by the insurer he cannot really be independent. Because of this some claimants employ specialist loss assessors to negotiate on their behalf. The loss assessor's fee is paid by the claimant and is not recoverable under the insurance.

The loss adjuster is briefed by the insurer on details of cover and any warranties. From his examination of the aftermath of the fire he will give an opinion as to whether the claim is valid. As investigations and negotiations proceed he will also advise the insurer on the appropriate reserve.

To help him advise on liability and quantum, the loss adjuster may well call on other professionals. If there is any suspicion of arson (perhaps evidence of accelerants) he will bring in forensic experts. Consulting engineers will advise on the extent to which property is damaged and whether it can be repaired.

The loss adjuster will also take such steps as are necessary to minimise losses. For example he will arrange for buildings to be shored up, machines to be greased to minimise water damage, and for the disposal of salvage. There are specialist firms who deal in dehydration, rehabilitation of furnishings affected by smoke, etc, and the loss adjuster will use them as necessary.

5.3 Legal Decisions

There are three main areas where the law has an important bearing on fire claims.

1. The meaning of 'fire'

   In order for a claim to be valid there has to be conflagration. If something is destroyed by heat without catching fire and not as a result of a fire there is no claim. An example of this might be plastic material melting because it was placed too near a heater.

2. Arson

   Arson, or wilful fire raising as it is called in Scotland, is often quite easy to prove. However this is no help to the insurer unless he can prove that the deed was done by (or on the orders of) the claimant. In practice this may mean that unless a successful prosecution is brought the insurer will normally have to settle.

3. Riot

   Riot damage will be covered if it is specifically covered in the policy. Otherwise, fire damage resulting from a riot will be covered unless specifically excluded. Riot damage applies to buildings and contents including garaged vehicles. Vehicles parked in the street are not included.

   Insurers paying for riot losses may in some circumstances be able to recover from the police.

5.4 Claims Reserving

Most insurers will normally be guided by the loss adjuster in setting up claims reserves. The loss adjuster will normally advise the possible loss - perhaps not the maximum possible, but a pessimistic view and more than the 'expected' cost in a probabilistic sense. As a result, the insurer's total reserves, but not necessarily each case reserve, will usually be more than sufficient. Typical reasons for the reserve to be an over-estimate include:

1. Settlement may be for market value (plus a sweetener, perhaps), when the initial estimate was based on the reinstatement cost.

2. Recoveries may be possible.

3. The claim may be repudiated.

SECTION 6

STATISTICS

6.1 Data collection and analysis

Until very recently, a rating tariff existed in the UK for commercial fire insurance. Major tariff companies supplied computer based information to the FOC, the body responsible for the administration of the tariff, and from this input, statistics were produced which enabled the tariff rates to be reviewed.

For many years, the underwriting experience was favourable and under these conditions, there was little incentive for offices, whether tariff or not, to create an improved statistical system or to carry out any other statistical analyses. When during the 1960's, the underwiting experience became increasingly adverse, companies did not have the systems or expertise to respond. Consultants were brought in to advise the FOC, but again the paucity of company systems did not allow their recommendations to be fully implemented. Despite some improvements since then, the data bases available within offices at the present time in respect of commercial fire insurance are still probably some 10 to 15 years behind those for major personal lines such as motor business.

The tariff statistics in principle showed loss ratios (ie the ratios of claims to premiums) burning costs and average rates by trade although in practice there were serious reservations regarding the burning cost statistics (see section 3.9). Few companies have been able to provide more than this, and many have not even been able to go this far. When the ABI Market Fire Statistics Scheme was established, it was agreed that the statistics produced should relate claims to sums insured rather than premiums; this was because, in the absence of a tariff, there will be no common premium for a given risk and the ratio of claims to premiums on a market basis would be of little use to individual offices in re-examining their own particular rating structure. It has become clear, though, that in many companies reliable information on sums insured was not available and so the provisions of such input has become a major administrative and data processing task. However, if accurate burning cost statistics are to be produced, whether on a company or market basis, it is essential that these be calculated from accurate sums insured and the current inability of much of the market to provide this information is the most serious deficiency at present to statistical underwriting.

It is not intended to discuss here all the problems associated with the provision of accurate sums insured information, but it must be acknowledged that these are not trivial. Amongst the matters which would need consideration are:-

- Retrospective adjustments to the sums insured, espcially in respect of stock;

- mid-term changes in sums insured or trade, especially if these do not affect the premium;

- varying methods of inflation provision.

All of these difficulties would be compounded if they affected only certain of the trade classification lines covered on a multi-line policy.

Beyond this fundamental point, there are other, though less vital, points which need to be considered. Amongst these are the need to record and analyse other factors which could influence either the risk or the nature of the claims which have to be met - amongst these would be levels of excess or deductibles, the age and standard of construction of the property, fire protection equipment available (particularly sprinkler systems), locality, security of premises and so on, as well as more basic points such as type of policy and nature of cover (eg indemnity or reinstatement cover, traditional full value policy or first loss or layered cover). For consequential loss insurances, the maximum indemnity period is also important. The treatment of conglomerate or experience rated risks will also need to be considered.

Another major consideration from a statistical point of view should be the treatment of 'perils'. It has been estimated that up to 30% of material damage claim payments are not in respect of fire losses, but are due to additional sections on the policy covering perils such as storm, flood, explosion etc. Despite this, many offices do not record details of the perils covered in a way which would allow premium rates or burning costs to be examined. The most vital need is therefore to record details of the perils covered by the policy and the sums insured associated with each. It could be argued that peril claims should be analysed by both trade and locality: for example, some trade processes may be more explosion prone whilst some localities may be more liable to flooding. This is undoubtedly true, but given the current state of the art, it would be a major development to obtain any information at all on individual perils, let alone by other factors, however desirable this may be in theory.

6.2 Availability of Data

It must regrettably be said that very few statistics are available for general use on commercial fire business. No doubt many companies carry out analyses of their own figures but are generally not prepared to make these publicly available.

In the UK statutory accounts, commercial and industrial fire insurance is included as part of the property class, but since this includes domestic property business as well as such other varied commercial lines as theft, engineering and so on, the figures available are far too broad for many purposes. In certain parts of these statutory returns, and in particular that section providing a claims run-off by year of origin, the main accounting classes have to be subdivided by risk group. The regulations do not define these risk groups and there is little conformity between offices in the groups which they choose to use. The majority of companies have a risk group called "fire" or something similar, but this may or may not include domestic business; the only way this can be determined is by seeing whether there is another risk group more likely to include domestic business and from a knowledge of the kind of business which that particular company writes.

For example, one company uses the five risk groups of fire, burglary, domestic, engineering and other. Under these conditions, it is highly likely that fire will be predominantly commercial fire. However, another company has four risk groups - fire, burglary, engineering and other ; the fact that the "other" category is extremely small in size suggests that "fire" includes both domestic and commercial business. A third company simply uses two categories - domestic and other. Clearly the range of possibilities and options is enormous. Of some 26 major property insurers considered, "fire" is likely to be predominantly commercial fire in only about half the cases.

Market statistics have already been referred to in section 3.9 but again these figures will only be available to those insurers who are members of the appropriate scheme. The FOC figures, with one exception referred to below, were confidential to the Committee itself and were used for the purpose of reviewing tariff rates. The ABI scheme is equally confidential and has the intention of making results available only to offices according to the level of detail provided: that is, an office which did not provide information on a particular factor would not receive the output from any market analysis examining this factor.

The exception referred to above is that FOC statistics have been provided on a regular basis to the Comite Europeen des Assurances (CEA). CEA is a European insurance association and for many years, the Paris based secretariat of its Fire Committee has collected statistics of material damage and consequential loss business from member states. Participating countries include Austria, Belgium, Denmark, France, Germany, Italy, Spain, Sweden, Switzerland and the UK.

The statistics are based on the CEA fire classification which is a decimal based system with ten main categories each subdivided into ten sub-categories and so on. Special perils (such as storm, flood, explosion) are excluded from the figures but non-sprinklered and sprinklered risks are collected separately, although most participating countries other than the UK cannot accurately separate these two types of risk.

As remarked, the present UK return is based on the tariff statistics supplied by the main ex-FOC companies, with the FOC classifications being converted in the UK to CEA classes as accurately as possible before being forwarded.

The collected returns are published by the CEA at least 18 months after the year to which they relate and are circulated to participating countries. At time of writing (February 1986) the latest available figures relate to 1983 with summary figures provided from 1968 to 1983. Although their subsequent distribution is the responsibility of each member state, it is inevitable that their circulation will be restricted.

The main declared use for the figures is to act as a basis for the rating of risks on a European basis. So far, Belgium is the only country to attempt a new rating system based on these European figures and it is too early to pronounce on the success of the exercise. The UK attitude to the figures is one of considerable scepticism.

Also on the international front, it may be worth referring to the World Fire Statistics Centre. The purpose of the Centre is the promotion, collection and use of international figures on fire damage; this, in turn, it is hoped would encourage fire prevention policies by Governments, insurers, commerce and industry and other interested bodies.

There is one other source of statistics which might be mentioned. In the UK, estimates of total fire damage are prepared and issued regularly by the ABI. These are based on the collection of information from insurers and the press on large fires; the information obtained is then grossed-up to give an estimate of all fire damage, regardless of size. The figures are intended to cover all material damage, whether insured or not, and cover both domestic and commercial properties. Although the precise figures will be subject to wide margins of error, it is hoped that a reasonable indication can be given of general trends. Summaries of these figures have been given in previous GIRO Bulletins and a further analysis of them is made in section 6.3 of this paper.

6.3 Analysis of Results and Statistics

As described in GIRO Bulletin No. 40 the ABI calculates and publishes an estimate of the total fire wastage for Great Britain. Monthly figures for the number of large fires and the corresponding total damage are compiled and also grossed up figures which estimate the grand total for fire damage for large and small fires are provided. For purposes of this investigation the ABI have made avilable the monthly figures for large fires from January 1970 to December 1985. The definition of a large fire is updated regularly using the RPI index and stood at £58,000 at the end of 1985. So as to eliminate to a large extent the effect of inflation for purposes of analysis it was thought best to concentrate on numbers of large fires rather than amounts of damage.

The data is as follows:-

Year	No. of large fires (GB)	No. of cigarettes (and cigars) sold. (UK) thousand million
	Y	C
1970	1,040	128.9
1971	1,093	123.8
1972	1,214	131.9
1973	1,225	138.9
1974	1,112	138.6
1975	1,129	134.2
1976	1,054	132.2
1977	980	127.5
1978	910	126.8
1979	941	126.0
1980	1,042	123.1
1981	905	111.8
1982	834	103.5
1983	841	103.0
1984	875	100.4
1985	834	99.2

Time Series Analysis

- Seasonality. Given the series of monthly figures for large fires it is natural to look for seasonal influences. The variation from month to month is considerable. The monthly average for June from 1970 to 1984 is 92 large fires whereas the monthly average for December from 1970 is 76 large fires. However there does not seem to be a real seasonal trend. The figures for May and July are lower than those for June and the figures for November and January are higher than those for December. An examination of the periodogram and the spectral estimates confirmed that there is no strong evidence of seasonality.

- Trend. There is a trend towards fewer large fires. The number has dropped over 12 years from 1,112 in 1974 to the peak in 1973 of 1,225 large fires to 834 in 1985. Fitting a straight line to allow for linear trend produces a much more stationary series but a rather noisy one.

- Stationarity and Differencing. First order differencing achieves stationarity but the result is very noisy.

- Box-Jenkins models. First order autoregressive and first order moving average models were fitted after differencing once. These both could account for some of the autocorrelation. The first order autocorrelation coefficient was reduced from .42 to .26 at lag one with both models. However the variance and the residuals remained large after fitting. Of the models fitted a first order moving average seems the most appropriate.

Causes of Large Fires

Each year the FPA - Fire Prevention Association obtains information for statistical analysis from insurance company returns and fire brigade reports. The analysis includes a table showing numbers of large fires and the corresponding loss under various headings.

The more important headings are:

Deliberate ignition.
Electrical appliances and installations.
Smoking materials and matches.
Unknown and under investigation.

Each of the above major headings can account for a substantial porportion of fires and fire losses. Deliberate ignition and unknown cases can each account for about one third of the large fires investigated in Great Britain.

Other minor headings often account for a small proportion, less than five per cent, of large fires:

Acetylene cutting and welding.
Oil appliances and installations.
Mains gas appliances and installations.
LPG equipment.
Chimneys, stoves, pipes and flues.
Spontaneous combustion.
Rubbish burning.
Solid fuel installations.
Naked light, taper, candle.
Other known causes.

Under both the major and the minor headings the figures and percentage of the total vary considerably from year to year.

Regression Analysis

When most fires are either of unknown causes or the result of deliberate ignition the development of a parametrized model to explain the incidence of large fires is to be approached with caution. However there is not so much serial correlation in the series of observations of numbers of large fires year by year that the use of regression is precluded.

The following illustrates the use of the simplest kind of regression model that of bivariate regression with a single explanatory variable it is possible to use the number of cigarettes (and cigars) sold in the United Kingdom in the years since 1970. Smoking materials and matches are known to account for a significant proportion of large fires and may account for a larger proportion of those where the cause is unknown. Here the response variable is the number of large fires each year and the explanatory variable is the number of cigarettes (and cigars) sold according to the figures supplied by the Tobacco Advisory Council. The figures are shown in the earlier table.

The correlation coefficient between number of large fires and number of cigarettes sold is .859.

The simple regression line as fitted is

$$Y = 8.195\ C + 3.149$$

The fit is good as the coefficient of determination ie the ratio of explained to total variation is the square of the correlation coefficient, which is here .737 is high. A full scale research programme into causes for the decline in the numbers of large fires would need to consider other factors besides smoking. These would include the decline in industrial activity since the early 1970's, the effect of using the RPI index to revise the definition of a large fire, Fire Prevention activity, regional variation and other possible influences. Also one would like more investigation of the trend over time as a Time Series.

The Distribution by Size of Loss from Commercial Fires.

The Lognormal is a two-parameter distribution that has been thought suitable to represent the distribution of fire claims by size.

The two parameters of the distribution are μ and σ .

The probability density function for the Lognormal is:-

$$f(x) = \frac{\exp\left[-\frac{1}{2}\frac{(\ell nx-\mu)^2}{\sigma^2}\right]}{x\sigma\sqrt{2\pi}}$$

and the Moments of the distribution are given by

$$E[X^n] = \exp\left[n\mu + \tfrac{1}{2}n^2\sigma^2\right]$$

for the nth moment.

The Mode of the distribution is $e^{\mu-\sigma}$.

For three pairs of values for μ and σ corresponding to a common mean of 4,195 three different Lognormal distributions give rise to the three curves shown.

Parameters

μ	σ	Means	Standard Deviation	Mode	Graph
6.5	2.0	4,915	35,981	90	———
7.0	1.7321	4,915	21,471	194	·····
7.5	1.4142	4,915	12,423	440	- - - - -

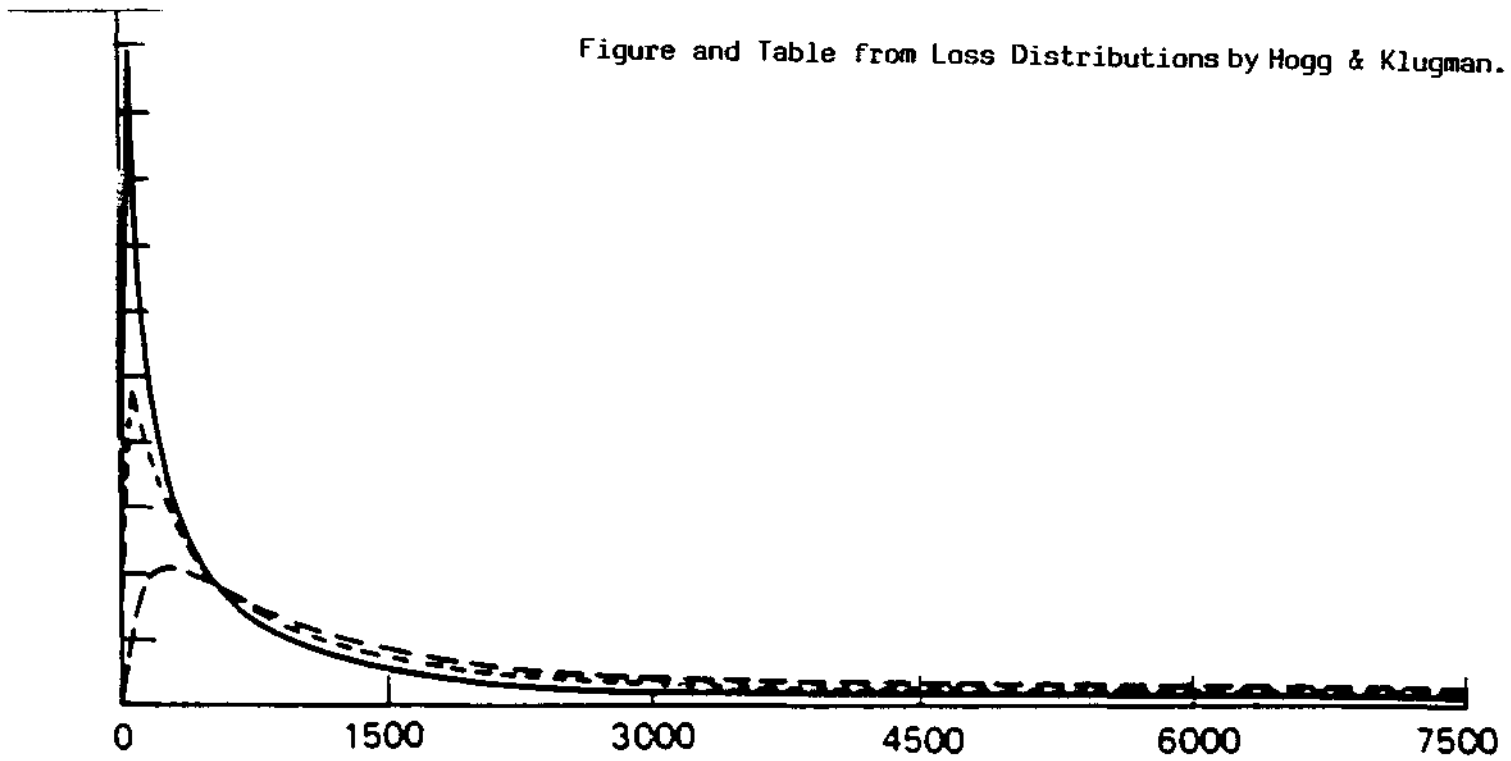

Figure and Table from Loss Distributions by Hogg & Klugman.

For the specimen distribution of Fire Losses by size of Loss given in Section 3.6 the mean was found to be £2,156 and the Standard Deviation £28,000. Thus the Lognormal with parameters 5.1 and 2.27 is the distribution fitted by using the method of moments. However, a closer inspection of this particular empirical distribution based on four years experience of a particular office shows that the fit is not good. The mode of the Lognormal with these parameters is only £9.3 and the empirical distribution has two peaks. A better fit could be obtained in this case by regarding the observed distribution as a mixture of two distributions.