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Summary

Marine Insurance is a vast subject and the aim of this paper is to provide background that will assist in understanding the principal features of the business. The paper examines each main class of business, Hull, Cargo & Specie, Liability and Energy, highlighting actuarial issues. The introductory section describes the market place, outlining how business is written and gives details of market organisations associated with Marine. It also covers some recent developments in the market, the way Marine business is accounted and key features on reserving.

For each class there is an outline of the main types of cover provided. This is followed by a detailed study of the key area of rating, both at risk and class level. It looks at the main rating factors, possible exposure measures, traditional approach to rating and possible actuarial methods. This analysis is necessary even though the market place will be the final decider of the price to be charged, this being particularly so in a worldwide market with the UK share written on a subscription (slip) basis.

We discuss how better data capture and enhanced analysis could improve the understanding of the past and likely future performance of the business, notwithstanding the problems caused by the diverse nature of Marine business.

The international nature of Marine business, the size in terms of premium income written in the UK and the variety of problems should provide a challenging opportunity with potentially high rewards for the actuary.

A bibliography is included for the reader who wishes to pursue the subject further.

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1. Introduction

1.1 Terms of Reference

The Working Party adopted the following terms of reference:

To consider Marine Insurance with the objectives of:

- ♦ providing background to assist actuaries in developing their knowledge and understanding of this business.
- ♦ describing each main class of business, highlighting actuarial issues.
- ♦ providing selected bibliography.

1.2 Scope

The paper concentrates on Marine business written mainly through the London Market. It considers each of the main classes of Marine and the reader should refer to 'Marine Insurance and Reinsurance' by C.J.Czapiewski et al presented at GIRO in 1988 which provides useful background. The reader is also referred to the paper presented by P.D.Smith on P & I Clubs at the 1991 GI Convention. Aviation business is excluded from our study, and the important issue of environmental and other latent claims is only mentioned briefly. This latter issue has been covered at recent GI Conventions.

1.3 Background Topics

1.3.1 Cover

The Lloyd's market began as the insurance of marine adventures. Merchants with, or without, interests in voyages would meet in Lloyd's coffee house and mutually insure their risks. This insurance helped to build up London as a maritime and insurance power.

London is still an insurance centre for Marine insurance, as well as other types. The London Marine market has its own character and market organisations.

It would seem obvious that Marine insurance covers ships. Marine implies risks arising from voyages on water or operations linked to water, such as oil rigs. It is less clear whether peripheral risks should be included. For example, a pipeline may be underwater and clearly a marine risk, but will come onto land at some point. It may then still be covered by a marine insurer. Cargo, whilst on board ship is clearly marine, but when stored in a warehouse its nature is less obvious. Once loaded onto trucks for delivery, is it still a marine risk? Some underwriters do cover it.

Boat builders and marinas are marine risks. Marinas often have hotels and restaurants linked to them which find their way into a Marine account.

Marine insurance is not a clear-cut class of business. One of the main problems in the late 1980s was that the distinction between marine and non-marine became blurred, with Marine insurers writing risks that were not marine in any way. As rating these risks was outside their area of expertise, large losses were incurred. These were not always immediately obvious, as the non-marine risks were effectively hidden.

Hopefully, the Marine market has learnt from this and is now concentrating on what it knows best.

1.3.2 Marine Law

Marine insurance in the UK and the US is regulated by the UK Marine Insurance Act 1906. Although this is a piece of UK legislation, in general the US has taken the pragmatic view that as marine business is worldwide, Marine insurance legal decisions should be harmonised between great maritime powers. It should not be assumed however, that US law will not apply.

Particular points to note are:-

i) Utmost Good Faith

Marine insurance contracts, like those of other General Insurance Classes, assume that the assured has disclosed all relevant facts. Any relevant non-disclosure can invalidate the contract.

ii) Warranties

If the underwriter issues cover on condition that a warranty is fulfilled, this must be done to the letter, or the contract is invalidated. This applies even in cases where the warranty cannot be fulfilled. For example, cover was issued for a consignment of frozen prawns from Pakistan to New York. The warranty required that the shipment be inspected by 'proper government authorities' in the country of origin prior to loading. At the time there was no such authority in Pakistan and the shipper obtained a certificate from a surveyor appointed by a Lloyd's agent. The prawns arrived decomposed, but the courts decided that recovery could not be made from the insurers as the warranty had not been performed.

iii) Seaworthiness

All Marine insurance contracts, except time covers, have an implied warranty on seaworthiness of the vessel.

1.4 Placing of Business

The majority of all Marine business written within the UK is handled by the London Market. Some business is written through provincial markets and agencies. There is a small amount of business which is placed directly by the insured however in the main the business is placed by a broker. There are both specialist Marine brokers and Marine broking divisions within the larger broking companies. Given the major role of Lloyd's in the Marine market most brokers are also Lloyd's brokers.

The broker will generally after consultation with the insured prepare a basic slip and associated placing information. The nature of the slip varies depending both on the nature of the risk being placed and also the broker handling the risk. In general the slip will contain:

- ◆ name of the insured (referred to as 'assured' in the Marine market),
- ◆ the period of insurance,
- ◆ the name of the vessel(s), together with brief details,
- ◆ the sum(s) insured,
- ◆ the perils covered,
- ◆ the general conditions,
- ◆ the premium payable,
- ◆ any deductions,
- ◆ brokerage.

(NB the slip is similar in most respects to slips used in the non-marine London Market).

The Marine market in London is dominated by Lloyd's, and companies which belong to the Institute of London Underwriters (ILU). There is a limited amount of reinsurance business placed outside these two markets. Consequently for most business the broker will seek a lead in both the ILU and Lloyd's.

Under the terms of the Marine Insurance Act the broker is responsible for the payment of the premium. The broker has a lien on the policy and may retain it until the insured pays the premium. The underwriter is responsible directly to the insured for the payment of claims and premiums not paid may not be used to offset claim payments. In reality the collection of claims is normally also handled by the broker who may charge a collecting commission for the service.

Large risks are often placed in different markets (e.g. London, Scandinavia, USA, Japan) and the broker may not initially know the percentage (i.e. order) being placed in London. At times the risk can be placed on different terms in different markets. This can cause extra complications when settling claims.

1.5 Market Bodies

1.5.1 Institute of London Underwriters & London Processing Centre

The Institute of London Underwriters (ILU) is the market body of the insurance companies which underwrite Marine and Aviation business in the London Market. It is a subscription market with the members each taking a share in large risks by acting as coinsurers.

Most member companies rent underwriting space in the ILU building in Leadenhall Street, London, and their underwriters are based there rather than at the member company offices. The ILU also operates from Folkestone and via a worldwide network of surveyors and claims-settling agents.

It was founded in 1884 as a market-wide forum for discussion and included Lloyd's underwriters. Later, membership was restricted to companies and other services such as policy issue and claims settlement were provided.

The ILU and Lloyd's are equally represented on Marine London Market bodies such as the Joint Hull Committee and Joint Cargo Committee. The ILU is also represented on bodies such as Lloyd's Register of Shipping and the Salvage Association.

Members of the ILU have to satisfy solvency conditions. They were able to boast that no member company had defaulted on claim payments. This led brokers and insureds to assume that all member companies were equally secure. Following the disastrous market results of 1988-1990, one current and one recent past member are in provisional liquidation and have stopped paying claims. Brokers and insureds are now looking more carefully at the security of member companies. Forty companies (mainly smaller ones) have left the market. Membership at the beginning of 1994 stood at 74 companies and it is likely to fall further.

This situation is a clear challenge to the ILU, which is trying to find better ways of policing the security of members. In addition, ways are being sought to raise standards of professionalism, including improvement of training in conjunction with the CII. Non-marine exposures, which had crept into the market in the late 1980's, are now being forced out. The volume of business being transacted is reducing as overseas markets grow and is changing in mix. In particular the proportion of Energy business is increasing.

The ILU produces a commentary on market results and some casualty statistics - particularly for Hull business. The exposure information within this analysis is limited.

Improvements could be made by extending the statistics to other areas of Marine business, extending the scope of the information produced, and supplying the annual statistics in an electronic format.

From the beginning of 1994 the ILU policy signing and IT functions have been merged with those of the London Insurance and Reinsurance Market Association (LIRMA). The merged bureau, the London Processing Centre (LPC) is 50% owned by the ILU and is based at the offices in Folkestone.

Data on risks, premiums and claims, is transmitted electronically on LIMNET from the LPC to the ILU's member companies. The usefulness of this data could be improved if it were sent as structured data fields using uniform statistical codes (rather than strings of text) and if more stringent data edit-and-review procedures were implemented by the processing centres.

1.5.2 Lloyd's Bodies

i) Lloyd's Policy Signing Office (LPSO)

The LPSO was established in 1916 with primarily an accounting role. From 1923 it became compulsory for Lloyd's syndicates to use the LPSO. It processes premiums and claims payment transactions for all classes of business other than motor, each transaction being identified by means of its LPSO number and date. The insurance and accounting details processed through LPSO are available to users electronically by means of the Lloyd's Underwriters' Signing Message (USM) transmitted on LIMNET.

ii) Lloyd's Claims Office (LCO)

The LCO acts on behalf of the 'following' market, that is, for underwriters other than the lead underwriters on a risk. It provides data capture and claims settlement services, advising underwriters of the movement in outstanding claims. Brokers liaise with lead underwriters and with the LCO on behalf of the followers. If there is a dispute between the lead and following underwriters over claims settlement then the LCO will assist with negotiations.

Historically there have been three offices:-

- | | |
|-----------|--|
| Marine: | Lloyd's Underwriters' Claims and Recoveries Office (LUCRO) which has been established for 50 years. The Outstanding Marine Claims Advice System (OMCAS) was Established in 1986. |
| Aviation: | Lloyd's Aviation Claims Centre (LACC) Established 1966 |

Non-Marine: Lloyd's Underwriters' Non-marine Claims Office (LUNCO)
Established 1968.

Standard advice cards are used to inform underwriters of their liabilities. These are colour coded as follows:-

LUCRO:	White
LACC:	Blue
LUNCO:	Yellow

iii) Lloyd's Underwriters' Association (LUA)

The Lloyd's Underwriter's Association was established in 1909 to act on behalf of Marine underwriters at Lloyd's. It is the oldest of the Lloyd's associations, which represent the interests of various parts of the market. The role of the LUA is to represent the Lloyd's Marine market in discussions with other organisations on technical and administrative issues relevant to Marine insurance. In particular there is liaison with the Institute of London Underwriters, which represents London Marine insurance companies, via various joint committees such as the Joint Clauses Committee and several specific class committees such as the Joint Hull Committee. Together with the ILU, the LUA also represents London Market interests on the International Union of Marine Insurance.

1.5.3 London Market Claims Service (LMCS)

The LMCS developed from a service to distribute Attorney Reports on asbestos related claims. It is now involved with asbestos related, environmental pollution and some health hazard claims. As well as Attorney Reports, they hold policy information relating to these latent claims. The LMCS serves both Lloyd's syndicates and companies in the London Market.

1.5.4 Joint Committees

These Committees are made up of Lloyd's and ILU underwriters. Their function can be split between advising the London Market on business matters and promoting London in the international arena.

The committees discuss topical matters within the market and may issue Working Party reports on these from time to time. These Working Parties will involve detailed research and contact with specialists within the Marine industry. The committees make recommendations to the market on clauses, types of coverage, discounts, recoveries and general underwriting guidelines. They are only advisory bodies and do not control rating levels or the activities of individual underwriters.

As an example, the International Market continues to look to London for leadership on Cargo matters. The Joint Cargo Committee is often asked to comment on issues affecting local markets, to participate in the negotiations for International conventions and to promote the interests of Cargo insurers.

The Committees have a guiding role; they are, however, often looked at for more than this. They do not have the authority to pronounce on rating.

1.5.5 Lloyd's Register

Lloyd's Register (LR) is one of more than a dozen Classification Societies operating in the world. Each July it publishes the Lloyd's Register of Ships, which provides a list consolidated from most Classification Societies of sea-going ships of 100 tons gross or greater. Monthly supplements are published to update the annual Register. It also provides statistics based on the Register, and other publications covering various specialist vessels.

Each ship contained in the Register is assigned its own unique LR number. This number is not changed throughout the life of the vessel. Further details of this, and other publications, are given in the Hull section (section 2.5).

1.5.6 Average Adjusters

Average adjusters are specialised Marine loss adjusters. They are employed by ship owners, and seek to determine how losses should be apportioned between the various involved parties in cases of "General Average"; that is cases where one party suffers a loss for the benefit of all the parties to an adventure, for example, the cargo being thrown off the ship to stop it sinking.

1.5.7 International Group of P & I Clubs

This is an arrangement between 15 of the largest Protection and Indemnity Associations. The Clubs meet in a number of committees and sub-committees to discuss matters of mutual interest. They are also parties to an agreement by which they pool large losses (see sections 4.2.1 and 4.3.2) and are also the joint purchasers of the International Group Excess Of Loss contract, which protects the Clubs against losses in some cases of up to \$1,150 million, although the Clubs limit their liability against oil pollution losses to \$500 million.

1.6 Recent Developments

Some of the main developments in the period since the paper by C.Czapiewski was written are:

- ◆ the disastrous losses from business written in 1988, 1989 and 1990 resulting from inadequate rating combined with an unprecedented number of catastrophes.
- ◆ the significant impact of the LMX spiral.
- ◆ the necessity for significant reserve strengthening, particularly for asbestos and pollution losses.
- ◆ the losses stemming from the above three factors have contributed to a dramatic fall in the number of Lloyd's syndicates and ILU companies writing Marine business.
- ◆ the big increase in rating together with a tightening in underwriting conditions since 1991, led by the Excess of Loss reinsurance market. Rating increases now seem to be levelling off.
- ◆ the greater focus on the security of reinsurers and on credit control.
- ◆ the mechanisation in processing systems and the move towards electronic transfer of information and electronic placement of business.

1.7 Accounting

Marine business is traditionally accounted on a three-year funded basis which is unique to the UK. Under this method a fund is created for each underwriting year to which written premiums on all policies or contracts incepting in that year are allocated, together with the related claims and other expenditure. The recognition of profit is deferred until the underwriting year is closed, which may not be later than the end of the third year following the underwriting year. The underwriting result disclosed in financial statements relating to business accounted for on a fund basis will comprise the result for the underwriting year closed at the end of the accounting period, adjustments to the estimates used in arriving at the results of previously closed years, provisions for anticipated deficiencies in respect of underwriting years which have not been closed (i.e. open years) and adjustments to such provisions previously established for open years.

The above applies to the Company market and there are small differences for the Lloyd's market.

Recently some companies have moved to the annual (revenue year) basis, and Lloyd's is also considering a move away from three-year accounting. When converting to the annual basis, a critical element is the premium writing and earning pattern. For example, under Cargo facultative covers the premium is usually earned very quickly so the standard 365ths basis is not appropriate. Also, premiums received under open covers are usually fully earned. The estimation of pipeline premium is also of interest, particularly as to how it is recognised in written or earned figures. Mis-estimating unearned premium will distort the apparent profitability of an account and give misleading impressions.

Recently there has been a move towards tighter terms of trade, reducing from 60 days to 45 days, and this can distort premium development terms. Likewise minimum and deposit (M & D) premiums are often now at 100% rather than the previous 80%.

1.8 Reserving

The actuary's role in reserving Marine business is well-established and we do not intend to cover the subject in detail. It is usual to apply standard actuarial techniques to reserving Marine business and these are described in 'An Actuarial View of Lloyd's and the London Reinsurance Market' edited by D.M. Hart, and in the Czapiewski paper.

Some features which are particularly relevant to Marine business are:

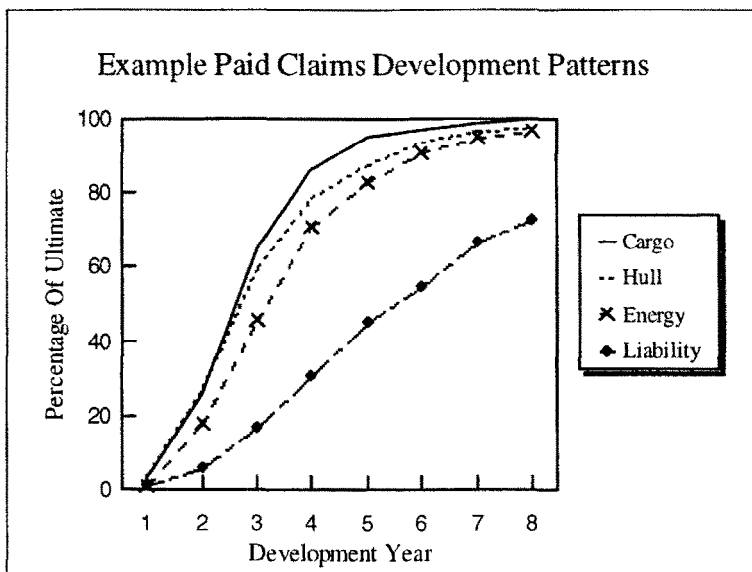
- ◆ Outstanding estimates are not comprehensively or accurately available. There has been a move in the market to provide these but the take-up is slow and will not necessarily apply to claims from older years of business and to certain classes of business. In addition, estimates are of little value if they are not taken down to reflect payments, hence methods are largely based on paid claims.
- ◆ Claim numbers are not generally used for reserving purposes.
- ◆ Claims amounts are in different currencies.
- ◆ Claims are usually shared because of the slip system and often subject to substantial deductibles.
- ◆ Because of the worldwide nature of the business, information is often incomplete and subject to delay.
- ◆ Triangulations are generally by underwriting year.

As with other classes of business, the main issue is one of understanding what is included in the data and what changes have taken place in the last few years, and consequently the extent to which historical data can be used as a guide to future development patterns. Examples of issues to be considered are:

- ♦ checking the wordings of slips.
- ♦ the presence of large loss events - either individual losses or multiple claims arising from, for example, a major weather event.
- ♦ changing mix of types of cover, for example in Energy business, the mix of property damage and liability covers as these are likely to exhibit quite distinct development patterns. Where cover is bought as a package it may be difficult to split the data for these.
- ♦ changes in reporting practices and the introduction of new systems.
- ♦ changes in the legal environment.
- ♦ claims-made wordings and sunset clauses on Liability business.
- ♦ variable and protracted exposure periods arising from construction contracts.
- ♦ the impact of whole account reinsurance, which covers all classes of Marine business, in estimating net ultimate losses.

1.8.1 Development Statistics

A small survey was carried out amongst Working Party members to collect information on the comparative development of the classes of business considered in this paper. For each class a pattern showing the development of net paid claims from year of underwriting was supplied. The following chart shows the average derived from the responses.



The chart demonstrates that the Liability business has a much longer-tailed development than the other three classes. The development for the other classes appears fairly similar, with Energy being longer-tailed than Hull, which is in turn longer-tailed than Cargo. Whilst, with one exception arising from a small class of business, this ordering was exhibited by each of the companies individually, it should be noted that there was considerable variation between the development patterns received from different companies. This variation was such that the longest observed Cargo pattern was longer-tailed than the shortest observed Energy pattern. The variation in patterns may have arisen from a number of sources, in particular, variation in the composition of inwards and outwards business. Also, if the patterns were derived from different groups of underwriting years this may have contributed to the variation if development has changed over time as retention levels and other policy conditions varied. This highlights the fact that these development statistics should be regarded as for illustration purposes only, and should not be relied upon as being representative of any individual book of business.

2. Hull

2.1 Introduction

This section of the paper considers the insurance of Hull risks. It begins with a discussion relating to coverage, rating factors and measures of exposure. The main sources of data available are then listed, and finally an actuarial approach to rating is described. The section concentrates on commercial vessels, and yachts are not considered.

2.2 The Risk

2.2.1 Coverage

A primary Marine Hull policy generally provides cover for the following:

i) Total loss (TLO)

This includes constructive total loss (CTL) where the cost of repairs etc. exceed the insured value of the vessel. If the vessel is insured on wider conditions, the direct writer may reinsure the TLO part of the risk.

ii) Particular Average

This is Marine parlance for partial losses.

iii) General Average

This is the deliberate sacrifice of property in a marine voyage to prevent the total loss of both ship and cargo, and may be partial or in severe cases the whole cargo may be lost.

iv) General Average Contributions

These are the contributions assessed against the Hull owners when a general average event takes place.

v) Collision Liability

vi) Salvage charges, Sue and Labour Charges

These are the costs involved to avoid or mitigate a loss once it has occurred.

The standard policy will cover trading on normal trade routes. The policy may however be restricted, to allow for more limited trading, or conversely extended. These restrictions are called the trading warranties. In general the Hull policy will exclude any trading in any areas where there are hostilities or threats of hostilities. Such risks must be covered separately by a War Risks policy (see also section 3.6).

Within the scope of Hull insurance there is the insurance of ships which are laid up (i.e. not trading). Secondly there is the risk during the building of a vessel. Both these areas are more specialised and are not considered further within this paper.

2.2.2 Exposure Measure

The exposure measure for the non-total loss perils is generally some measure of the size of the vessel. The appropriate measure depends on the nature of the vessel. For cargo vessels the Dead Weight Tonnage (DWT) which measures the maximum amount which may be carried (the difference in weight between unladen and laden including bunker fuel) is appropriate. For passenger vessels the Gross Registered Tonnage (GRT) which measures the volume of the space below deck is more appropriate. For vessels like tugs the power rating of the engines gives the best indication of the nature of the vessels. A certain degree of caution is needed when using these measures. Firstly different surveyors will measure in different ways and arrive at different sizes. Secondly similar sounding titles can be subtly different, one might include bunker fuel for instance, while the other does not.

For total loss the best measure of exposure is the sum insured. An interesting feature in Marine insurance is that the sum insured may be over- or under-stated relative to the actual value of the vessel. It is critical that the underwriter makes an assessment of this and then rates accordingly. A vessel which is insured with a low sum insured will be more likely to suffer constructive total loss (the value of repairs exceed the sum insured) than a vessel which is insured for a sum insured which equals its replacement value. The converse is true for high sums insured and in this case there is the additional issue of moral hazard to be considered.

Vessels are generally insured for twelve-month periods. Clearly the above measures need to be adjusted if the insurance is for a shorter or longer period.

2.3 Rating factors (Exposure)

The main rating factors are:

i) Type of Vessel/Trade.

The type may be split at the top level into cargo vessels, passenger vessels, fishing vessels, specialist vessels (e.g. tugs, dredgers) and yachts (and other private vessels). Within these categories vessels can be further defined, for example, cargo vessels can be split into tankers and bulk carriers.

As with all rating it is possible to sub-divide into smaller and smaller groupings and the main difficulty is obtaining groupings which are both credible and homogeneous.

ii) Type of Machinery

A Hull policy includes cover for machinery. The type of machinery needs to be considered (whether it is used for propulsion/navigation or related to maintaining cargo, for example, refrigeration plants).

Machinery claims are generally high frequency and low severity, but can sometimes be very large. Thus machinery is a key factor on primary policies with low deductibles.

iii) Age of Vessel

A study conducted by Thygood and Nielsen of the Danish Institute of Statistics and Operational Research (IMSOR) indicates how important this rating factor can be. One feature which is analogous to the experience of vintage cars is that a vessel in excess of 30 years generally has much better experience than younger vessels.

iv) Flag

All vessels need to be registered. The state in which it is registered is the vessel's flag state. This need not be related to where the vessel trades. The choice of flag is determined in general by financial considerations. In simplistic terms the states of the Organisation for Economic Co-operation and Development (OECD) impose conditions which increase the costs of owning a vessel. The conditions imposed are a mixture of sound Marine management and nationalistic self-interest. Some states operate two-tier registration systems; a more controlled level in the main for vessels trading within or with the flag state and a more lax open register. The flag of a vessel in itself should not affect the experience. However the constraints imposed by the OECD and other states encourage poorer quality fleets to use flags of convenience.

v) Management and Ownership

The structure of management and ownership of vessels can be extremely complex. The important factor for the underwriter to establish is who is responsible for maintaining the ship in an adequate state of repair.

Management is arguably more important than flag since many of the best ships are insured with flags of convenience for tax reasons but are maintained to very high standards. The difficulty with using management as a rating factor is that a lot of skill is required to differentiate one manager from another. To a certain extent management/ownership is the risk factor (i.e. what determines the amount of risk) while flag is a rating factor which can be a proxy for management. As ever there is the moral hazard and rating by management should mitigate that danger.

vi) Classification Society

Most vessels are entered with a Classification Society. The Classification Society carries out periodic surveys to verify that a ship is seaworthy. There has been much discussion over the last few years of whether the Classification Societies are effective in their role. Consequently this factor does not prove as successful as it could be in determining risk.

vii) Deductibles and other Conditions of Insurance

Clearly the precise conditions will influence the rate. Deductibles affect both the frequency and severity of claims. From an actuarial viewpoint deductibles can be easily handled once the claim distribution is known and the issue reduces to whether the distribution can be determined.

Conditions like the trading warranties discussed in 2.2.1 are important but are more difficult to rate properly.

The more minor rating factors are:

viii) Trading Pattern

Vessels trading a single route (e.g. shipping crude from the Gulf to Japan) with infrequent docking and sailing in well charted waters will have quite different experience from cruise ships which dock frequently and which generally sail in more remote areas which are scenically spectacular but less well charted. Much of this variation is captured within the vessel type. There will however be residual variation.

ix) Repair Costs

This will depend, to a large extent, on age and the type of machinery involved. In general older machinery will be harder (and consequently more costly) to repair with spare parts harder to obtain.

x) Special Features

Many vessels have special features. An example of this is ice-strengthening. The importance of this depends on where the vessel is trading.

xi) Area of Profile of Vessel

This is a measure of the area of the side of the vessel. Vessels, especially when unladen, present a very large surface area. This makes the vessel vulnerable to being blown off course by severe winds.

2.4 Rating Factors (Experience)

Section 2.3 has identified the major rating factors when attempting to exposure rate a policy. In particular for primary policies and policies with low deductibles there will generally be a large amount of recent and relevant experience. Even where the deductible is fairly high the experience of the fleet below the deductible (i.e. from ground up, 'FGU') may be available for rating.

2.5 Data Sources for Hull Rating

The following data sources are available for Marine risks.

2.5.1 List of Shipowners

This volume, published annually in September, contains a list of owners and managers of the ships recorded in the Lloyd's Register. It also lists former names and compound names of ships.

2.5.2 Maritime Guide

The Guide, published annually, has various sections, including lists of call signs, ports, docks, marine insurance companies, marine associations and shipbuilders (including the names of existing ships built by them).

2.5.3 Lloyd's Register of Class Yachts

The annual Register, published in April, contains details of yachts and periodical survey records.

2.5.4 Statistical Tables

An annual analysis of world Merchant shipping, divided into a number of tables by type, tonnage and age. Also recorded are totals of vessels lost and broken up in the past five years.

2.5.5 Lloyd's Maritime Atlas

An atlas with special emphasis on ports and world weather seasons.

2.5.6 Lloyd's Confidential Index

The index is published twice a year, in March and September. It shows an alphabetical list of world shipowners and each vessel owned/managed by them. Details of each vessels include former names, year of acquisition, type, country of build, year of build, gross, net and deadweight tonnage, Classification Society and flag. Also shown is the owner/manager's history with regard to total loss.

2.5.7 Lloyd's Shipping Index

Published daily, the Index records the movements and latest reports on all merchant vessels (except some trading in certain coastal areas). The detail given includes name of vessel, type, owner/manager, flag, gross, net and deadweight tonnage, year of build, ports of destination and departure, and any casualty data available.

2.5.8 Casualty Report Service

Subscribers to Lloyd's Casualty Report Service are advised daily of any occurrence likely to affect underwriters, and these advices are reproduced the following day in "Lloyd's List" and weekly in the "Weekly Casualty Reports". The Institute of London Underwriters compiles casualty statistics of vessels of at least 500 tons gross in addition to an Annual Report.

2.5.9 Lloyd's List

The daily newspaper produced by Lloyd's of London Press.

2.5.10 Lloyd's Loading List

This shows details of vessels currently available for loading, their destination etc., their type of capacity and a contact address. It is available weekly and/or monthly.

2.5.11 Lloyd's Voyage Records

Show details of a vessel's itinerary during recent months.

2.6 Problems with the Available Data

One may try to use both the external data described above and information from the company's own internal sources. However, the following are problems that will have to be addressed:

When using external data sources, one should try to match losses and exposure for each level of the various underwriting factors. This may be more difficult than it sounds, particularly when it comes to identifying the exposure in any individual year.

Public sources of information are unlikely to capture comprehensively losses below a certain threshold level. Therefore, it may be necessary to use other sources of information for small routine losses. This will be a greater problem with low deductible policies.

One will need to adjust the public sources of losses to exclude losses from perils not covered by the policy, such as war losses. This may be relatively easy.

In principle, an internal "Hull" database could have been constructed to provide the information that would be required for a rating exercise. However, practices in the Marine market have evolved historically to meet a variety of needs, but quite often the need to retain detailed statistical information was not the most urgent priority. A database, if it exists, is likely to require a significant amount of cleaning up. It would not be unusual, for example, for a number of risk factors not to have been recorded accurately or to be completely missing. On the claim side, outstanding claims below a certain threshold level may be missing and individual claim detail on historic payments may have been retained only in a summarised form.

So the first issue to be addressed is the degree of confidence in the accuracy of the underlying data. Appropriate margins will need to be loaded into the derived rates to allow for understatement of the historical experience (e.g. because "small claim" data is not comprehensive). In general terms very comprehensive current exposure data is available. The main difficulty with exposure data is obtaining historical data in a computer readable format. The loss data is much harder to obtain - in particular the insured loss amounts are generally not disclosed.

2.7 Exposure Rating

In an idealised world, an actuary may approach the problem of Hull rating from first principles. This will involve estimating the "relativities" that would be appropriate for different combinations of the risk factors outlined earlier in this section, as well as the overall expected risk premium for a given portfolio. Separate models will be needed for Total Loss Only covers and standard covers. There is an obvious similarity with other areas where actuaries have had significant involvement in the rating process. The temptation would be therefore to draw on that work and apply similar concepts and techniques to estimate the effects of each rating factor. The use of generalised linear models to "fit" simultaneously a variety of different factors, both continuous and categorical, is becoming widespread. In addition to being theoretically rigorous, the techniques are also very flexible. However, before getting carried away with fitting complicated models, one must remember the limitations of the data used for the rating analysis. In any case, it is unlikely that there will be sufficient volume of data to fit all but very simple models.

In addition to establishing relativities, it will be necessary to consider changes in secular trends which cannot be explicitly factored in the rating of an individual risk (e.g. changes in level of world trading activity). Such trends may have significant effect on both the frequency and severity of claims. This is perhaps also the place to consider general trends in factors that have been left out from the explicit model.

A more modest, but perhaps more practical, exercise would be to consider overall rate changes required given the projected results of the previous years, taking into account particularly changes in conditions and changes in deductibles. Then, starting from any existing relativities across broad groups of underwriting factors (categories or classes), rebalance the relativity structure to allow for the emerging experience. The steps in this process are set out below:

- ♦ Project losses to ultimate for earlier underwriting years.
- ♦ Allow for loss trend to restate losses to current level.
- ♦ Estimate amount of losses eliminated from changes in deductible. This at its simplest level can be a "what if" analysis to examine the amount of trended losses that would be eliminated if the current deductible was applied historically. At a more sophisticated and preferred level, one may fit a distribution to the losses and estimate the effect of deductible changes on loss elimination using the fitted distribution.
- ♦ Restate projected ultimate premium for past years to current levels, using historic rate changes.
- ♦ Estimate overall premium change required by estimating the overall "restated loss ratio".
- ♦ Investigate crudely any changes in rating between different categories required. This may be achieved by defining a number of broad categories (groups of underwriting factors) and investigating the current premium relativities (excluding experience discounts) between such categories, relative, say, to the overall average for all accounts. Then the projected historic premium restated at current levels for each category can be "standardised" by dividing the premium by the projected relativity factor. A new set of updated relativities can be calculated by dividing projected historic losses for each category by the standardised premium. Of course, one has to take care that the overall change produced is equal to the overall indicated rate change.

A potential problem with this approach is that it may be difficult to establish group relativities in the first place because rates are charged for various fleets in the aggregate and "good experience" credits are applied. It may be difficult to disentangle from the actual rates charged credit that has been given for good experience.

2.8 Experience Rating

The rates quoted for Hull risks are highly individualised to the circumstances of the particular risk. Inevitably the question of credit or penalty for worse than average experience for a particular fleet arises. In this area, the credibility approach outlined in Appendix 1 can be useful.

Given the particular method of placing Marine Hull insurance and the high degree of personal contact, perhaps an initial role for actuaries may be to help underwriters assess the overall effects of their pricing decisions across broad sections of their book. With some simple calculations, it may be possible to quantify the effects of what are vaguely referred to as the "market conditions". An early quantification of such effects may help avoid a repeat of some of the disastrous competition on pricing in the late 1980s and early 1990s.

3. Cargo and Specie

3.1 Introduction

This section covers Cargo and Specie insurance and reinsurance. It describes the way Cargo is written, the problems associated with aggregations of risk and rating issues, and provides an introduction to Specie business.

There are a number of issues in respect of a Cargo account that differ from other types of business, principally:

- ♦ The original period of exposure is uncertain but is usually very short, being the duration of a voyage,
- ♦ There is uncertainty as to the extent of aggregation of risks (see section 3.4).

3.2 Background

Cargo is defined as goods and/or property and/or merchandise carried by a vessel for the purpose of earning freight, freight being the technical term for the remuneration paid for such carriage.

The insurance of goods in transit is not compulsory in English law and it is surprising how much uninsured transit takes place. However, it is common prudence for a merchant to insure his goods to obtain financial recompense for loss of or damage to them whilst in transit. In fact when a merchant insures goods he has sold to an overseas buyer he includes the cost of insurance in the price of the goods so that he receives protection from financial loss for no outlay and passes on the protection to the buyer by assignment of the policy.

Cargo insurance indemnifies the policyholder against loss of goods or merchandise whilst being transferred from one place to another. Transit may be by any means, not just ship. It usually covers Cargo whilst on land also. Cargo insurance normally provides indemnity against loss of or damage to merchandise however caused but subject to certain named exclusions. In addition coverage is granted for general average losses and may be granted for sundry peripheral coverages such as rejection, deterioration, or consequential loss. Damage to Cargo directly caused by processing is normally excluded. Cargo insurance usually attaches from the time goods leave the warehouse or place of storage, continues during the ordinary course of transit and terminates on the earlier of delivery to the final destination or the expiry of 60 days after discharge at the final port or any other point where the ordinary course of transit is interrupted.

3.3 Cover

In the United Kingdom, Cargo is written as a sub-branch of the United Kingdom business as Inland Marine, i.e. covers goods in transit, or may be written internationally through the ILU or Lloyd's.

Cargo insurance is written on a facultative or open cover basis.

3.3.1 Facultative

Facultative business issued on slips has the following information:

- ◆ Type or nature of risk.
- ◆ Form - type of policy.
- ◆ Name of insured or reinsured.
- ◆ Conveyance - nature and carrying vessel. The carrying vessel may be approved or held covered, (approved means that the assured must notify the insurer as soon as he is aware of the name of the vessel, the insurer reserving the right not to insure, but in practice normally accepting, without additional premium, if within the required classification and age tolerance; where held covered, approval need not be sought, the insurer cannot refuse to cover the goods so carried, but the insured may be required to pay an additional premium when the risk is closed).
- ◆ Period or voyage. This defines where transit commences and terminates. Any extension, such as warehousing, also needs to be shown.
- ◆ Interest. The quantity and description of goods.
- ◆ Sum insured.
- ◆ Conditions of insurance.
- ◆ Premium rate expressed as a percentage or fixed amount.
- ◆ Any additional information.
- ◆ Brokerage, taxes etc.

3.3.2 Open Covers

To aid in the placing of standard risks and to avoid the necessity of renegotiating before each voyage, a number of types of policy have been devised:

- i) **Floating Policy.** The policy is for a fixed amount to cover several shipments the details of which are delivered at a later date. There is no time limit but it is usually subject to a cancellation clause. The policy remains in force until the sum insured is exhausted unless cancelled by either party giving the requisite notice of cancellation. All declarations coming within the scope of the policy must be accepted by the insurer, and, equally, the insured must declare all shipments as they go forward. The premium is on a deposit basis and is adjusted to the correct premium when the policy expires. The main

problem with the floating policy is that cover expires suddenly with the exhaustion of the sum insured.

- ii) **Open Cover.** This has largely replaced the floating policy. The insurer guarantees to accept risks when they are put forward by the insured during the period of the contract. The insured agrees to declare every item that falls within the scope of the cover. The open cover is an obligatory contract binding both parties to its terms, rates and conditions. Either party may cancel the contract at any time, subject to the notice of cancellation terms in the policy. A Cargo open cover has no aggregate limit regarding sums insured but always has a limit for each declaration e.g. per any one sending, any one vessel or any other limit as agreed.
- iii) **Binding Authority (or Binder).** This usually takes the form of a slip open cover and is indistinguishable from other types of open cover except for two major factors:
 - ♦ The cover is in the name of the broker (or other agent) rather than any particular client of the broker
 - ♦ The cover has a much wider scope in that it is designed to allow the broker to accept a wide range of business.

The binding authority indicates considerable trust between the underwriter and broker.

3.3.3 Reinsurance Treaties

Treaties normally cover all insurances written by a ceding company in its Cargo account, for specified types of goods and specie and methods of transportation. Besides sendings by sea, they may cover international consignments overland, and sendings by post or air. Exclusions will apply as the reinsurer may wish to exercise some control over liabilities accepted under automatic treaties, particularly Excess of Loss, and a separate limit per location may be imposed for proportional treaties.

As Cargo original insurances are arranged on a voyage basis and as an insurer will be interested in many consignments, a large number of which will overlap two underwriting years, excess of loss treaties are normally arranged on a losses occurring basis. Treaty losses normally apply to any one event or occurrence although some working covers are effected on an any one vessel basis. Neither method has a clear advantage as everything depends on the particular circumstances of losses and the treaty limits. Whichever method is used, considerable thought must be given by the cedant to the treaty limits and to the aggregation of net retained losses.

3.4 Aggregation of Risk

Special considerations apply to the management and aggregation of risk. There are a number of aggregation problems in respect of Cargo, as follows:

- i) **An aggregation on a specific vessel.** Although vessels are declared on a facultative basis, the information on the open cover may not be available to assess complete aggregation. The authority to use a vessel of specific classification will not help.
- ii) **Stock Throughput** is cover provided for storage in warehouses etc. and a considerable amount of exposure may aggregate in any one warehouse. The underwriter is not aware of the amounts of such aggregation until a loss occurs although throughput risks may specify major locations.
- iii) **Large Exposures.** For Specie (see below) insurers have been known to underestimate the potential risk of robberies.

3.5 War Risks

War risks cover for Cargo is normally provided by the extension of original policies and is normally included in Cargo treaties. Cargo reinsurance contracts and treaties are covered by the Paramount War Clause. The object of the clause is to limit cover to terms and conditions no wider than the relevant London Institute war clauses. The basic requirement is for cedants to apply to original insurances the limitations of the United Kingdom Waterborne Agreement of 1976 which essentially restricts war risk cover to goods whilst on board vessels, with a time limitation after arrival at the port of destination.

The acceptance of war risks is at all times subject to seven days' notice of cancellation by either party.

3.5.1 War Risk Rating

For guidance of the market on war risk rating the War Risks Rating Committee publishes a set of rates for use in the market. The scale is compulsory in the London market for all voyages other than those within the Western hemisphere, for which the scale is advisory. The rates vary from time to time as world circumstances change.

3.6 Rating of Cargo

Cargo rates are dependent on a very large number of factors. For a voyage, knowing the starting point and destination are only part of the picture. Other factors are:

- ◆ route to be taken (dangerous seas, proximity to war-zones, etc.),
- ◆ alternative routes may be used to get from A to B,
- ◆ type(s) of transporter,
- ◆ nature of goods (food, animals, manufactured goods, etc.),
- ◆ age and condition of ship,
- ◆ makeup of crew (in particular: nationality),
- ◆ length of journey,
- ◆ value of goods,
- ◆ time of year / weather conditions,
- ◆ reputation of ship-owners and managers,
- ◆ insured's record,
- ◆ packing.

Taking account of the number of factors involved it may be considered that actuarial assistance on rating is impractical. The underwriter's experience and knowledge of the principal factors involved may be considered to be the best guide to whether rating is adequate. However, actuarial assistance could be of use in establishing statistics based on the factors that are available, and in requesting other more relevant factors, in order to provide a sound background to the underwriter's decision making process.

For Excess of Loss treaties, the reinsurer could attempt to estimate his exposure by calculating the cedant's aggregate liability according to the main trading routes covered by its portfolio of business and possible accumulations ashore. For example, most of the consignments insured by a local company may pass through a small number of ports. The reinsurer could calculate the premium rate to be applied to the cedant's OGNPI (Original Gross Net Premium Income) to produce the premium for a working cover. The rate would have to take account of accumulations ashore.

When dealing with large companies writing Cargo business world-wide such a procedure is impractical. In practice burning cost methods are commonly used, with five-year averages being used for working covers and ten-year averages for catastrophe layers, with 100/70 being a common factor applied for expenses and profit. Swing-rated plans are also used, i.e. with the rate charged being subject to a minimum and a maximum rate.

3.7 Recent Experience

Recent experience on Cargo and Specie classes has presented some poor results which have been due to:

- ◆ Over-capacity in the London market.
- ◆ Competition from overseas markets.
- ◆ Ease of entering into the market.

- ♦ Low levels of rating.
- ♦ Extraordinary number of losses.
- ♦ Poor standards of underwriting.
- ♦ Under-estimation of losses from past writings.

More recently rates and conditions have improved considerably.

3.8 Specie

Specie is used as a collective term to embrace all forms of valuables, supposedly carried as cargo but also more broadly defined than this as can be seen from some of the areas covered as shown below. All relevant perils are covered. Specie has traditionally been placed in the Marine market for two main reasons:

- i) Greater capacity in the Marine market than in Non-marine.
- ii) Non-marine market unwilling to be involved with the transit element.

The following are some of the areas that are covered under Specie:

Jewellers' Block:

Jewellery and stones.
 Manufacturers, wholesalers, retailers.
 Stock on premises.
 Local transits by personal conveyance.
 Entrustment of stock to third parties.
 World-wide sendings of stock.

Fine Art:

Paintings, sculptures, ceramics, objets d'art.
 Museum risks.
 Exhibitions including transits.
 Galleries.
 Personal collections.
 Auctioneers.
 Transit risks.

Armoured Car:

Cash, securities, items of value.
 Risk in vault at premises.
 Premises risk while being counted or sorted.
 Risk while in armoured car.
 Pavement risk.

Vault:

Cash, securities, diamonds, invaluable items.
Storage in bank vaults.
Purpose built vault centres.
No risk outside vault.

Bank:

Cash and securities.
Storage in vault.
Armoured car exposure for transits between premises.
Premises risk while out of vault.

Stock Brokers:

Documents.
Certificates/ Bearer Bonds.

3.8.1 Specie - Rating

Rating of Specie could be amenable to actuarial assistance. Details should be available on exposures and on frequency and severity of losses for several of the areas listed above, in particular statistics should be obtainable on vault losses, armoured car losses etc.

Rating and risk factors applicable to Specie vary considerably but common ones are:

- ♦ Turnover (e.g. for jewellers, galleries, exhibitions).
- ♦ Sum insured (e.g. for vaults, banks).
- ♦ Exposure (jewellers).
- ♦ Values carried (Armoured car).
- ♦ Security.
- ♦ Local crime conditions.
- ♦ Nature of risk.

3.8.2 Loss of Specie

For the record, Specie has another completely different definition within Marine Insurance. Loss of Specie occurs where an insured property is so damaged that it ceases to be a thing of the kind insured, i.e. it changes its specie.

4. Liability

4.1 Introduction

Section 4.2 provides a brief description of the market for Marine Liability insurance - essentially the Protection and Indemnity Associations (P&I Clubs) and the specialist Companies providing similar cover.

Problems afflicting this market are discussed in section 4.3, together with some ideas as to how these problems can be alleviated by actuaries working together with underwriters and company managers.

Coverage and rating factors are described in sections 4.4 and 4.5.

Section 4.6 and Appendix 1 set out a broad model of an actuarial approach to evaluating and modelling risk. Much of this is based on the experience of fellow actuaries and statisticians in the field of Motor Insurance. We make no apologies for this - there are many features of Marine Liability cover that are directly comparable to Motor, and we believe that the techniques developed over many years to model Motor can be applied with much success to this business. The Appendix has simple numerical examples which illustrate the methods being proposed.

Section 4.7 covers reinsurance aspects.

4.2 Brief Outline of Market

Marine Liability insurance is provided for shipowners and/or charterers through proprietary insurance companies, Lloyd's syndicates and mutual associations (the P&I Clubs).

In general, the larger risks or groups of risks will tend to be insured through the P&I Clubs, and the smaller risks, for example US Brown Water (barge) business or smaller vessels requiring limited liability cover or cover on a fixed premium basis, tend to be insured by the company/Lloyd's market.

The total market is of the order of \$2 billion premium per annum (including supplementary Calls), and of this the P&I Clubs account for the vast majority (probably well in excess of 90%).

4.2.1 P&I Clubs

A full description of the Clubs appeared in Smith (1991), and there is little to be gained by repeating its contents here. The salient points are:

There are 20 or so P & I Clubs, of which 15 are members of the International Group.

The International Group Clubs are mutuals, being entirely owned by their shipowning members. They are usually governed by elected Boards of the shipowners, although the day to day management is ceded to the Clubs' Managers, who may be an independent agency (as in the case of Thomas Miller & Co and the United Kingdom Association) or a wholly owned subsidiary of the Club itself (as in the case of the West of England Association).

Shipowners or charterers "enter" their ships with specific Clubs. Fleets may be split amongst various Clubs and occasionally more complicated arrangements may exist where individual vessels may be split between Clubs, or inter-club reinsurances may have been written to share fleet risks.

Premium is paid on the basis of an "Advance Call", which, typically, may be projected by the Club to be, say, 75% of the expected total Call. Supplementary Calls are made at various stages so that when the Policy Year is closed (usually three years after its start) the Club can reasonably expect to cover its projected ultimate net losses with its Call and investment income. Members seeking to leave the Club before the year is closed can usually expect to pay a "Release Call", which would normally be set at the Club's highest level of probable future Calls on that year.

The Clubs in the International Group operate a Claims Pooling agreement by which large claims are shared between them on an equitable basis derived from their entered tonnages, called premium and aggregate claims experience over some twenty years. Currently (1994/95), each Club retains the first \$4 million of each loss, and the next \$26 million is pooled. Above the Pool, the Clubs are all joint parties to what is probably the largest single reinsurance contract placed in the London Market, worth some \$400 million annually in premium. This Excess of Loss contract protects the Clubs for all losses (without any payment of reinstatement premiums) up to \$1,150 million. Any loss beyond that limit would revert to the Group Clubs. Oil Pollution losses are limited by the Clubs to \$500 million per loss, but for the time-being at least, all other losses are covered without limit of liability.

There has been considerable debate within the International Group in recent years on this issue, with some Clubs arguing strongly that the time has come to limit liability and others arguing that as the risk of an overspill claim is statistically small, the loss of market differentiation that would be caused by the Clubs limiting liability outweighs the benefits. This latter argument tends to be based on the premise that as there has never been an overspill claim, so therefore the risk of one is small. This, of course, makes no attempt to evaluate the risk from an exposure point of view, and the reader can draw his own conclusions as to its validity!

4.2.2 The Company/Lloyd's Marine Liability Market

The major difference between insurance companies / Lloyd's syndicates and P&I Clubs is that with the former, the premium is fixed and there is a limit to the liability. Some contracts may have adjustable premiums with the adjustment depending on claims experience, but the total premium will be limited and the minimum and maximum fixed at the outset of the contract. Premiums may also be adjustable for changes in exposure over the term of the contract. As companies are not mutuals, there is limited liability in the event of insolvency.

Insurance companies may cover smaller organisations than the P&I Clubs and risks will not necessarily renew on 20th February (the date on which the Baltic thaws and therefore traditionally the day most P&I risks renew).

There is less control of the cover by the insured - the chain may be as follows:

Insured

Broker

London Broker

Insurance Company

This chain also applies for claims handling, so there may be delays in receiving payment.

This compares with the (usually) much shorter P&I Club chain, where the insured will tend to deal directly with the Club or through a Marine broker.

In London the fixed premium P&I market is dominated by a very small number of companies. US carriers also write this business.

Liability insurance is written by most Marine insurers. Liability cover forms part of most Energy packages.

Reinsurance is purchased individually by each company.

4.3 Market Problems and Possible Actuarial Solutions

It is possible to identify a number of problems that have afflicted the Marine Liability market in recent years. Many of these problems, we believe, can be alleviated by the introduction of actuarial methods to assist managers in their decision making. Some of these problems are described below.

4.3.1 Changing Climate (Environmental Considerations)

In common with many classes of insurance, recent changes in attitudes to environmental damage (particularly in the US) have had a dramatic effect on claims costs. This manifests itself in two ways:

- ♦ There may be sudden and previously unanticipated deteriorations on what were previously considered to be dormant policy years. Many Clubs are beginning to experience asbestosis claims dating back decades. At present, these claims in general are confined to legal fees, but this situation may change.
- ♦ Current claims are experiencing cost inflation way in excess of the published governmental indices.

Traditional reserving methods quite clearly cannot cope with these problems, and the use of modern actuarial techniques to arrive at proper reserves will become essential. There have not been any failures amongst the International Group Clubs, and only one has ceased underwriting. There is an increasing awareness among the Clubs' managers that empirical approaches to the reserving question are no longer sufficient and the obvious consequence of that awareness is that more of them will seek professional guidance.

4.3.2 Year-to-year Volatility of Risks

As the potential size of losses has increased in recent years, there has been a parallel development in that the risk retained by the individual Clubs has also risen sharply. The following table illustrates this point:

Policy Year	Club Retention \$m	Int. Group Retention \$m
1984/85	1.0	8
1985/86 to 1989/90	1.2	12
1990/91	1.6	12
1991/92	1.6	12
1992/93	2.0	15
1993/94	3.0	25
1994/95	4.0	30

These figures are illustrated in *Graph 1*.

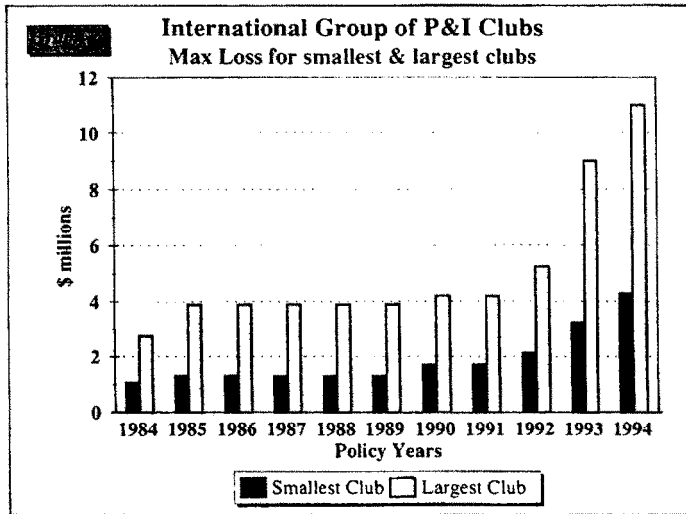
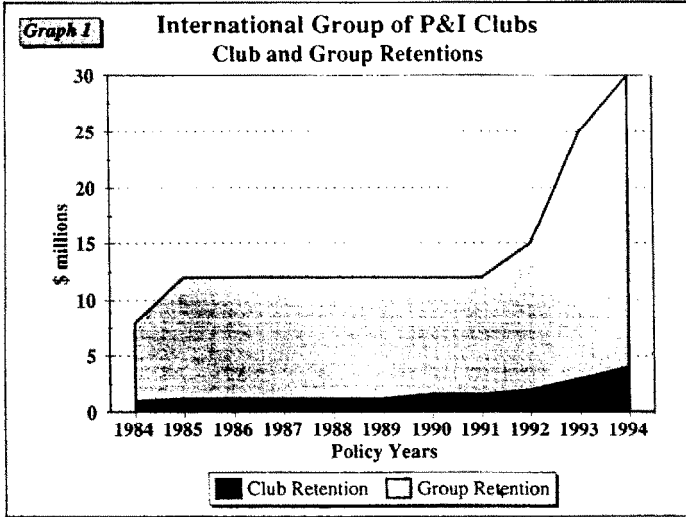
With Club contributions varying from 1% to 25% of the Pooled element, this means that for the smallest Clubs, the largest possible loss (ignoring the possibility of an overspill claim going right through the reinsurance protections) has increased from \$1.07m in 1984 to approximately \$4.3m in 1994 and for the largest Club, the change is from \$2.75m (1984) to \$11m (1994). (These calculations are approximate, and allow for the 20% loading on a Club's contribution in the top \$10m layer of the Pool in 1994.)

This point is illustrated in *Graph 2*.

This underlines the increasing difficulties that Clubs have in assessing their maximum likely losses, and the ever more important need to protect themselves with appropriate reinsurance programmes that reduce those losses. There is a clear rôle for the actuary in advising managers in assessing the need for such programmes and in evaluating the various schemes and proposals that emerge from reinsurance brokers. What is not so clear is the extent to which traditional underwriters and their management colleagues accept that rôle.

4.3.3 Excessive Additional Calls

These can be caused by poor initial projections of expected ultimate losses. The use of actuarial projection techniques by the Clubs on their prior years accumulated losses would help them achieve a better understanding of their likely future losses. A related problem exists where Clubs have been over-optimistic in setting final Calls when closing a year. Clubs have been forced either to fund losses from reserves or



to load additional Calls in order to restore equilibrium. A better understanding of the year to be closed would reduce the likelihood of such measures being necessary.

4.3.4 Poor Underwriting Results for Individual Fleets

Most P&I rating consists of a flat rate per ton across the entire fleet (or maybe, in some cases, a group of broadly similar vessels). The rate charged may be based loosely on the member's record over a number of years, but is often arrived at by essentially "broad brush" methods. New business, not previously entered with a P&I Club, will often be underwritten using largely empirical methods and underwriting skill. However, the Clubs collect a vast amount of data about the risks they underwrite and it is clear that statistical models of the kind familiar in other classes of insurance could be developed to assist underwriters in exercising their judgement. One should not suggest a rigid "rate book" approach, as that is clearly not appropriate in a business where large premiums are negotiated at very senior levels in the shipping companies concerned. But that does not mean that underwriters going into negotiations should not be armed with a full statistical analysis of past and expected future losses. Some Clubs have started down this path, and are exploring the development of statistical rating models, and also other forms of macro-economic modelling. The actuary can assist underwriters greatly in their rating, but there is a clear need for the actuary to "sell" the benefits to a potentially sceptical audience.

Appendix 1 describes in some detail how statistical methods can be applied to underwriting data to arrive at such a model.

4.3.5 Expenses

P&I Clubs vary significantly in the way in which they actually handle claims. Some employ fewer staff and sub-contract more of the claims handling to specialist law firms. Others employ a large staff of professionally qualified claims correspondents whose job it is both to handle claims in-house and also to offer an advice service to the Clubs' members. However, even the latter type of Club will frequently instruct outside lawyers, particularly in US cases or complicated injury or pollution claims. This leads to discrepancies in the way in which loss adjustment expenses are accounted for - the in-house claim will frequently not include any allowance for costs, which are absorbed in the general management expenses, while the externally handled claim will carry an explicit cost element. This makes comparisons both between and within Clubs difficult, and there is also the issue that arises if a Club has at any time changed its handling policy - traditional claims projection methods will deliver a false result. A further issue arises in regard to expenses and their allocation to members when discussing rating. The traditional methods of spreading all management costs equally between policyholders are increasingly seen to be unfair, and the adoption of actuarial methods of apportioning these costs across the policyholder base more equitably must surely come. As with the adoption of

statistical rating methodologies, the Clubs that lead the way will reap the benefits, leaving the others in danger of antiselection.

4.3.6 Poor Management Information

Like many organisations, the Clubs collect a vast wealth of information into their computer systems, and then have had difficulty in putting it to good use. Some are experimenting with management and/or executive information systems, and this is an area where the actuary's experience with data manipulation can be put to excellent use in the design of effective management reporting systems. There are a number of issues here, but among the most important are:

- ♦ *Effective management requires the routine production of short, pithy management reports that are timely and accurate. Such reports, possibly accompanied by graphics, should enable the recipient to draw a rapid view of the current state of the organisation. The actuary's rôle should be to assist in the design of these reports, drawing on his experience and knowledge of key indicators of financial well-being.*
- ♦ *There also need to be in place systems that allow the actuary and others direct access to corporate data, so that they can quickly generate ad hoc analyses, without the need to learn complex programming languages, and also without interfering with the normal day-to-day running of the corporate systems. This last point is important, because such ad hoc analyses often require access to large data volumes, and poorly designed systems (maybe sharing data or processors with "on line" systems) can be unusable for such purposes. Again, the experienced actuary will have much to offer in the design of these analytical tools.*

At the core of this discussion is the simple truth that all too often, what is collected is data. By itself, that data is of very little use. For any insurer, it has been said that data is the life blood of the organisation. However, unless the data is converted into useful information, no good will come of having it. Good management information means that executives are able to get at the core of their business without having to wade through vast amounts of meaningless numbers.

4.4 Coverage

The coverage offered by Marine Liability policies, generally consists of the following main risks:

- ♦ *Employer's Liability type cover for crew members or other employees.*
- ♦ *Liability to third parties for injury or property damage.*

Individual policies will have different limits and deductibles (noting that in the Marine market, a deductible is indeed deducted from the limit) both for each occurrence and overall annual aggregates. In addition, policy conditions may be worded slightly differently around the world. Notwithstanding these differences, a statistical approach to rating can be used and combined with the experience of an individual risk to produce a premium.

4.4.1 "Wrap up" Liabilities

This is not traditional Marine business, although it is often written in Marine accounts. The cover is an Owner Controlled Insurance Programme (OCIP) which is purchased by the owner of land when he employs a contractor to build on his land. The contractor will employ subcontractors, giving the land owner exposure to his liability to them when on his land and also to third party liabilities. There is also products exposure from the finished building. The subcontractors will also have liabilities to the owner, for example for faulty work, for which they may have difficulty in buying cover to a large enough extent. To avoid inadequate cover with less sound insurers, the owner will arrange cover for all Liability risks for the whole project - "Wrap Up" cover. The term of the cover is for the term of the contract with usually two years completed operations cover and a two-year discovery clause. Cover is given on an occurrence basis.

4.4.2 Environmental Impairment Liability (EIL)

Standard clauses give cover for sudden and accidental pollution events.

The US Oil Pollution Act 1990 (OPA 90) and its implementation by the US Coast Guard will require vessels operating in US waters to carry Certificates of Financial Responsibility (COFRS), which are a binding undertaking by their insurers to provide cover up to \$1,200 per ton insured for oil pollution risks plus a further \$300 per ton for land-based oil pollution and/or hazardous substances risks. P&I Clubs have refused to issue COFRS as they feel that such binding undertakings, which would be enforceable irrespective of whether the insured had breached Club Rules or otherwise prejudiced his cover, are inappropriate for an insurer which provides cover on an indemnity basis and undesirable from the viewpoint of those Club members who do not trade in US waters, but whose Calls would be used to meet claims arising out of the use of these certificates. In an attempt to fill the gap, it is understood that a Mutual or Mutuals are being set up in Bermuda (one such is to be called Shoreline), which it is believed intend to provide COFRS together with pollution cover of up to \$300 million to meet all US Federal and State liabilities. It has been suggested that conventional P&I cover might operate above this level, but there are likely to be difficult issues to be resolved if the Clubs, traditionally primary insurers, are to become Excess of Loss underwriters.

4.4.3 D&O and E&O

This would generally be excluded under Marine Liability policy coverage although this has been written in the past by Marine insurers on Non-marine policies. The cover would need to be purchased from a specialist insurer. Any further comments are outside the scope of this paper.

4.4.4 Freight, Demurrage and Defence (FD&D)

A number of Clubs (as well as specialist insurers) offer an additional class of cover offering shipowners protections against the cost of defending legal actions in cases where normal P&I cover does not operate. These might include claims for compensation where the vessel has been delayed or has deviated from its route, but where the delay or deviation is not covered for in the standard terms of entry with the Club. Other examples may include claims against the shipowner arising out of contractual disputes, matters concerning freight, detention, salvage, or indeed anything that the Club considers admissible under this cover. One unusual characteristic of this cover is that the Club will frequently have the explicit right to decide whether or not to support the member in the pursuit of his claim and having done so, can then make the decision to cease supporting him, or to set a limit to the support.

4.4.5 Other Classes of Cover

Many P&I Clubs offer additional cover to their members for losses arising out of Port or crew strikes, and there is also a separate Strikes Club offering similar cover. War Risks cover is also often available. Finally, the Through Transport (TT) Club offers insurance facilities to cargo transport operators in respect of their equipment and liabilities wherever the cargo may be on its journey - that is on land or at sea.

4.5 Exposure Measures and Rating Factors

Risk	P & I Risks
Exposure	Number of crew per year (for Employer's Liability type risks). Tonnage (for traditional P & I).
Rating Factors	Area of Operation (Country/State), Vessel Type, Blue or Brown Water, GRT (Gross Registered Tonnage), Nationalities of Crew, Safety procedures, Deductible, Limit, Age of Vessel, Flag, Classification Society.

Risk	General Liability (Ship Repairers, etc.)
Exposure	Turnover.
Rating Factors	Types of Operation, Areas of Operation, Occupancy Rate of Berths, Goods Stored, Number of vessels in yard, Deductible, Limit.

4.6 Rating Assessment

4.6.1 An Actuarial Approach

The underlying premise is that Marine Liability risks are similar in many ways to personal lines risks such as motor or household, in particular motor. In many cases small risks are covered which may be one vessel or one small repair yard. This is analogous to a private motor policy. Other risks may be large fleets of many vessels. These are analogous to motor fleets. This is described in detail in Appendix 1.

This is really the start of the negotiation process. In practice, the underwriter and actuary could work together to structure a contract and negotiate the premium. The combination of negotiation skills and statistical expertise should be formidable. Below, we outline a suggested procedure for rating of risks.

- ◆ Broker provides details of risk to underwriter,
- ◆ underwriter passes information to the actuary,
- ◆ actuary analyses the risk and provides a report to the underwriter,
- ◆ the report is discussed with particular attention paid to major areas of uncertainty,
- ◆ the underwriter and actuary decide on whether to quote and at what price and on what terms.

Negotiations with the client take place based on the discussions above.

4.6.2 Risk Information

- ◆ Name.
- ◆ Policy number (if already written).
- ◆ Inception date.
- ◆ Exposure - changes over time.
- ◆ Rating factors - changes over time.
- ◆ Historical data for the risk on claims - both paid and outstanding - preferably over several years.

4.6.3 Contents of Actuarial Report

- ◆ Summary of risk.
- ◆ Comment on data quality and correspondence with in-house data.
- ◆ Comment on changes in the major rating factors and exposure.
- ◆ Projection of past claims to ultimate (with description of method and assumptions).
- ◆ Statistics - frequency of claims, average size with standard deviation.
- ◆ Premium or loss ratio of proposed premium suggested by this review, with description of method used and assumptions.
- ◆ Sensitivity of results.

4.7 Reinsurance

The present arrangements in place for the International Group P & I Clubs are described in section 4.2.1. Several Clubs also individually purchase other reinsurance contracts - Stop Loss, Excess Of Loss below the pooling layers and so on. Arrangements have also existed where larger Clubs partially reinsure the business of smaller Clubs, as well as non-International Group Clubs.

5. Energy

5.1 Introduction

This section describes Marine Energy insurance, which is the insurance of the offshore risks of the oil and gas industries. This may sometimes be described as Rig or Drill.

A brief outline of coverages is given, as well as the approach to rating. An overview is included of some areas which are of particular importance to this class of business - risk management, catastrophe exposures and reinsurance. Some particular current issues are outlined.

5.2 Background

Energy insurance is bought by oil and gas companies engaged in one or more of the following areas:

- ♦ prospecting,
- ♦ developing fields,
- ♦ constructing rigs and equipment,
- ♦ production,
- ♦ delivering oil and gas and
- ♦ refining,

and by those companies providing specialist ancillary services to these companies.

It is provided by the London Market, US major carriers centred on Houston and New Orleans, Scandinavia and France.

In addition, an industry mutual, Oil Insurance Ltd (O.I.L.), has been set up in Bermuda. O.I.L. gives property damage, control of well, seepage and pollution coverage. Oil Casualty Insurance Ltd. (O.C.I.L.) provides Liability coverage. In addition, the various oil majors have their own off-shore captives. Until recently O.I.L. purchased reinsurance from the London Market.

In the past it was common for some onshore risks - in particular petrochemical refineries - to be included in this class. This is less common now as Marine insurers choose to concentrate on pure Marine risks, and reinsurers increasingly impose Non-Marine exclusions in the cover they offer. Risks including onshore coverages continue to be written by composite Non-Marine / Marine insurers, e.g. composite Lloyd's syndicates.

One major feature of this class is the large size of individual risks. A single platform can be worth hundreds of millions of dollars. Insureds often have only a percentage interest in a platform or group of platforms, and wish to insure their interest. It is important that the aggregation of different insureds' interests in the same platform is kept under control (see further section 5.6 below). Few insurers would wish (or have the capacity) to insure individual risks of this size, so most risks are shared round the market with the rating being carried out by the leader.

5.3 Coverage provided

Cover is usually divided into broad categories or sections which may be as follows:

i) **Property Damage (PD)**

Exploration:	Mobile drilling rigs (including semi-submersibles, jack-ups, drill ships, drill barges),
Production:	Platforms. Sub-sea systems (these collect the oil/gas from several wells for onward transmission via flowlines to a central gathering platform). Pipelines and Flowlines Terminals (e.g. Sullom Voe). Crude oil in store. Installation risks. Storage vessels.

ii) **Removal of Wreck or debris (ROW)**

Sue and labour (i.e. the costs to avoid or mitigate losses)

iii) **Control of Well (OEE)**

i.e. when a well goes out of control; normally because of an unintended flow
- this coverage is known as Operators Extra Expenses (OEE)

Cost of (bringing well back under) control.
Clean up, containment, and third party seepage,
and pollution liability resulting from the
blowout.
Redrilling expenses.
Evacuation expenses.

- iv) **Business interruption and loss of production**
- v) **War, Strikes, Political and Terrorist risks**
- vi) **Increased cost of production**
- vii) **Cargo and Equipment**
- viii) **Liabilities**

Cover is usually subject to numerous terms, clauses and conditions which are laid out in the policy wording agreed by the lead underwriter. The London Market has been prepared to produce coverages to cater for individual client needs.

5.3.1 Exclusions / Inclusions

In specific instances reference should be made to the terms of each policy.

Generally, war coverage is excluded for fixed platforms but included for mobile units, terrorism cover tends to be excluded on the basic policy, but written by underwriters as an endorsement. Pollution cover is generally given for temporarily sudden and accidental losses, but gradual losses are excluded.

In the event of a total loss, the insurer will generally pay the entire loss if the policy has a deductible, analogous to Hull total loss cover; but only that part above the excess point if the policy is excess of a self-insured amount. Generally larger insureds will have a self-insured excess.

5.4 Rating

5.4.1 Property Damage / Removal of Wreck coverages

i) Data

Data is limited and frequently not in a form which can easily be of use to construct rates. Some insurance industry bodies (e.g. International Union Marine Insurers - IUMI) produce lists of major losses and comment on these but detailed market wide claims information related to exposures seems to be rare.

Most insurers seem to rely on their own internal data and the experience of their underwriters. The Energy insurance market is small and incestuous with underwriters frequently moving to and from companies and Lloyd's, so knowledge of rating practices and results is spread around the market. In addition since risks in this market are spread among many insurers most large insurers have some involvement in the major market losses.

There are limitations on internal data too. Few insurers appear to record detailed exposure information or claims information in an easily analysable form, however catastrophe exposures and aggregations are often monitored closely: see section 5.6 below.

Even if this were available, care would have to be taken in applying the results of past experience to current exposures since technological changes and different environmental conditions as new areas are explored can invalidate the use of historic results.

ii) Methodology

Cover is usually subject to a substantial excess and/or placed in layers.

The amounts insured in each section are listed on a schedule. They are ranked in order of probability of loss (for example, it would be unusual to incur Control of Well costs without Property Damage costs, but common to have Property Damage costs without Control of Well costs). The excess is applied to each section in turn in order of probability of loss until it is exhausted. This then leaves a schedule of amounts insured above the excess level. This is rated down in line with the insured's interest in the risk. Rates are applied to the insured's interest in the amount insured in each section, and the total premium calculated.

If the platforms insured are fairly close to each other, it is possible that a loss event could involve several platforms. In this case an additional premium is payable, calculated by applying the excess to the total insured amounts from all platforms, and subtracting the insured amounts already charged for in the individual calculations. A simple example is shown below.

Suppose an insured has a 10% interest in three platforms in one field, and is buying insurance with a \$7m excess. The exposure is twofold: firstly, to events (for example, blowouts) which would normally only impact one platform, and secondly, to events which may cause losses to all three platforms simultaneously (for example, weather related losses). The rating methodology reflects this:

Suppose the coverages given are Property Damage, Removal of Wreck and Control of Well, and the exposures (100% insured interests) are:

	Exposure			Excess	Exposure above excess		
	P.D.	Removal of Wreck	Control of Well		P.D.	Removal of Wreck	Control of Well
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Platform							
A	10,000	2,500	1,500	7,000	3,000	2,500	1,500
B	5,000	1,250	1,500	7,000	0	0	750
G	2,500	500	1,500	7,000	0	0	0
Total	17,500	4,250	4,500	7,000	10,500	4,250	4,500
Total excluding individually rated:					7,500	1,750	2,250

Note: the deductible is applied to each section in turn in order of probability of loss until it is exhausted.

Next the insured's interest is calculated:

	Insured interest above Excess			Rates			Total Prem
	P.D.	Removal of Wreck	Control of Well	P.D.	Removal of Wreck	Control of Well	
	\$'000	\$'000	\$'000	%	%	%	\$'000
Platform							
A	300	250	150	2 %	1.5 %	1 %	11.25
B	0	0	75	2 %	1.5 %	1 %	0.75
G	0	0	0	2 %	1.5 %	1 %	0.00
Accum- ulated	750	175	225	.5 %	.25 %	.25 %	4.75
Total Premium							16.75

Note: a different rate is applied to the accumulated exposure, reflecting the different perils to which it is exposed.

Rates are applied to the sums insured in each section of cover. Rates depend on the cover given and particular features of each risk. However, the price eventually charged is heavily influenced by the prevailing insurance market conditions. When capacity is limited, following the withdrawal of insurers from the market, prices may be much higher than calculated rates.

The rates for each section of cover will depend on numerous factors which will usually include:

- ♦ Sums insured.
- ♦ Excess point / deductible.
- ♦ Geographical zone (climate and environment).
- ♦ Depth of water.
- ♦ Quality of seabed.
- ♦ Level of maintenance.
- ♦ Record of operator.
- ♦ Terms and conditions of policy.

5.4.2

In addition factors applying to different sections may be:

Platforms:	Function (e.g. well head, treatment, accommodation or multipurpose). Type of construction. Exploratory / in production / shut. Pressure and Temperature of well head. Age.
Pipelines:	Rigid or flexible. Diameter. Age. Trenched / untrenched.
Control of well :	Depth of drilling. Exploratory / in production / shut. Land or Sea. Nature of product. Pressure and Temperature of well head. Geographic area. Original cost of drilling well.

**Construction
risks:**

Type of construction
Method of construction or of laying pipelines.
Record and experience of
contractor(s) being employed.

5.4.3 Improvements

Improvements could be made if more data were recorded in an accessible and analysable form, so that the base rates applied to each section of cover and loading applied for the various rating factors could be compared more easily to actual experience. In addition some use of the underlying economic variables, such as the price of oil might be brought into consideration when setting rates.

5.4.4 Liabilities

Typically for well operators the rating factors comprise:

- ♦ the number of and status of each well (under development, producing, non-producing).
- ♦ the operator's percentage interest in each well / field.
- ♦ the location of each well and in particular whether it is on or off shore.

Exposure units and rating variables for those providing services mirror those used for other commercial liability lines, typically payroll / number of employees or turnover, with different rates being applied for different types of service providers.

5.5 Risk Management / Loss Prevention

Generally, satisfactory surveys are required by underwriters prior to new rigs being commissioned, towed to new sites or being brought back into production after having been laid up.

Many assureds employ specialist risk managers often reporting directly to the company board. Companies not only ensure that contractual and statutory safety requirements are met, but often expend considerable sums on training, education, quality circles etc.

5.6 Catastrophe Exposures & Reinsurance

There are two sources of catastrophic claims:

- ♦ A major incident on an individual drilling platform, for example, Piper Alpha.
- ♦ A major windstorm related incident where there is an accumulation of loss as many individual installations are damaged, for example, Hurricane Andrew.

In addition it is possible that there may be catastrophic accumulations resulting from seismic events, earthquakes or seaquakes and tsunamis (giant tidal waves induced by seaquakes).

In parts of the world, notably the gulf of Mexico, there are large accumulations of fixed production platforms which present underwriters with catastrophic exposures in the event of large hurricanes. Currently this is monitored by splitting the region into major named blocks, and identifying their exposures by line (P.D., ROW etc.) on the structures within each block and estimating probable maximum losses. These exposures are often accumulated using "ERAS" - a PC package designed to aggregate these exposures.

Generally an Excess of Loss programme is purchased in the light of the underwriters' catastrophic exposures. In addition facultative reinsurance may be purchased to limit exposures to particular fields or structures or to exclude downstream refinery or other non-marine exposures.

5.7 Problems

Energy is a relatively new class of business, and new issues frequently arise. It is difficult to know how to adjust rating when there is little history and the nature of the risk continues to change and develop.

As in any other industry, the introduction of new technologies, with the consequent lack of any track record, introduces uncertainty into the pricing equation. In particular, drilling in ever deeper water at ever increasing pressures, pushes existing technologies to their limits, and gives rise to consequential concern over the impact on safety margins. The exploitation of the Russian Caspian sea and oil fields in other new areas will also give rise to interesting rating decisions as underwriters and actuaries seek to assess and price the possibly increased risk due to different cultural and industrial practices.

The trend to continue to use ageing rigs, beyond their original design lives, may give rise to questions of metal fatigue and / or corrosion, which may result in catastrophic failure of crucial components.

Many North Sea oil rigs are coming to the end of their useful lives. They will need to be dismantled or otherwise made safe for shipping. This gives rise to two coverage issues: the interpretation of the scope of the existing removal of wreck clause, and the design of appropriate cover for the dismantling process.

6. Conclusion

Marine insurance covers a fascinatingly wide range of risks and produces significant premium income for UK insurers. It has its own traditions and interesting peculiarities which may deter the actuary from becoming involved with it. However, as we have described in the earlier sections there are tremendous opportunities for actuaries to contribute, in lots of different ways, to the better management of Marine business. A sound understanding of the business will enhance the actuary's contribution and also assist in convincing the rest of the Marine management that the actuary has something to offer. Besides the traditional area of reserving, the importance of which should not be under-estimated, the actuary can assist in:

- ♦ improvements in the rating process through:-
 - better management of data: this would include definition, collection, consistency (both between organisations and over time) and improved standards across the market;
 - enhanced analysis of existing data, including the use of "what-ifs";
 - the use of simple actuarial models;
- ♦ designing effective management reporting systems;
- ♦ monitoring of aggregates and devising reinsurance programmes;
- ♦ applying total return and return on capital concepts in evaluating future business volumes and mix.

7. Acknowledgements

The Working Party received considerable help and advice from a number of underwriters and other Marine practitioners in writing this report and their contribution is gratefully acknowledged. Any errors and omissions are, of course, the responsibility of the Working Party.

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700	Marine Insurance and World Trade.
705	Marine Risks and their Assessment.
710	Marine Insurance - the Legal and Documentary Framework.
715	Marine Account Management and Reinsurance.
720	Marine Claims.

Appendix 1

Rating - An Actuarial Approach

i) Approach

The underlying premise is that Marine Liability risks are similar in many ways to personal lines risks such as motor or household, in particular motor. In many cases small risks are covered which may be one vessel or one small repair yard. This is analogous to a private motor policy. Other risks may be large fleets of many vessels. These are analogous to motor fleets.

A motor insurer will use a statistical approach for rating individual cars. A premium to apply to one particular vehicle is based on the experience of many similar vehicles. The experience of an individual driver is allowed for by using the NCD system. However, the main rating variables have little to do with individual claims experience. The approach takes many similar risks and analyses the claims experience of the group to produce a premium rate. This is applied to the individual vehicle.

Fleet rating is based on a mixture of individual vehicle rating, based on the statistically produced rates, and an experience rating, based on the fleet's claims experience.

The weight given to each part will depend on the size of the fleet - a larger fleet will have more weight on its own history. The formula below demonstrates:

$$\text{Premium} = Z \times A + (1-Z) \times E$$

$$A = \text{Actual experience}$$

$$E = \text{Statistical premium}$$

$$Z = \text{the lower of the square root of } M/m_0 \text{ and } 1$$

$$M = \text{observed number of claims in the data}$$

$$m_0 = \text{the number of claims required for full statistical credibility (1082 often used)}$$

ii) Statistical Rating

Much research has been done into statistical motor rating by the actuarial profession. The approach can be summarised as:

- ♦ hypothesise the rating factors that are relevant,
- ♦ split the data into the subgroups that are defined by the rating factors above,
- ♦ using statistical techniques, assess the importance of each rating factor and its correlation with other rating factors. There are various sophisticated statistical packages (for example, GLIM) which actuaries are well versed in using,
- ♦ do this for claims frequency and amount,
- ♦ use these results to produce a model of the relativities of each rating factor,
- ♦ set the base premium with an appropriate allowance for expenses and profit.

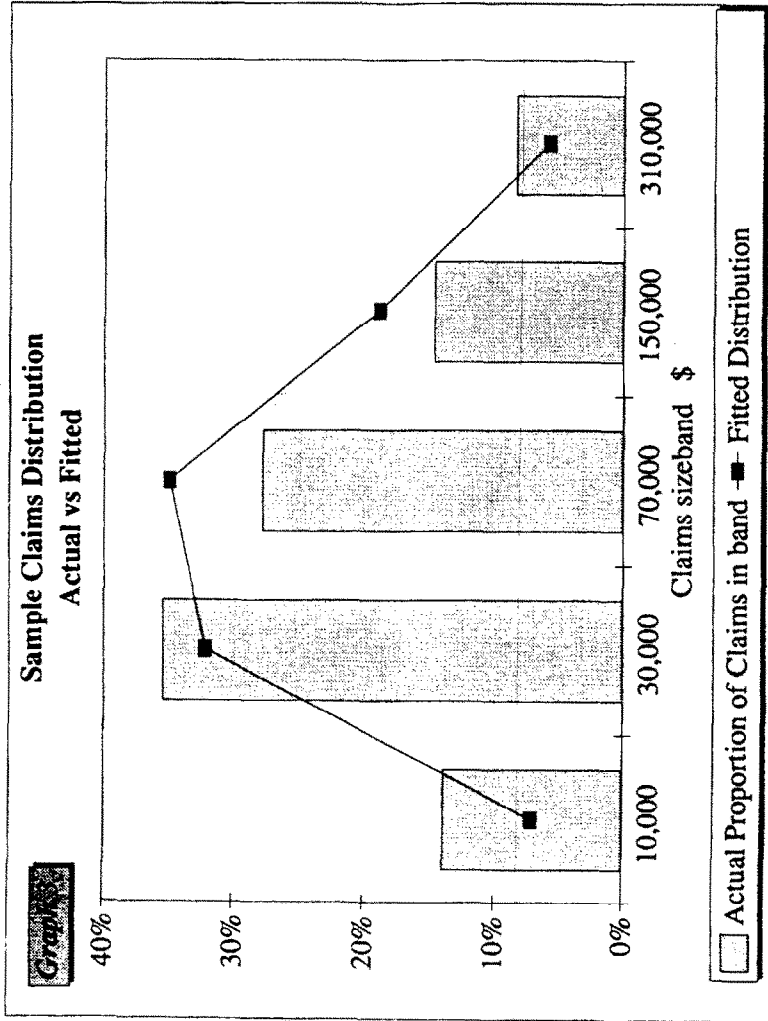
iii) Alternative Average Cost Approach

The method above looks at the base average cost and adjusts for different rating factors. An alternative is to fit a size of loss distribution to the experience. For example:

Claim Size	Number of Claims
0-10000	20
10001-30000	51
30001-70000	40
70001-150000	21
150001+	12

By fitting well known statistical distributions, their features can be used to draw conclusions about the losses. This is shown in *Graph 3*. For example, large losses are infrequent, and usually covered by reinsurance. This type of distribution can aid in costing and designing reinsurance programmes. This is described in Appendix 2. Deductibles and limits can also be assessed.

An example of this approach is shown at the end of this section.



iv) Confidence Intervals

By combining the frequency and amounts distributions we can simulate the experience. This involves generating random samples from the distributions for numbers and amounts of losses many times. (Packages such as Crystal Ball and @Risk make this a simple, spreadsheet task). This gives information on potential variability of the experience, and the likelihood of large losses (and hence the need for reinsurance). The choice of distribution is a key factor.

The method is very reliant on timely and detailed data.

v) Experience Rating

Larger risks, such as fleets of vessels, will have extensive claims information. In fact, we would recommend that insureds who cannot provide such information be penalised with a higher premium. (In effect, lack of information is another rating factor). The information should include, for each claim:

- ◆ date of loss,
- ◆ details of loss - what happened and to whom,
- ◆ amounts paid and outstanding from the ground up, and in total i.e. ignoring policy limits,
- ◆ whether it was covered by the policy under consideration.

This information should be provided for as many years as is practicable.

In addition, details of exposures are needed:

- ◆ number of vessels of each type,
- ◆ number of crew by type of vessel,
- ◆ areas of operation.

Other information on safety may also be provided.

The claims information can be used to produce a claims cost for each policy year by projecting the total claims each year to ultimate. Adjustments for deductibles and limits will be made at this stage. To compare different years, the amounts will need to be adjusted for claims inflation. If the exposure has changed over the years we will need to adjust the experience to reflect the expected exposure.

The average claims cost, once adjusted, will produce the experience rated premium.

vi) Final Premium

The final premium will depend on the size of the risk, as mentioned above.

Additions must be made for:

- ♦ expenses, both internal and external,
- ♦ profit,
- ♦ investment income,
- ♦ reinsurance cost.

vii) Example

Exposure measure: number of crew

Rating factors: area of operation / type of vessel

Data

<u>Area</u>	<u>Type of Vessel</u>	<u>Number of Crew</u>	<u>No. of Claims</u>	<u>Total</u>
<u>Incur'd</u>				\$000
Gulf of Mexico	Tug	500	50	250
Gulf of Mexico	Jack Up	200	40	100
California	Tug	250	38	95
California	Jack Up	100	30	38

Analysis

<u>Area</u>	<u>Vessel</u>	<u>Frequency</u>	<u>Average Cost \$</u>
Gulf of Mexico	Tug	10%	5000
Gulf of Mexico	Jack Up	20%	2500
California	Tug	15%	2500
California	Jack Up	30%	1250

Premium

Ignoring expenses and profit, the risk premium is Frequency x Average Cost.

Frequency = base frequency x area factor x vessel type factor

In our example, using Gulf of Mexico, Tugs as the base, the factors are:

<u>Area</u>	<u>Factor</u>	<u>Vessel Type</u>	<u>Factor</u>
Gulf of Mexico	1.00	Tug	1.00
California	1.50	Jack Up	1.50

Base frequency = 10% per crew year.

Similarly, for average cost:

Base cost = \$5000 per claim.

<u>Area</u>	<u>Factor</u>	<u>Vessel Type</u>	<u>Factor</u>
Gulf of Mexico	1.00	Tug	1.00
California	0.50	Jack Up	0.50

This gives premiums per crew year as follows:

	<u>Tug</u>	<u>Jack Up</u>
<u>Gulf of Mexico</u>	500	500
<u>California</u>	375	375

Results

The data above gives (unsurprisingly, as it was intended to) an immediate answer. With more rating factors more sophisticated techniques can be used, such as GLIM.

The above also demonstrates the necessity of analysing as many rating factors as possible, as effects may be hidden. If we had ignored area 1 for example:

<u>Vessel</u>	<u>Number of Crew</u>	<u>Number of Claims</u>	<u>Total Cost (\$000s)</u>
Tug	750	88	345
Jack Up	300	70	138

Analysis

<u>Vessel</u>	<u>Frequency</u>	<u>Average Cost (\$)</u>	<u>Premium per Crew Year</u>
Tug	12%	3920	470
Jack Up	23%	1971	453

This would overcharge in California, leading to lost business, and undercharge in the Gulf of Mexico.

Appendix 2

Reinsurance Programme Design for Marine Liability Business

i) Aim of Reinsurance

The main reason for buying reinsurance is to limit uncertain claims outgo in return for a certain premium (ignoring arbitrage). The purchase of reinsurance should smooth the results of a company.

The dilemma for any purchaser is the conflict between smoothing profits and the cost. Paying a premium to a reinsurer will cede profits (otherwise the reinsurer would not be writing the business). However, the willing buyer, willing seller situation arises because there is an information asymmetry - the insurer will base his decision on his own company's experience and the reinsurer will base his on his knowledge of the market. An insurer will want to maximise the smoothing and minimise the cost by assessing the most efficient programme design and calculating the cost of this programme. In addition, the insurer may want to build up a relationship with his reinsurer and may pay more for perceived security.

ii) Sources of Claims

The main uncertainties in the total amount of claim payments come from infrequent large losses and an excess frequency of smaller losses. *Graph 4* shows the individual claim amounts for one year. The total cost to the insurer is the sum of the columns.

By adding reinsurance, the insurer can limit the cost and restrict his exposure to the more certain areas of the claims.

Large losses can be limited by Excess of Loss reinsurance and attritional or catastrophe losses by stop loss or catastrophe excess of loss cover.

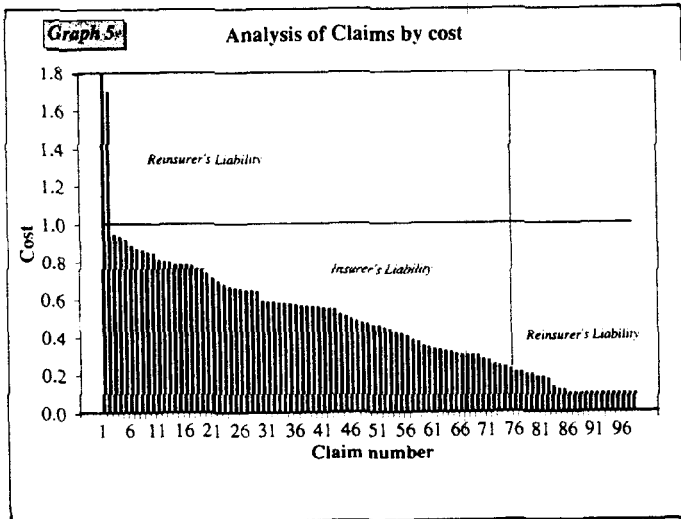
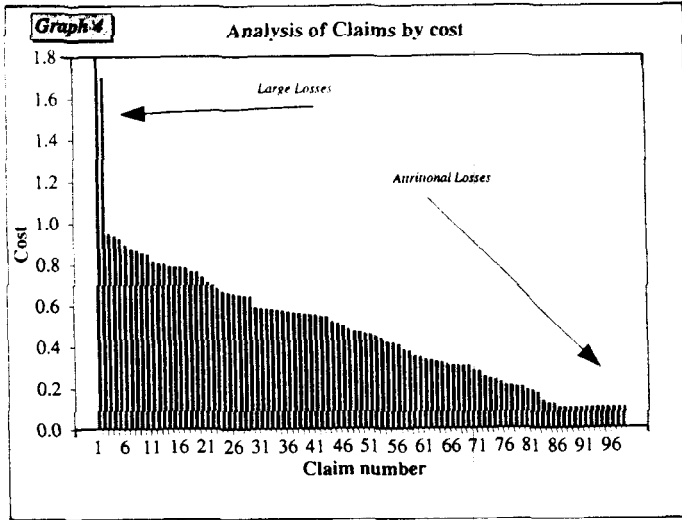
Graph 5 shows the same claims distribution with reinsurance added.

This shows how the cost can be limited.

iii) Excess of Loss protections

The first question an insurer needs to ask is "How large is large?". This will depend on the size of the company, the size of its parent, the size of the premium base for this class and all classes of business, and the attitude of shareholders and management to risk. If policies are limited, then this will restrict the cover needed.

The next question is how many large losses can we expect?



The section on premium rating addressed the idea of a claim size distribution. This effectively said that for a given number of claims we can expect a certain percentage of them to be greater than a given amount. We can assess the expected number of claims by estimating the next underwriting year's exposure and applying the probability of a claim. For example, if we expect to have an exposure of 100,000 crew years and we expect one crew member in 12 to claim we would expect a total of 8333 claims. We may have established from our claim size distribution that 0.012% of claims will be over \$500,000 (our "large" loss) so we expect 10 large losses. With a policy limit of \$1m, the most we might expect to recover would be \$5m.

However, the estimate of 10 large losses is an estimate. In one year there may be nine, another 11. Also, we would not expect all losses to be total losses. We need to assess the effect of this and the sensitivity of our exposure in this layer. This can be done by simulating the claims experience using our experience of the past. This can be done in two ways - either by simulating the whole claims experience i.e. all 8333 claims or just the large losses. The process is:

- ♦ generate a random number of claims. This involves sampling from a distribution for the number of claims, probably a Poisson for large losses and Normal for all losses as the number is large. For the large losses, this will produce 10 most frequently, but 9 and 11 fairly often, 8 and 12 less so.
- ♦ for each of the losses generate a claim cost, using the claim size distribution assessed when rating. When simulating all losses, this will produce a large loss for approximately one loss in 100.
- ♦ calculate the total cost to the reinsurance layer.
- ♦ repeat this 1000 times (using some appropriate software) and analyse the spread of results.

Using the results gives an assessment of whether reinsurance is under or overpriced, and also whether worth buying - if the results are fairly stable with not much variation, then the reinsurance may just be dollar swapping.

iv) Stop Loss

This may not be always available. However, if it is available and the price is deemed to be inexpensive it is worth buying. The price can be assessed in a similar way to that described above to assess the likely sensitivity of the total claims cost.

v) Catastrophe Excess of Loss

The main question is where will these losses come from? Accumulations of risk should be closely monitored. These depend on the types of risk written (e.g. product liability exposure) and the geographical areas covered. One large assured will also increase exposure here. Exposures from other classes of business may also lead to accumulations of risk so the issue should be considered on a whole account basis rather than for an individual class.

Frequency of catastrophe losses is difficult to assess.

The P&I Clubs' pooling arrangement and the reinsurance above that are catastrophe excess of loss covers.

vi) Facultative Reinsurance

For Energy risks, Liability cover is often offered as part of the Energy package. This may be facultatively reinsured out. For large risks, the underwriter will often purchase facultative reinsurance to reduce his exposure. Again, the question how large is large arises in working out how much to reinsure.