



Institute  
and Faculty  
of Actuaries

# Marine and Energy Pricing

## Working Party

Darren Farr (Co Chair)  
Hasitha Subasinghe (Co Chair)  
Andrew Newman  
Chris Gingell  
David Stuart  
Emma Montague  
Ewa Peacock  
Gemma Dawson  
Giorgia Rama  
Jenny Gardner  
Kiran Patel  
Layna Frontado  
Miriam Lo  
Sejal Haria  
Shamim Ashraf  
Suzanne Hodgkinson  
Tony Hartington

8<sup>th</sup> August 2014

# Index

## Sections

A.	Introduction	Page 3
B.	Methods	Pages 4 – 27
C.	Exposure Management	Pages 28 – 39
D.	Rate Change	Pages 40 – 49
E.	Requirement for Quality Data	Pages 50 – 51
F.	Pricing Within a Control Cycle Environment	Pages 52 – 54
G.	Use of Actuaries in Marine & Energy Pricing	Pages 55 – 62
H.	PRA Statement	Page 62

## Appendices

A.	A Brief History of Hull & Cargo Insurance	Pages 63 – 64
B.	Cargo INCOTERMS	Page 65
C.	Market Survey Interviews	Pages 66 – 75
D.	Glossary of Terminology	Pages 76 – 77

# A. Introduction

This paper covers the methods used and key issues in pricing risks for classes within Marine and Energy, with a focus on the London Market. The general lack of data and understanding of the complexities of the business leads to a considerable variation in approaches to Pricing. This Paper seeks to give a good cross section of how risks are priced given the specialty nature of this business.

We have also considered other issues key to pricing these classes of business, such as assessing and allowing for the impact of Catastrophes (“Cats”). Issues surrounding Rate Change Monitoring are discussed, along with suggestions for best practice, and some examples to illustrate the problems faced due to the complex nature of these classes.

The need for good quality data is also referred to in this paper, as well as demonstrating the importance of Pricing within the Control Cycle, with specific reference to Marine and Energy classes.

Finally we have conducted a survey into current and future use of Pricing Actuaries within Marine and Energy Insurance, including obtaining a statement from the Prudential Regulation Authority. The results of how Actuaries interact with Underwriters, along with views on how well Actuaries understand the business they work in, are summarised in the Paper and detailed in the appendix.

The intended audience for this paper would be an actuary either at the senior level or the qualified level who has worked in Pricing, or is looking to work in Pricing in these specific areas. We have assumed that the reader would have already read the GRIP paper, particularly the section on Pricing in the London Market:

<http://www.actuaries.org.uk/research-and-resources/documents/general-insurance-premium-rating-issues-working-party-grip-report-f> (2007, Anderson et al).

There are numerous acronyms and terms used in the paper as this is common practice within Marine and Energy Insurance. We have provided a glossary of the main terminology in the final appendix.

The specificities of compliance with actuarial standards (e.g. the IFoA’s Technical Actuarial Standards) are beyond the scope of this paper, but please consider where appropriate.

# B.Pricing Methods

We have specified suggested methods for pricing by class, focusing on the major classes of business.

## Hull

### Overview

Hull Insurance is usually bought on a time (e.g. annual) basis for a shipowner's fleet of vessels and covers the following main perils:

- Engine Damage
- Machinery Damage
- Fire / Explosion
- Collision
- Grounding
- Sinking
- Piracy / Violent Theft (though usually now covered by War Insurers)

This section is concerned with Bluewater and Brownwater vessels and refers to commercial coverages rather than domestic and pleasure. Time policies usually contain standard clauses referring to voyage locations; e.g. avoiding areas prone to ice in winter - breaches of these would warrant additional premium.

There are other ancillary classes often purchased by the shipowner along with Hull insurance (though sometimes they are bought as 'stand alone' covers):

- Increase Value ("IV") – covers the difference between the insured value of the vessel and the market value of the vessel following an Actual Total Loss ("TL") or Constructive Total Loss ("CTL").
- Freight – covers loss of anticipated future freight earnings following a TL / CTL.
- Mortgagees' Interest Insurance ("MII") – covers the lender's interest in the vessel and responds where the owner's hull insurance fails.
- Loss of Hire – covers loss of shipowner's earnings whilst a vessel is being repaired.

### Data Sources and Further Information

The Lloyd's Market Association ("LMA") and the International Underwriting Association ("IUA") regularly provide summarised market data, including triangulations, to its members. Their Joint Hull Committee ("JHC") also provides detailed reports and guidance on underwriting matters which can also affect pricing.

Market data within Lloyd's is also available by subscription from Marine Statistics Limited, which is sponsored by the LMA. Market reports on Hull are also available from the Institute of Marine Insurers ("IUMI") and The Nordic Association of Marine Insurers ("CEFOR").

Further details of Hull Insurance can be obtained from courses run by the Chartered Insurance Institute ("CII") and via Marsh's Marine Insurance Courses. Finally the Marine Insurance Act 1906 is the current legislation codifying Hull Insurance within the English jurisdiction, though this is currently being reviewed.

## Rating Factors - Hull

There are a number of factors to consider when technically pricing each vessel. The common ones reflect the characteristics of each individual vessel and are as follows:

- Size
  - o Deadweight Tonnage (Tankers, Bulkers, Dry Cargo vessels)
  - o TEUs (Containers)
  - o Cubic Capacity (LNGs, LPGs)
  - o Gross Tonnage (Other vessels)
- Type
- Age
- Flag
- Domicile
- Speed

This list should not be seen as exhaustive and other quantitative factors could be incorporated.

Qualitative factors also need to be considered. Although not directly quantifiable they should be included to reflect the underlying nuances and heterogeneity of the risk. These aspects generally reflect the characteristics of the management of the vessels. Examples include:

- Risk Management
  - o e.g. Lloyd's Intelligence MIU Score
- Number of Detentions
- Date and Result of Last Survey
- Length of Time with Current Shipowner

The level of cover required needs to be taken into account. This is usually defined by the insuring clauses (e.g. Institute Time Clauses, Norwegian Plan, American Institute Hull Clauses, ADS-DTV).

It should be noted that rates are split between those for partial losses with another to cover the likelihood of a Total Loss ("TLO Cover"). These are combined to produce an overall rate per vessel.

## Rating Factors – Ancillary Insurances

For IV, Freight, and MII insurances just the type, value and age of the vessel are typically used as quantitative factors when pricing the risk. Though the shipowner's attitude to risk management again needs to be considered.

Loss of Hire insurance is rated based on a combination of the length of cover and the period of the time deductible.

## Methods - Hull

Hull insurance can be technically priced per vessel using either or both of experience and exposure rating methods (refer to page 128 of GRIP (2007, Anderson et al)).

For exposure rating, tables by rating factors, or combinations thereof, can be generated based on claims frequency and average cost. These can be generated from internal experience, from market data, using underwriters' expert opinions, or combinations thereof. If there is sufficient volume of data, Generalised Linear Models can be used to rigorously analyse the data.

The experience of the individual fleet can also be analysed to produce an expected burning cost, though care must be taken where the size and/or makeup of the fleet has materially altered recently.

Brokers often provide up to 5 years (at least) of claims history which can be utilised, though this is rarely triangulated and is usually just a snapshot. It should be noted that claims figures provided by brokers are usually net of deductibles rather than From Ground Up ("FGU") so allowance may have to be made for claims that were historically below the deductible level but may not be now.

As per standard actuarial methodology, claims history needs to be adjusted for changes in the fleet's exposure, tonnage inflation, claims inflation, IBNR / IBNER in the incurred figures, the influence of actual large claims (or lack of), and changes in Terms & Conditions from previous policy periods. When considering claims inflation, the Facts & Figures Committee of the International Union of Marine Insurers organization has produced a paper which can be found in the Statistics section of <http://www.iumi.com/>.

Trends in frequency and claim size should also be considered to reflect improvements in technology, safety standards (cf. IMO), and training budgets.

For either approach, consideration of Cat losses must also be included – refer to the *Exposure Management* section of this paper for more information.

## **Methods - Ancillary Insurances**

These classes of insurance are normally priced on an exposure basis since the frequency of these types of losses is particularly low (though average costs are high).

## **Other Comments**

Risks are rated on a per vessel basis, with rates applied to the sums insured to produce the technical premium for each. These are summated to produce an overall technical price for the fleet.

The level of collision cover can be amended either for an individual vessel or for the fleet via the insurance clauses. For instance, the standard ITC clauses provide 3/4ths Running Down Clause ("RDC") for collisions with other vessels but no Fixed and Floating Object ("FFO") cover whereas the Norwegian plan provides full 4/4ths RDC along with FFO cover. Such changes in Terms and Conditions need to be allowed for in both pricing methods.

Where possible it may be worth considering types of cargo (e.g. iron ore) carried by Container and Cargo vessels, and patterns in losses over time.

Base rates generated on an exposure basis need to be adjusted for individual vessel's deductibles, including any Additional Machinery Deductibles ("AMDs"), by using standard actuarial techniques such as First Loss Curves or Increased Limit Factors to calculate the impact on FGU losses.

Further adjustments will be required if there are (and/or were) Annual Aggregate Deductibles ("AADs") in the policy.

When considering the impact of large losses within the technical assessment of the risk, it should be borne in mind the impact of losses being declared a Total Loss once they reach a certain ratio of the vessel's insured amount (e.g. 75%); i.e. the loss is classed as a CTL. When assessing historic claims, those reaching the CTL point after adjusting for inflation etc need to be treated as if they were Total Losses. As vessels age, their value tends to decrease which can increase the risk of a CTL as an average claim will be a higher percentage of the value

The exposure period of the risk may not be for the standard 12 months, either for the renewal or previously. Thus if the experience method is used the estimated burning cost will again require adjusting to take such changes in exposure into account.

Risks are considered initially gross of brokerage (and gross of reinsurance), and figures provided by brokers will be on this basis. Therefore pricing must take into account Brokerage and any other Deductions when considering its technical profitability. A consistent view is required on how to deal with contingent deductions such as No Claims Bonuses.

Fleets, and even individual vessels, can be insured in more than one currency. So the impact of rates of exchange on both premiums and claims will need to be considered.

Finally, any Hull pricing model needs to consider the pricing of laid up vessels, including the likelihood of claims arising from restarting such vessels, and the impact of endorsements such as additions to, or deletions from, the fleet.

# Cargo

## Overview

Cargo Insurance protects traders against the risk of loss, or damage of cargo transported by all types of carriers including ocean-going vessels, inland waterway vessels, trucks, railcars, and airplanes. A trader may obtain Cargo Insurance directly from an insurance company or through the carrier, freight forwarder, or logistics firm handling the shipment.

Exposure rating dominates the pricing of cargo insurance, which must then be adjusted for the numerous clauses, exclusions, warranties and Articles that exist. These have a significant impact by cargo type on coverage provided and consequently the price of insurance charged.

## Methods

Cargo is actuarially priced using two common techniques – experience and exposure rating. Although data integrity has improved over the past decade, volumes and detail are still not readily available to perform stochastic pricing techniques on an individual case basis.

## Exposure Rating

The insurance premium is determined by use of base rates that apply by risk classification applied against premium exposure (i.e. cargo value). Rating manuals are developed independently by insurance companies. The general steps are provided below:

- Desired level of coverage to be priced
- Define value of cargo being transported
- Assign a rate on the value of the shipment e.g. \$0.50 per \$100 of value insured. This may vary by type of cargo shipped
- Apply discount/loadings for
  - Applicable rating factors
  - Size of deductible that applies (usually percentage of value insured)
  - Pricing excess of loss reinsurance layer
  - Natural Catastrophe exposure
  - Exclusions
  - Applicable endorsements and warranties
- Insurance Tax payable – local and international
- Acquisition Costs if via a third party e.g. brokerage company, cost of capital, profit loading



## Experience Rating

Prospective premium is based on the actual loss experience of the insured. The general steps are provided below:

- Obtain historical claims information (ideally minimum of 5 years of individual claims information).
- Segment by key claims characteristics
  - Claim type (total / partial / salvage / increased value – see below for further details)
  - Risk factors (e.g. cargo type);
- Project historical claims to today's value using standard actuarial reserving techniques;
- On-level premium and/or exposure information using appropriate rate change indices;
- Adjust for changes in underlying risk profiles, for example changes in coverage, type of contract and types of cargo shipped;
- Load resulting pure loss cost for additional expenses incurred – profit loading, internal expenses, cost of capital, insurer tax payable and acquisition costs.

## Rating Factors

The following are key rating factors that are considered in the pricing of cargo insurance. The list is by no means exhaustive and an illustration of what may be considered.

- Coverage Type
- Number & Type of Goods Shipped
- Value of Goods Shipped
- Countries and Ports of Origin & Destination
- Mode of Transport e.g. air, land, sea etc.
- Carrier(s)
- Route, Length of Voyage and Transshipments
- Storage
- Packing / Containerised
- Assured's Trading Experience
- Assured's Attitude towards Claims
- Assured's Attitude towards Third-Party recoveries
- Excess / Limit
- Port facilities
- Loss History / Length of relationship
- Vessel Age / Classification / Condition
- Crew makeup (nationality)
- Duration of Cover
- Risk management processes

## Key Cargo Clauses Explained

For cargoes insured at Lloyds, or in the London market, it will usually be the case that the insurance will be subject to the Institute Cargo Clauses (ICC). These standard wordings are widely used, or closely copied around the world:

- All Risks - ICC (A):
  - “This insurance covers all risks of loss or damage to the subject-matter insured except as excluded by the provisions of Clauses 4, 5, 6 and 7 below” (exclusions covered below).
  - The insured only has to show that something fortuitous caused loss or damage to goods.
- Restricted or limited conditions – ICC (B) and (C):
  - These are named peril policies only and as such, are provided for a cheaper premium.

A number of important clauses should be considered but only a brief overview is provided here:

- Trade and Special Clauses – tailored for specific cargo types. Of key consideration are: frozen foods; coal; bulk oil; commodity trades; jute; natural rubber; oil, seeds and fats; frozen meat and timber.
- Institute Bulk Oil Clauses
- Damage to machines/manufactured items
- Theft, pilferage and non-delivery
- Alternatives and adaptations to ICC ([www.fortunes-de-mer.com](http://www.fortunes-de-mer.com) for many international clauses)
- Institute Cargo Clauses (Air) – to deal with air freight.
- Packaging
- The Transit Clause – specifies where the risk starts and ends. Usually on a “warehouse-to-warehouse” basis.

## Exclusions

This concentrates on the exclusions in Clauses 4, 5, 6 and 7 of (A), (B) and (C) clauses above, that is, the type of loss or damage which an insurer expressly does not want to cover.

- Clause 4: General Exclusions – “in no case shall this insurance cover loss damage or expense attributable to...”:
  - Wilful misconduct;
  - Ordinary leakage, ordinary loss in volume/weight, or ordinary wear and tear of the subject-matter-insured;
  - Insufficient or unsuitable packing or preparation of subject-matter;
  - Inherent vice (i.e. natural condition or characteristic within the cargo itself e.g. fruit decay);
  - Delay, even though the delay be caused by a risk insured against;
  - Insolvency or financial default of the owners charterers or operators
  - War / nuclear specific matters
  - Deliberate damage to or destruction of subject-matter insured [in (B) and (C) clauses only]
- The remaining Clause 5-7 cover unseaworthiness/unfitness, war and strikes.

## Endorsements

Endorsements provide extensions to the “normal provision of cover” for extra premium. Examples include:

- Domestic transit
- Strikes, Riots & Civil Commotions (S.R & C.C)
- War Risk Policy
- FOB Endorsement
- Rust, Oxidation & Discolouration
- Spontaneous Combustion
- Sweating
- Heating
- Contamination
- Tainting
- Fresh water
- Shortage and Non-delivery
- Country Damage
- Pollution
- Port Security Risk
- Political Risk

## Specific cargo loss considerations

- Partial loss – defined as that which is not a total loss.
- Total loss
  - Actual Total Loss (“ATL”) – insured property destroyed or so badly damaged that it ceases to be a thing of the kind insured.
  - Constructive Total Loss – assured abandons the property in circumstances where an ATL seems unavoidable or insured property cannot be preserved from an ATL without costs that exceed its value.
- Salvage Loss – neither partial nor total. Arisen as a matter of practice rather than law.
  - A type of settlement that takes place when goods are sold at an intermediate place on the voyage, usually when goods are landed at a port of distress and are in damaged condition.
- Increased Value Policy – whether goods have been “sold on” during the course of transit for a higher value thus original insurance unlikely to be sufficient. ICC Clause 14 discusses how claims are dealt with in such a case.

# Protection & Indemnity (P&I)

## Introduction

Protection and Indemnity (P&I) clubs started in the 19th century to fill the gaps in insurance provided by the standard commercially available hull policy, which covered damages caused by collisions but only up to  $\frac{3}{4}$  of the value of the ship. P&I cover has evolved to provide third party legal liability insurance for ship owners, operators and charterers.

The principal risks covered are liabilities, costs and expenses for:

- Injury, illness and death of crew, passengers or other persons
- Cargo loss or damage
- Wreck removal
- Pollution
- Collision
- Dock damage
- Fines or administrative penalties arising out of the operation or management of ships (including those arising from stowaways, diversions, refugees, salvage and towage, etc.)

## P&I Clubs

P&I clubs are constituted as mutual insurance companies, by which shipping companies share - or pool - their liabilities. Being mutuals, clubs are owned by their members. If premiums prove insufficient to cover claims, then depending on the financial health of the club, the members may be called on to make up the shortfall. Most clubs try to avoid making such supplementary calls.

The pooling of risks happens in two ways:

- Within each P&I club (between members, due to the nature of mutual insurance).
- Between some P&I clubs (e.g. those clubs that belong to the International Group).

Not all risks are pooled:

- Within clubs, some business is written on a fixed premium rather than mutual basis.
- The International Group Agreement specifies the risks that can be pooled between clubs  
([http://www.igpandi.org/downloadables/International\\_Group\\_Agreement\\_2013.pdf](http://www.igpandi.org/downloadables/International_Group_Agreement_2013.pdf)).

Even those risks that are pooled are generally not fully pooled:

- P&I clubs will impose deductibles (which may vary by member and by type of cover) below which members' liabilities are not reimbursed.
- Similarly, P&I clubs that are members of the International Group only pool their liabilities for claims above an agreed threshold.

Each club sets its own rules of entry, exit and coverage. Just as shipping companies compete for customers yet pool their liability insurance risks through P&I clubs, so P&I clubs compete for members yet pool their insurance risks through the International Group.

## Rating Factors - Club P&I

There are a number of factors to consider when technically pricing each vessel. The common ones reflect the characteristics of each individual vessel and are as follows:

- Size (typically 'Tonnage', which is actually a volume measure)
- Type
- Age
- Flag
- Domicile (of management company)
- Classification society

This list should not be seen as exhaustive and other quantitative factors could be incorporated.

Qualitative factors also need to be considered. Although not directly quantifiable they should be included to reflect the underlying nuances and heterogeneity of the risk. These aspects generally reflect the characteristics of the management of the vessels. Examples include:

- Risk Management (e.g. ISO standards)
- Loss record
- Stability of finances
- Experience of Shipowner
- Time with club
- Area of trading activity

## Methods - Club P&I

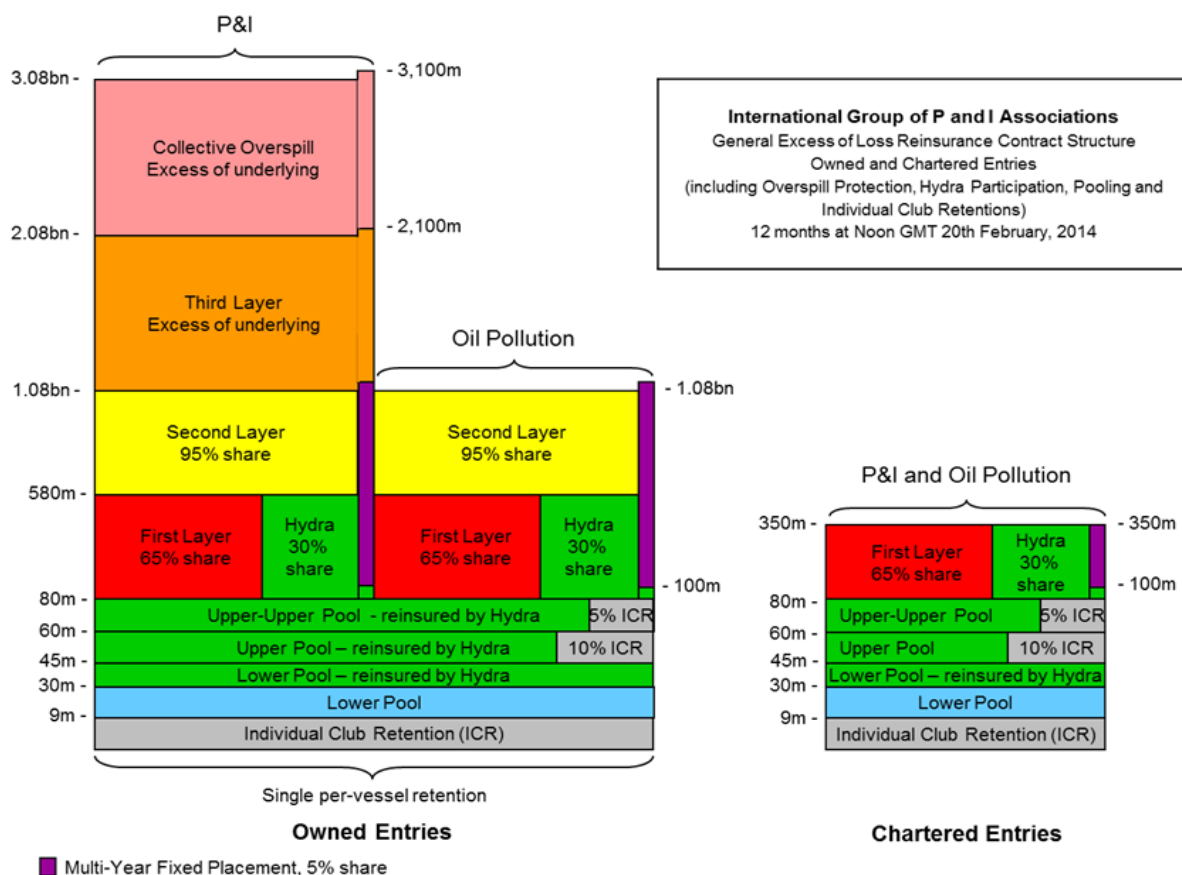
For historical reasons, P&I risks renew at midday on 20th February each year. If a vessel is entered in (i.e. insured with) a club during a policy year, the coverage will not last for 12 months but will expire on 20th February. Two modes of pricing emerge from this. Vessels entered during the year are assessed using exposure rating on the individual vessels, while renewal premiums are typically assessed for the member at the fleet level based on the member's experience over a number of years, with the total premium then being allocated to individual vessels.

In exposure rating, historical claims are analysed at various levels of sophistication to produce an expected burning cost using one or more rating factors. Data availability is a constraint on the analysis: while members of the International Group will have data on other clubs' large claims that have exceeded the International Group retention, the vast majority of claims fall are smaller than that and the club will only have its own internal experience to go on.

As per standard actuarial methodology, claims history needs to be adjusted for claims inflation, IBNER / IBNYR in the incurred figures, the influence of actual large claims (or lack of), and changes in terms & conditions (e.g. member deductibles) from previous policy periods. The effect of changes in tonnage should also be taken into consideration: although premiums are typically quoted in dollars per ton, the relationship between claims and tonnage may not be linear.

## The International Group

97% of the world tonnage belongs to the P&I clubs that are part of the International Group. Understanding the International Group, in particular its reinsurance arrangements are crucial to the understanding of P&I insurance. The reinsurance arrangements are illustrated below:



Source: [http://www.igpandi.org/downloadables/2014\\_-\\_Reinsurance\\_Diagram\\_v2.pdf](http://www.igpandi.org/downloadables/2014_-_Reinsurance_Diagram_v2.pdf)

Hydra is the captive reinsurance company for the International Group, in which each club has a protected cell (segregated account). Its structure and funding arrangement provide each club with some protection against reinsurance default by the other clubs. It also serves as a vehicle to facilitate the strategic purchase of reinsurance by the International Group.

The excess-of-loss programme is known by various names, including IGP&I and IGXL.

## Market information - IGP&I

- The structure of the pools is publicly known.
- Miller's are the sole broker to placing the International Group and Catlin is the leader of this contract
- Generally there is a large participation on the IGP&I and also there are large facultative outwards placements of writers of this contract.

## Methods and issues to consider - IGP&I

- For the clubs that pool there are historic losses going back to the 1970s. Past data may not be that relevant as shipping has changed over the years.
- The tonnage information gives a good indication of the exposure changes.
- Use standard actuarial pricing techniques to derive prices of the layers that are on offer.
- Consider changes in the deductible of the historic losses. 'As if'-ing the losses to the latest deductible structure needs to be reflected. Marine hull deductibles rarely move. These features exist to some extent within the P&I clubs.
- Take note of the relevant coverage details and hence the losses that are relevant.
- Assess indexation of losses beyond the growth in tonnage, such as change in freight rates.
- Allow for IBNR on open claims.
- Claims are usually complex; e.g. Costa Concordia. The extraction of fuel to prevent pollution to removal of the wreck is complicated and the quantum of loss is unknown at outset.

## Interesting Paper

- The broker Tysers provide an annual report<sup>1</sup> on P&I clubs and how they work including insights in to their future strategy. It is a recommended read as this provides a high-level picture of the clubs.

---

<sup>1</sup> [www.tysers.com/assets/403bb83c35/pi-report-2013---07.10.13.pdf](http://www.tysers.com/assets/403bb83c35/pi-report-2013---07.10.13.pdf)

# Energy Construction

## Stages of construction

Reference: "Upstream and Offshore Energy Insurance" (David Sharp)

In order to understand the risks of an energy construction contract and price appropriately, one needs to understand the different stages of construction.

An offshore facility, for instance, is comprised of many different components, which are usually built on land and then towed to the offshore site, often at long distances.

The key stages of offshore energy construction are listed in the table below:

#	Stage	Output	Key Insured Perils
1.	Design Engineering, Planning and Safety Case Submission	Project Execution Plan, Front End Engineering Design (FEED), Detailed design, hazard identification (HAZOP and HAZID studies), Safety Case studies, cost and schedule planning. Safety level of the proposal verified by the regulators.	N/A
2.	Procurement	Raw materials and equipment purchased and stored at construction sites.	Physical Damage (PD)
3.	Fabrication and load-out	<p>Topside module constructed.</p> <p><i>Steel Jacket:</i> Steel jacket constructed and "loaded-out", where the jacket is installed and connected to the launch barge.</p> <p><i>Concrete Platform:</i> GBS (Gravity Based Structure) built, tested for submergence and mated with topside.</p>	<p>PD, especially during load-out.</p> <p>PD</p>
4.	Towage to Site and Positioning to Site	Jacket towed and launched onto installation site.	PD risks during towing and adverse weather conditions during towing and launch
5.	Offshore Installation and Piling	<p><i>Steel Jacket:</i> Jacket secured on seabed, satisfies the required foundation load and verified to withstand storms (e.g. the 100 year storm criteria).</p> <p><i>Concrete platform:</i> Structure sunk onto the site and grouted to the seabed. Topside modules lifted onto structure.</p>	<p>PD, remedial costs, cancellation costs, stand-by time (e.g. due to pile damage).</p> <p>PD, objects dropped/ lost.</p>



6.	Pipelaying and Subsea Installation	Laying route surveyed, mattresses installed over existing pipelines/ cables, subsea pipelines installed, tested for pressure resistance and water tightness, pipelines buried/ protected by rock dumping. Other subsea properties installed (e.g. subsea wellheads, manifolds, jumpers, controls)	Liabilities (damage, pollution and consequential loss); faulty welding (excluded in CAR) and leaks. Pipelines buckled/ bent/ deformed/ mishandled.
7.	Drilling	Production wells drilled	Blowout
8.	HookUp, Commissioning and Testing	Topside and other separate modules connected into a functioning production unit. "Punch list" of outstanding construction issues defined.	If this happens in parallel with drilling, blowout.
9.	Maintenance and discovery	N/A (ongoing phase)	Some construction policies cover construction defects when the construction phase is finished.

### Rating considerations:

Below is a list of rating considerations for a typical energy construction contract. In practice, it is important to consider the project as a whole as well as the individual phases.

- Premium worksheet: shows breakdown of project between main components, completed values at various milestone stages of the project
  - Period
  - Sum insured
- Assured
  - Identity and experience of operator and contractors
  - Number of contractors
- Coverage scope
- Third party liabilities (including EL)
- Limits / Deductibles
- Depth of construction
- Location
- Insured works
  - Type of construction
    - Type of platforms
      - Steel, piled platform
      - Concrete Gravity Base Platform (GBS)
    - Type of topside modules
      - one piece integrated deck
      - MSF (module support frame) and a number of separate modules
      - TLP (Tension Leg Platform)
      - Compliant towers
- Transit and towage distance/ route
- Method of installation
- Pipelaying distance/ route

- Additional Coverage, e.g.
  - Standby-Charges
  - Contingency
  - Defective Parts Buy Back (DPBB)
  - Delay to Start-Up / Business Interruption

# Offshore Energy - Exploration & Production

Exploration and Production (E&P) companies can be national oil companies, independent operators and drilling contractors involved in the exploration and production of oil and gas. They typically buy insurance to cover one or more of physical damage (PD), control of well (COW), third party liability (TPL), and business interruption (BI). These coverages can be underwritten as sections in a “package policy” or form separate insurance contracts.

## Physical Damage (PD)

Covers loss or damage to offshore facilities and associated sub-sea equipment.

In comparison to Marine, the definition of a single ‘asset’ is less clear cut. This is because people can refer interchangeably to individual pieces of equipment and the aggregate exposure at a field.

In general you will see the following declared:

- Major Production Facilities e.g. Fixed, Spar, Floating, FPSO
- Subsea equipment e.g. Templates, Well Heads, Riser systems
- Pipelines
- Mobile Drilling Rigs and Drill Ships

For each item there should be a declared replacement value (RV), however, pipelines are often insured for less than RV under a ‘first loss limit’. In many cases, there is an extra top-up of value for Removal of Wreck and Sue & Labour. Note that these coverages can vary between markets; e.g. London vs Nordic Plan.

Values are almost always declared both in 100% terms and for the assured’s equity interest. It’s not uncommon to see different insureds declare different values for the same asset, hence it is important to base calculations on data received from the insured in question only.

The important thing to consider for Energy pricing is how these values aggregate. Typically we are interested in the total insured value for these items across a field. However, even facilities for the same field can be tens of kilometres apart and so a field name can be misleading. To understand the total insured value which we need to aggregate for pricing purposes we need to estimate how much could be affected by a single disaster scenario.

These values also need to be aggregated with exposures for LOPI and OEE where there is a shared insurance limit. For regions exposed to natural catastrophes an insurer will also need to take into account the aggregation across different fields which are exposed to a single event (refer to later *Exposure Management* section).

## Major Rating Factors for PD

- Replacement Cost
- Asset Type e.g. FPSO vs Fixed Structure
- Location (e.g. North Sea and Latitude-Longitude)
- Proposed policy attachment points and limits (note these may be expressed either for assured interest (FAI) or 100%)
- Deductibles
- Engineering Reports
- Year of Construction
- Operator reputation
- Windstorm protection (e.g. modern drillships can just get out of the way; fixed platforms can't)
- Loss History

## Loss of Production Income (LOPI)

E&P companies would be required to declare the monetary amount of production per field they want insured prior to policy inception. For example they might declare "18 months of net production with value \$800m". In most cases these monetary values are declared in advance and are based on a fixed price per barrel (or cubic metre) because insurance markets are reluctant to take hydrocarbon pricing risk.

Loss of production income varies from traditional business interruption coverage because, in most cases, you are just delaying recovery of hydrocarbon assets. If an insurable event means there is no production for 2 years, then the oil is still in the reservoir and you will be able to extract it eventually. Hence LOPI is protecting cash flow rather than capital values. It is for this reason that many E&P companies do not buy LOPI insurance.

E&P companies actually have quite a lot of freedom when deciding on how much Loss of Production Income to declare. The declaration is usually a function of:

1. Expected daily net production
2. Length of indemnity period
  - E.g. 12 months
3. Expected price per barrel
  - E.g. \$50 per barrel. Often based on sales projections or forward curves. These are sometimes discounted for variable costs
4. Remaining Lifetime of field
  - Some companies consider the NPV of lost income and will make appropriate discounting assumptions based on when they expect to recover the lost production
5. Field dependencies
  - Where a platform is also used as a hub for through-put of production for other facilities, the production from the other facilities is also included if it would be affected by a loss at the master platform.

LOPI limits are often shared with PD and OEE so care needs to be taken. This is often referred to as a 'CSL' which stands for combined single limit.

The largest energy mutual OIL does not underwrite LOPI risks and hence a commercial market insurance programme which works as a co-insurer alongside the mutual is likely to have a bias towards LOPI. Such programmes are often called 'OIL wraps'.

As LOPI events can usually only be triggered by a PD or OEE loss the rating factors are largely similar.

### **Operator's Extra Expense (OEE)**

OEE insurance (also referred to interchangeably as 'Control of Well') covers the risks associated with wells. There are three broad heads of cover:

1. The direct costs of bringing a well under control following a loss of control (usually a blowout) (COW)
2. The cost of re-drilling the well (OEE)
3. Costs related to cleaning up a related oil spill (OEE)

There are many types of well but for the purpose of this document we will focus on two broad categories:

- Wells to be drilled (often called exploratory, wildcat or developmental wells)
- Production wells

### **Drilling wells**

OEE insurance covers the process of drilling a new well rather than physical assets. This cover does not protect the drilling rig (or platform) which will be normally insured separately under PD wording.

For exploratory drilling, the rig does not normally belong to the operator but rather a specialist drilling company. The OEE coverage is bought by the operator but the rig would be insured under a normal PD policy and this would be bought by the rig owner. For example, the Deepwater Horizon rig was owned by Transocean who received a pay-out for the loss of their rig, whereas BP was responsible for costs related to the well control.

Developmental drilling can also occur on mature fields, this is seen as lower risk, but the accumulation of risk can be far higher because an accident could also trigger a PD or LOPI loss.

### **Producing wells**

These are wells which already have a flow of hydrocarbons and are linked to a platform or FPSO. They are generally much less risky than drilling because the contents and pressures of a reservoir are known and can be monitored in real-time. Nevertheless, a blow-out can still occur and when it does the effects can be severe (see the recent Elgin loss). However, due to the low perceived risk, many companies do not even insure these so do not be surprised to see no producing wells on a schedule.

It is not uncommon for companies to insure shut-in or abandoned wells.

## **OEE Rating Factors**

These include:

- Limit
- Well type (e.g. exploratory, developmental, producing, shut-in etc...)
- Location
- Well depth (feet)
- Water depth
- Insured Interest
- Pressure and Temperature (risk wells are often labelled HTHP which means High Temp High Pressure)
- Rig Type
- Hydrocarbon Type
- Production (gross and net)
- Sewage & Pollution (if included)
- Redrilling costs (if included)

Traditional OEE rating was based on a function of depth usually expressed in terms of 'For-interest Footage', well type and water depth. Further underwriting adjustments may be made for other factors such as HTHP.

However, it is increasingly common to rate simply on "Authorisation For Expenditure" (AFE). The AFE could be interpreted as the budget for drilling a well. A high budget implies a complicated and potentially risky well and vice-versa. This means it is a good proxy for the joint effect of all the other rating factors. For example, a key cost for OEE is the re-drill cost or cost of a relief well. A good estimate of what this would cost is the AFE of the original well.

As previously mentioned, care needs to be taken where there is a clash between an insured's PD, OEE and LOPI coverage.

## **Third Party Liability (TPL)**

Despite the perception that offshore exploration and production is a risky activity, TPL often costs a fraction of the main PD/OEE/LOPI programme. In many cases it is part of a package policy, bought separately or a hybrid of the two where the package provides primary coverage and then only excess liability is purchased. Offshore TPL risk is generally lower than for onshore because there is a reduced potential to affect a third party in the middle of an ocean. Although there have been high profile cases such as Macondo, major oil spills are still rare and even when they do occur, only a minority might reach land and cause TP damage.

## Methods

Offshore energy losses are low frequency and high severity in nature. Therefore, even the largest energy companies are unlikely to have enough losses to build a credible model based on their own losses alone.

This means that most energy pricing revolves around the analysis of industry data and exposure and then making suitable adjustments to reflect a given insured's exposures.

There are two key data sources for any analysis:

- Loss data – internal data or third party sources such as the Willis Energy Loss Database
- Exposure data which summarises the activity corresponding to the losses you are analysing

Exposure data is important to put the loss data into context. For example, if we knew there were 10 deep-water drilling OEE losses per year it also helps to know if 10 or 1,000 wells have been drilled in a year.

Note that OEE is based on the “spud” date so a well spudded on the last day of the policy can be on risk for up to 90 days until drilling is complete, so a bit more IBNR needs to be factored in.

With Energy it is also most likely that you will be pricing a portfolio of assets rather than individual platforms or wells.

There are two high level approaches to pricing a risk which will be discussed in more detail below:

1. Explicitly model the portfolio
2. Apply standard rates to individual assets, make suitable adjustments and sum to get the total premium

### Explicit Modelling (similar to experience rating)

This can be using burning cost type methods or frequency-severity stochastic modelling; the advantage of the latter is that you can more easily assess impacts of deductibles and limits. A typical approach might be:

1. Identify appropriate industry loss and exposure data which is similar to exposures faced by the insured
2. Make suitable adjustments for inflation and IBNR using standard actuarial techniques
3. Calculate the frequency of losses per unit of exposure
4. Derive a frequency assumption based on insured and industry loss experience
5. Fit a claim severity model based on industry and insured's experience
6. Simulate losses using sampling techniques
7. Apply relevant insurance structure to estimate net losses to your company (e.g. after limits, deductibles and captive retentions have been taken into account)
8. Gross up net losses to a price allowing for capital considerations, expenses and commissions

The process might need to be done separately for different asset types and exposures e.g. FPSOs would require a separate model to OEE. Also check for any correlation between different coverages as part of step 5.

For nat cat exposures it may be appropriate to incorporate the outputs from a specialised exposure based model such as RMS (refer to Exposure Management section for more details).

## Rating Factor Approaches

The insurance premium is determined by use of base rates that apply by risk classification applied against premium exposure. These can be derived using an analysis of historical experience or taken from an underwriter's or broker's standard rating tables.

From an actuarial perspective, deriving rates is more satisfactory but not always possible. Base rates would then be adjusted for the rating factors described in earlier sections.

Care needs to be taken with deductibles and limits. Analysis should be done to estimate the reduction in loss cost for imposing a higher deductible. This can be done using industry data, burning cost or if all else fails 'standard' exposure rating curves or ILF tables.

## Other Considerations (for both methods)

<b>Capacity</b>	Many offshore energy risks are very large (e.g. sums insured of greater than \$5bn) and therefore push or exceed insurance market capacity. Some risks could require participation from almost the entire market and so pricing can be more driven by supply and demand rather than loss expectancies.
<b>High Limits</b>	There have been very few losses greater than \$1bn. Therefore modelling the risks for high excess layer programmes in excess of this is difficult and pricing is likely to be capital driven or be subject to 'minimum rates on line'
<b>Mutuals</b>	There are a number of Mutuals which offer Energy coverage such as OIL. These provide pricing challenges for the commercial markets because the commercial market policy may 'wrap' around the Mutual. The pricing actuary should be clear what is and isn't covered by the mutual.
<b>100% or For Assured's Interest (FAI)</b>	Limits and deductibles are either expressed in 100% terms or FAI. 100% means that the limits and deductibles would scale for the insured's interest in an asset. FAI on the other hand is fixed whatever the insured's exposure may be. This is important for pricing because a \$5m deductible (FIA) on an asset with a 5% share means that a loss actually has to exceed \$100m. Whereas if this was for 100% the loss only needs to exceed \$5m to trigger a claim. Most confusingly of all, you may come across limits expressed one way and deductibles the other!
<b>Captives</b>	Energy company captives often provide significant capacity and can have retentions in the hundreds of millions of dollars



# Other Classes

## War

Perils covered could vary depending on the company. Political Risk, Political Violence, Kidnap & Ransom (K&R), Terrorism and War risk could have their individual classes or they could get grouped. Pricing methodology varies as the rating and risk factors for these vary. The discussion in this context is purely on War risks related to Marine and Energy.

There is very little data for these classes that derive a statistical tested rate as events are very rare and unique. The overall methodology is based on rate on sum insured that is adjusted for rating factors. The insurance companies that specialise in these classes mainly focus on monitoring aggregations and limitations they have put on themselves given their risk appetite.

## Marine Liability

The main perils in this class are property damage, bodily injury and business interruption to third parties within marine. (NB: P&I is dealt with separately above). This could include big events like clean-up of oil pollution or a removal of wreck, and small events like a fall that causes injury to an individual at a port or marina.

Subclasses of Marine Liability coverage are Shipowners and Charterers' Coverage Liability (some which fall outside P&I clubs), Ports and Terminals, Stevedores (i.e. operators or contractors within ports and terminals), Marinas, Storage and warehouses Liability, Yacht Liability (some elements of yacht liability go to Yacht P&I clubs and some fall into commercial markets).

The pricing methods vary depending on the type of liability that is covered. It is common to see pricing per tonne or price per million. Also the coverage can be in layers of cover. Various curves are used in pricing layered business hence pay special attention to the curves used. Compared to other classes in Marine the tail of development and claims inflation are significant considerations here.

The liability element of Energy coverage is also in Marine Liability. Do take special care regarding package policies which combine property damage and liability.

## Specie

There are multiple sub classes within Specie. Fine art, Jewellers Block and Goods In Transit are some common classes within Specie. It can be categorised as precious cargo. Usually the values are high and irreplaceable. The values could be subjective. Damage to fine art and hence the loss in value could be subjective. However the theft of diamonds or gold bullion is specific with their own claims characteristics. There are significant catastrophe exposures that are usually very poorly modelled. The pricing is basically a rate on sum insured and is dependent on the item and its value and the layer of coverage.

## **Pleasure Boat & Yacht Insurance**

There are two basic sections of a typical boat or yacht insurance policy: physical damage and liability. The physical damage section covers accidental loss or damage to the boat and its machinery. The liability section, sometimes referred to as Protection & Indemnity, covers legal obligations to third parties.

The underwriter must consider many factors when determining the rate (or premium) to charge for a boat policy. The most common determinants are: value, length, and age of boat; type of boat (i.e. power, sail); type of engine(s); intended area of navigation; mooring location; previous boating experience and claim history of the owner; and deductible amount.

Other rating considerations are:

- Lay-up period (time yacht is out of commission, such as during winter months in colder climates).
- Limited navigational coverage; e.g. East Coast of US rather than Worldwide coverage.
- Attendance and completion of safe boat courses.
- Installation of safety devices e.g. automatic fire extinguishing system in engine compartment, a fume or vapour detector in the bilge, or certain anti-theft alarm or tracking devices.

## **Ports and Terminals**

This covers Port Authorities and Terminal Operators. The main perils are:

- All Risks (Physical loss or damage)
- Business Interruption
- Machinery Breakdown
- Vessel impact
- Port and berth blockage

Individual assets on the rating schedule are priced, separately by PD and BI.

It is also important to monitor exposure aggregations and adjust the pricing for Cats such as windstorms and earthquakes.

## **Builders' Risks**

This insurance covers vessels under construction or conversion at a shipyard. Perils include damage to the vessel, damage to on-board equipment, faulty materials, faulty workmanship, an unsuccessful launch attempt and removal of wreck. Pricing of the risk is based on the Final Completed Value plus period of cover, and varies by the type of level.

# Generic Facultative Pricing

Note that this section does not refer to Treaty or Excess of Loss pricing, since this Paper is focused on individual risk pricing.

The method is effectively a quasi-‘reserving exercise’ though forward looking. Ideally this involves triangulated data, with preferably up to ten years of history. Ultimate premiums and claims are generated using standard actuarial techniques (e.g. chain ladder, BF, Mack, Bootstrapping etc), but these need to be trended forward to cover the renewal period. Therefore ultimates should be adjusted for:

- Claims Inflation
- Changes in exposure
- Changes in deductibles
- Large claims, both actual and expected
- Previous policy T&Cs
- Legislative and other external environment changes

Data should be analysed at the 100% level rather than company / syndicate share to avoid impact of change in line size. Metrics to analyse include:

- Gross Net Premium (prior to any PCs and contingent commissions)
- Paid Claims
- Incurred Claims
- Claims volumes

## Model Outputs

Although outputs may vary by class of business, the key metrics include:

- Technical premium
- Expected burning cost
- Technical Loss Ratio
- Technical Return on Capital
- Rate change / movements in premium
- Adequacy of insurer premium calculated to that presented by the broker
- Adequacy against similarly rated contracts
- Risk appetite (by subclass; e.g. cargo type, geographical routes)
- Entity exposure – maximum line size, exposure to single assured or a particular broker
- Average rate achieved

# C.Exposure Management

Exposure management views risks at the macro level, intertwining key areas within a general insurance company such as capital modelling, business planning, portfolio management and reinsurance purchasing. This understanding at a whole account level, particularly the interaction between different classes, is what then feeds the individual case pricing of marine & energy risks.

Exposure management is effectively managing your exposure to natural & man-made catastrophe perils and accumulations of risk. Accumulation occurs when more than one risk can be involved in the same event. This is a very common problem in marine & energy although the monetary amount of the total accumulation may often be difficult to quantify due to lack of information on the location of the insured interests. Typically the largest accumulations in marine occur in:

- Ports and Airports: accumulation of cargo and hull interests
- Vessels: accumulation of cargo and crew/passengers
- Warehouses/storage locations: accumulation of cargo
- Shipyards: accumulation of vessels under construction
- Marinas: accumulation of yachts
- Energy: clash accumulation from assureds with different interests on different policies

To aggravate the problem, the size of this accumulation has steadily increased in recent years as the size of the vessels, storage locations and platforms have increased e.g. new Floating Liquefied Natural Gas ("FLNG") Prelude.

## Risk/Cat clash matrix

In order to summarise the sources of potential accumulation in a marine portfolio and to provide an indication of the severity, we have produced a clash matrix.

The matrix considers:

- different natures of events such as natural and man-made catastrophes
- class clash between marine lines of business, e.g. cargo and hull interests affected due to damage to a cargo vessel,
- risk clash within lines of business e.g. several policies in a cargo portfolio hit as consequence of a flood
- The grade from 1 to 5 gives an indication of the frequency and the severity of the loss for the different marine classes, with 1 being the least and 5 being the most severe.

## Risk/Cat clash matrix

	Cargo	Specie	Hull	Yachts / Small vessels	Energy PD	Energy Liabs	Marine Liabs	Natural Perils
Cargo	4	2	4	1	2	2	4	5
Specie		4	1	2	1	1	1	5
Hull			3	2	2	2	5	2
Yachts / Small vessels				3	1	1	3	4
Energy PD					5	5	2	5
Energy Liabs						5	3	5
Marine Liabs							3	2

## Hull and P&I

In the case of an incident, together with the damage to the assured's own ship<sup>2</sup>, covered by the Hull & Machinery policy, the ship-owner is liable for unintentional damage to third parties such as crew, passengers and cargo owners. The assured is also liable for the removal of the wreck and eventual cleaning actions in case of pollution.

### Loss Example:

- 2012 Costa Concordia, Italy. During the night of the 13th of January 2012 the cruise vessel Costa Concordia sunk along the coast of Giglio Island in Italy. Thirty two people died. The vessel was written off as a constructive total loss generating a loss for the hull market of 515m USD, this being the total insured value. The P&I policy covers third party liability to passengers, crew, removal of

<sup>2</sup> In case of Collision with another vessel the hull policy includes damage resulting from a total or partial loss of own ship and for liabilities to the other ship (Running Down Clause). P&I will be liable for the portion of costs not covered by the H&M cover.

wreck and to damage to the island. The hull was required to be refloated in one piece and towed to Genoa in order to minimise the environmental impact. At the time of this paper, a salvage operation on such a large scale had never been tried before and it is generating unprecedented costs for the P&I sector.

## **Cargo**

For cargo it is very common to observe static risks of the same portfolio simultaneously exposed to the same event, particularly in case of natural catastrophes. For these events, ports and warehouses are generally the locations where the accumulation is largest. Man-made events such as fire or incidents on board cargo vessels can also trigger clashes in the same portfolio. The accumulation of cargo is often very difficult to control due to the lack of information on the location of goods at any point in time.

### Loss Examples:

- 2008, Emden, Germany. Hail damaged up to 30,000 brand new Volkswagen cars. Hail is considered one of the most difficult perils to model due to the very local nature of the event. It is very common for an underwriter that writes this product to face very large accumulations (one policy covers the transit of a large number of cars from the same dealer/manufacturer).
- 2011 Thai floods, Thailand. Heavy rain caused water levels to rise in the area around Bangkok. At the time there was very limited knowledge of the extent of accumulation of static cargo in this area, and the event produced unexpected large losses.

## **Offshore Energy**

When an Offshore Energy loss occurs the physical damage element of the oil rig is paid by the Energy Physical Damage (PD) policy, but many other covers can be triggered in the same event. These covers can include control of well, bodily injury, oil pollution, removal of wreck and loss of hire. Most of these can be written in an energy package or as a stand-alone Energy liability cover.

Many parties can be involved in the same event as commonly the rigs are leased/owned as joint ventures and the activities are outsourced to contractors. Each party will have a separate policy for liability that can be purchased in the marine or sometimes in the casualty market.

The same claim event can impact different assets simultaneously. This is most common in the case of natural catastrophes but it can also occur in the case of interconnected offshore facilities. The Gulf of Mexico has the largest concentration of offshore platforms and has produced large losses as the result of Hurricanes such as Hurricane Katrina.

Offshore Energy has several complications for aggregate modelling. Pipelines are difficult to model as they can cover great distances rather than being located in a specific location. It is also difficult to model mobile drilling units as their location is not fixed.

### Loss Examples:

- 2010, Deep Water Horizon, US. The Transocean owned Deepwater Horizon semi-submersible deep-water rig was contracted to the field operator (BP) to drill the Macondo well 40 miles offshore Venice, Louisiana. During cementing operations there was a sudden uncontrolled release of gas that ignited explosively. There was an ensuing fire requiring an immediate evacuation of the rig. The rig collapsed and sank to the seabed 2 days later and was an Actual Total Loss. The Transocean insurance package responded by paying for the total loss of the rig (\$560m, of which \$270m was insured by Lloyd's<sup>3</sup>). The well released hydrocarbons for 3 months resulting in a major pollution incident and 4.9 million barrels of oil spilled.

There were many policies affected by the incident with coverages including property damage, control of well, pollution, D&O and business interruption. Many Energy liability policies responded including joint-venture partners Mitsui and Anadarko as well as cement contractor Halliburton and Cameron International (blowout preventer). BP was mainly self-insured through its captive Jupiter.

- 2005 Hurricane Katrina, US. Strong winds and storm surge impacted multiple marine and energy lines. This is an example of Marine lines clashing with other P&C lines mainly property.

## **Specie**

Specie and in particular fine art can be highly affected by natural catastrophes. Accumulation can be observed in museums and galleries, but natural cat events can also affect large zones and cause damage to a large number of private collectors (who generally apply weaker loss prevention measures than museums and galleries). Large storage accumulation of values can be found in specific locations such as the Geneva Free Port and diamond centres such as Antwerp.<sup>4</sup>

### Loss Examples:

- 2003 Antwerp Diamond Centre, Belgium. The theft of loose diamonds, gold, and other jewellery valued at more than \$100 million in the Antwerp Diamond Centre. Numerous assureds used the same location to store precious stones creating accumulation for insurers.

- 2012 Superstorm Sandy, US. Sandy produced a record wind speed and storm surge flooding highly populated areas on the east coast of the US. In the marine market Sandy produced severe damages to warehouses and art galleries in New York. The loss particularly for the fine art market was unprecedented.

---

<sup>3</sup> Lloyds, Drilling in extreme environments: Challenges and implication for the energy insurance industry

<http://www.lloyds.com/~media/Lloyds/Reports/Emerging%20Risk%20Reports/Lloyds%20Drilling%20i n%20extreme%20environments%20V5c%20Single%20pg%203.pdf>

<sup>4</sup> [http://en.wikipedia.org/wiki/Antwerp\\_Diamond\\_Heist](http://en.wikipedia.org/wiki/Antwerp_Diamond_Heist)

# Methods

## Dependency Modelling

Modelling dependency between different lines of business can be modelled in a number of different ways depending on the level and nature of the interaction, and computational restraints. For Marine and Energy classes of business, where natural catastrophe events are not well defined by vendor models, ad hoc techniques are necessary to model the accumulation effects.

There are numerous methods used to model the dependencies within marine classes. Understanding the likely scenarios that could occur is key to modelling the dependencies. The dependencies within a line of business and between two lines of business should be considered separately.

## Copulas

Copulas are used to combine probability distributions. A copula is simply a probability distribution function that combines individual (cumulative) probability distributions into a joint (cumulative) probability distribution. They get their power from Sklar's Theorem<sup>5</sup>, which says this is all you need to describe any relationship between random variables.

Copulas are particularly useful for modelling non-linear relationships. For general insurance lines of business the relationship between losses from two lines of business may be sensitive to, or conditional upon, the percentile observed in one of the distributions. The strength and nature of the relationship may vary from one part of the distribution to another. This is relevant to general insurance lines of business where the relationship between the right hand tails of two loss distributions might be strong and non-linear compared to a weaker and more linear relationship between the bodies of the same distributions.

To use a copula we need to select the analytical form of the copula and calibrate the relevant copula parameters. There are several different forms that are commonly used<sup>6</sup>. The Gumbel Copula is the most commonly used in general insurance as it exhibits strong tail dependence, appropriate for modelling clash losses. It is parameterized via a single parameter.

Copulas are often implemented through stochastic simulation. There are a number of possible methods to model clash losses. The following are two of the most prominent approaches:

1. If losses from the marginal distributions are modelled using an aggregate distribution approach then the copula can be applied to the marginal distributions directly to arrive at the overall loss aggregate loss distribution adjusted for the relationship between the lines of business.

---

<sup>5</sup> Additional information on Sklar's Theorem <http://mathworld.wolfram.com/SklarsTheorem.html>

<sup>6</sup> Additional information on Copulas: <http://www.actuaries.org.uk/research-and-resources/documents/b03-it-all-depends%E2%80%A6>



2. If losses from the marginal distributions are modelled using a frequency-severity approach then the set of clash events contributing to the marginal frequency distributions need to be modelled before applying a copula to the marginal severity distributions to arrive at the overall loss distribution adjusted for the relationship between the lines of business. An example of the implementation of the second method is provided below.

In modelling a clash between classes of business (e.g. a cargo risk and a hull risk when a ship sinks), we must consider which classes of business can clash and with what probability this is likely to happen. Considering the earlier Risk/Cat Clash Matrix, we would need to allocate a probability to each square of the matrix, e.g. 5 = 40%, 4 = 30%, 3 = 20%, 2 = 10%, 1 = 5%. These probabilities will be called the 'clash probabilities', and they represent the conditional probability that a given event in class 1 also impacts on class 2, that is:

The frequency for each class of business is split into a 'clash' component and an independent (or residual) component. The 'clash' component will be called the 'clash frequency'.

The clash frequency can be calculated using the formula below:

Average (frequency class 1 \* clash probability, frequency class 2 \* clash probability)

(This assumes that the frequencies are measured using a consistent exposure base, otherwise you need a weighted average formula.)

The residual class frequency is then the sum of all class frequencies affecting that class subtracted from the original frequency.

If this results in the class frequency being negative the copula frequencies can be calculated using the minimum instead of average above. If the class frequency is still negative the clash probability assumption may need revising.

### **Clash Within a Class of Business**

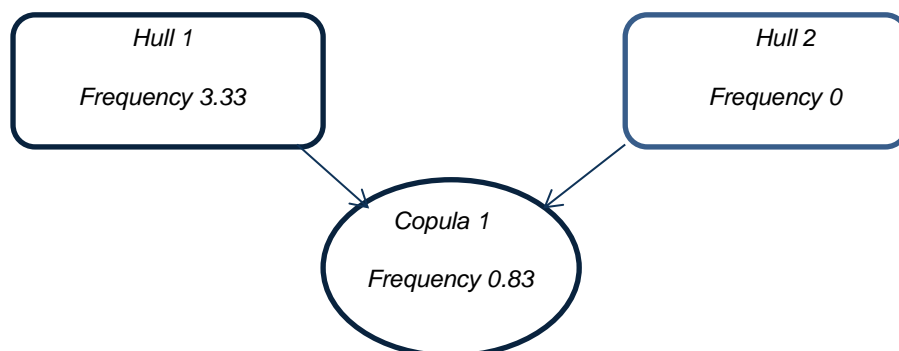
Clash within a class of business (e.g. two vessels colliding) can be modelled by considering the distribution of the number of claims in a possible event. The frequency parameters for the class can then be split into component frequencies per event by dividing by the average number of claims per event and multiplying the frequency by the probability from the distribution. A copula is then needed to correlate the multiple claim event classes.

#### Example

The Hull class has a frequency of 5 claims a year above a given threshold, and we assume that 80% of these claims occur from 1 claim event and 20% of the claims occur from 2 claim events. Then the Hull class would be modelled as 2 separate classes, Hull 1 (1 claim events) and Hull 2 (2 claim events). The average number of claims per event is 1.2 ( $80\% \times 1 + 20\% \times 2$ ).

So the frequency of Hull 1 events is 3.33 ( $5 / 1.2 \times 80\%$ ) and the frequency of Hull 2 events is 0.8333 ( $5 / 1.2 \times 20\%$ ). Note that the original claims frequency of five events per year is maintained ( $3.33$  events with one claim,  $0.833$  events with two claims, for a total of  $3.33 + (0.833 \times 2) = 5$  claims per year).

Then in a similar way to the example above, a clash frequency is needed containing all of the frequency from the Hull 2 class. The Hull 2 now has 0 residual frequency (so that every claim is a correlated claim). The severity distribution is unaffected.



### Data Required and Issues Involved

Copulas require the Individual distributions of each random variable to be correlated. This will be available from the underlying modelling.

The form of the copula is needed; the choice of this may be restricted by computational restraints if using a proprietary model.

The matrix defining the correlations between each class is vital and highly subjective. The actuary will need to exercise his/her judgment when selecting the probability with which the classes correlate. The underwriter/broker is best placed to estimate these probabilities, different underwriters will have different views and they may be reluctant to give actual percentages.

## Natural Catastrophe Models ("vendor models")

### Method and Data required

The main difficulty in assessing marine accumulation is caused by the scarcity of information on the location of the risks. Information on cargo transiting through ports and airports is not tracked by the insurance companies. For cargo insured under open-policy covers the exact value and number of shipments is not declared; only the policy limit for each transit is known. On this topic an increasing number of technical documents have been published in the latest years (see Guy Carpenter<sup>7</sup> and Swiss Re<sup>8</sup> publications). The approaches described in such documents refer to company proprietary models. There are no vendor models for transit cargo is currently available.

<sup>7</sup> Cargo Accumulation Modelling - The Guy Carpenter Approach (2007)

<sup>8</sup> Safe Havens: Measuring natural catastrophe exposure to cargo traded through ports (2010) / Safe havens revisited – an update of Swiss Re's cargo accumulation model (2011)

In the case that the location of the risk and its value can be defined, the traditional natural catastrophes models (used for property lines) can be seen as a solution. These are used to evaluate the exposure of static cargo (cargo in warehouses), builders' risks (shipyard accumulation), yachts in marinas and fixed energy assets such as platforms and oil wells.

Most of the natural catastrophe models either developed by vendor companies or by insurance/broker companies present the same structure which can be summarised in 4 steps:

- **Exposure:** the user defines the exposure distribution that corresponds to the list of a portfolio's objects and their characteristics. This should include information on the type of risk and its physical characteristics e.g. building type, location, monetary value and policy conditions.
- **Hazard:** The natural catastrophe model simulates catastrophes events. For each of these simulations an intensity is associated to each specific location hit by such event. When applying the Exposure data to the Hazard, we obtain a description on how badly each insurance object has been hit by each simulated event.
- **Vulnerability:** The Vulnerability defines the level of damage as consequence of natural catastrophe event on a specific portfolio object. This is typically described by the mean damage ratio which is the ratio between the anticipated loss over the value of the portfolio object and it is represented as a function of the intensity of the natural catastrophe event (i.e. intuitively the stronger the intensity of the event the higher the damage ratio). This result is called the vulnerability curve. The curve changes its shape dependent on the type of peril considered (earthquake, hurricane etc) and the characteristics of the insured object.
- **Financial loss:** The damage ratio calculated in the previous 3 steps can now be combined to the monetary amount of the portfolio objects. This value together with the policy conditions will allow translating the physical damage to the incurred loss amount.

## Issues with Method

Natural catastrophe modelling has been developed with the property insurance market in mind. Property experts have worked intensively on these models for the last 20 years and have accumulated a significant amount of experience. When applying it to marine we face a large number of potential pitfalls and limitations.

For some marine risks, although the location is known the value of the portfolio might fluctuate during the year. This is the case for warehouses where the high seasonality of the shipping market changes quantity and quality of the goods in storage all through the year. The marine actuary should use the best method to capture such fluctuation of values, for example adopting average inventory values, or Maximum Probable Loss ("MPL") adjustments. At the same time the seasonality of the perils should also be considered along with the seasonality of the exposure, for example Gulf of Mexico storm season officially runs from 1st June to 30th November. If the most intense months in terms of shipping activity should coincide with the storm season one should allow capturing such peak events in their model and should not limit the analysis only to average values through the year.

Along with difficulties in valuation, it is very common that some key information, such as the type of building where the risks are stored, is missing. This can create difficulties in selecting the right vulnerability curve. The marine actuary should give importance to the selection of the correct occupancy type. Catastrophe losses may vary significantly from modelled results if the assumptions are different from true exposure details. One model vendor, RMS ("Risk Modelling Solutions") shows in a case study that inaccurate information can lead to underestimation of 400% of the loss cost, mainly driven by geocoding errors and wrong occupancy types<sup>9</sup>.

Not only the type of building but also the type of good has an importance as the packaging and the level of attention during transportation and storage will be different for different types of good. Intuitively goods stored in containers will be less vulnerable to a natural event than goods stored in open air. In regards to types of goods, it is of key importance to analyse the cargo risks separately from the specie risks. Specie risks are in general much more protected. Classifying a specie risk as simple "content" (content is one of the vulnerability adjustments available in RMS) is making the assumption that these high value goods are treated as common furniture which is generally not the case. The actuary should recognise the loss mitigation measures adopted in the specie market using maximum probable loss factors or by using modifiers within the catastrophe modelling process.

For risks such as newly built-vessels it is important to consider the construction period which for large or complex vessels is generally longer than one year. The value of the risk is not constant over time and it usually increases at the end of each construction phase until it reaches its full value at delivery time. The actuary should consider value adjustments accordingly with the different building stages: these can vary by the type, size and complexity of the vessels. Moreover they should consider the eventuality that more than one almost finalised risk (thus highest exposure value) are situated in the same yard at the time the natural catastrophe loss occurs.

## Realistic Disaster Scenarios (RDS)

### Method

The idea of RDS events is to consider scenarios which do not occur frequently but are realistic and can occur. Realistic disaster scenarios can be used to ascertain the potential exposure an insured may have to specific types of events. Lloyd's requires syndicates to complete exhibits which include a number of RDS events. Insurers, outside of Lloyd's, could use a similar methodology to understand their exposure to these types of events.

The process of estimating an RDS event also helps an insurer to understand more clearly what their aggregations may be and what kind of mitigating actions (such as reinsurance purchasing/aggregation management) might be required.

Examples of RDS events requested by Lloyd's are:

---

<sup>9</sup> A Guide to catastrophe models – The Review, in association with RMS, 2008

- Windstorms with a specific storm footprint
- Earthquake with a specific footprint
- Specific marine loss events

The first two examples pose the usual problems with using vendor models to estimate marine losses. Please see the section above for more details on considerations that should be made.

An example of a specific Marine event is:

A fully laden tanker is involved in a collision with a cruise vessel carrying 500 passengers and 200 staff and crew. The incident involves the tanker spilling its cargo and there is a loss of lives aboard both vessels. Assumptions will need to be made about the apportionment of negligence between the tanker and the cruise vessel. In addition, the location of the incident is likely to have a large impact on the liability exposure. If we assume the collision occurs in the US then the average liability settlement per person is likely to be higher than in other parts of the world.

An assumption is required about the cost of oil pollution. A realistic assumption could be in the order of \$2bn. This would lead to oil pollution recoveries on the International Group of P&I Associations' General Excess of Loss Reinsurance Programme (IG RI programme).

An assumption would be required of the number of fatalities arising from this incident. The Lloyd's RDS has an example of 125 fatalities, 125 persons with serious injuries and 250 persons with minor injuries. If, as discussed above, the collision occurs in the US the liability settlement is likely to be higher than in other parts of the world. The assumption within the Lloyd's RDS scenario is an average compensation of \$1.5m for each fatality, \$2.5m for each person with a serious injury and \$0.5m for each person with minor injuries.

The above example provides an indication of an insurer's potential exposure to large, realistic, even if not frequent, events. The exposure will come through various lines of business including potentially the hull, cargo and liability lines of business.

## **Data Required**

The data required for assessing the insurer's exposure to the above kind of example will be:

- The details of the line sizes that the insurer writes for tankers
- The details of the line sizes that the insurer writes for cruise vessels
- Potential line size on the IG RI programme
- The current reinsurance contracts in place as an indication of both the gross and net exposure is important

In addition, when setting the RDS scenario, assumptions will be required about the following:

- Cost of oil pollution
- Apportionment of losses between the various parties
- Location of loss
- Assessment of likely compensation settlements for various parties involved
- Number of fatalities and other injuries

## Issues with method

The RDS approach gives an insurer an idea of how much exposure they may have to specific events. The approach does not provide the insurer with an understanding of how likely this event would be. Insurers would need to do further market research to understand the likelihood of these kinds of events happening as well as the likelihood of the insurer being on risk when an event like this happens.

There are a number of assumptions feeding the above calculations, which will not necessarily be correct in practice. Sensitivity testing some of these assumptions may help in ascertaining the various outcomes for RDS events, for example different hurricane tracks or accumulations of different geographical regions.

In addition, limitations of the vendor models being used need to be taken into consideration, for example the current inability to accurately model pipeline specific losses for Offshore Energy.

## Probable Maximum Loss (PML) method

For some regions and classes, it is not possible to use vendor models or the RDS approach as they may not be available. For example, a fleet of tug and barges operating in Louisiana will have exposure to Gulf of Mexico windstorms but this would not be included in either the Lloyd's RDS or standard vendor models.

It is possible to estimate potential losses with a combination of assumptions about frequency of events and the damage they will cause. It is possible to use an event set from a Cat model for the frequency of events but the damage requires additional assumptions.

## Loss = Hazard x Exposure x Vulnerability

For standard property exposures, it is reasonable to assume the location of the building will be fixed but that is not the case for Hull exposures.

It is difficult to predict the location of vessels at any point in time due to the mobile nature of boats. However some attempt should be made to consider trading patterns to estimate the expected locations of the fleets. This can then be used to estimate the probability of the vessels being in the storm track when a Hurricane warning is issued and therefore the exposed values.

The advantage that boats and some classes of mobile drilling units such as drillships and rigs have over conventional assets is their ability to move out of the way of a Hurricane. This can help to mitigate potential exposures. Factors which need to be considered include:

- Type of vessel (faster vessels more able to avoid weather)
- Permanent crew or unmanned
- Hurricane plans in place
- Requirement for outside assistance (e.g. barge without dedicated tug)
- Potential for machinery breakdown preventing evacuation
- Time required to move off location (e.g. liftboats and laid up vessels)

The overall loss can then be estimated as:

$$\begin{aligned} \text{Loss in Cat X Hurricane} = \\ \text{Total value of Hulls} \times P(\text{vessel in storm track}) \\ \times P(\text{not able to move out track}) \times P(\text{loss given Cat X}) \end{aligned}$$

This methodology requires more judgement and assumption compared with vendor models and RDS approaches but can be used to produce a probabilistic claims estimate where the other two can't. Other approaches include a loading added to the non-cat loss cost but this assumes the potential losses from natural catastrophes are directly proportional to those coming from other perils.

## Uses

Catastrophe modelling is an important part of Marine and Energy pricing and forms a large part of the loss and capital cost for many policies written.

Exposure Management is also used in many different ways by many different departments. Uses include capital modelling, outwards reinsurance purchase, setting aggregate caps by peril and region, business planning, and portfolio management.

The most common use is capital modelling where a global view of the company is required. Exposure management is an integral part of this process.

Reinsurance purchasing requires whole account analysis at different levels such as a single account for a facultative purchase or all Marine and Energy classes for a whole account cover. The Marine reinsurance market often provides cover on a combined risk and event basis which differs from the non-Marine market.

Understanding exposures helps to set aggregate limits for specific peril regions such as Gulf of Mexico windstorm. It can also assist with setting risk limit such as maximum allowable exposure in a port or a specific offshore facility.

It is important to quantify exposures when business planning and also to anticipate requirement for future capital as the underlying exposures change. The Marine market can produce unexpected exposures due to the global transient nature of many classes such as the movement of cargo or vessels. Every natural catastrophe or major marine incident is unique and provides lessons to be learnt and evolution of the market.



# D. Rate Change

Rate change is widely used in the insurance and reinsurance markets with rate indices not only relied upon internally but also by reinsurers and regulators such as Lloyd's. Rate change typically measures the variation in the Expected Loss Ratio (ELR) for a contract from one insurance period to the next and gives a gauge as to the current rating environment and market conditions faced by the underwriter. This information is vital for both the underwriter and management to understand where the business is positioned with regard to the underwriting cycle, allowing management to make strategic business decisions to maximise profitability. This section explores the following elements of rate change:

1. Definition of rate change and why it is important
2. The regulatory reporting requirements for rate change
3. Suggestions for best-practice rate change and rate monitoring
4. Example rate change
5. Dealing with the challenges and pitfalls of rate change

## Definition of rate change and why it is important

The focus of this section is the Risk Adjusted Rate Change (RARC) which, for an individual contract, can be defined as a measure of the change in rate charged per unit of exposure. Note that this is as opposed to change in profitability which can be assessed using Pricing Models discussed in the earlier Methods section.

There are alternative measures of rate change, including the simple change in premium between insurance periods. However, a pure rate change calculation removes all the other factors affecting the premium charged e.g. change in deductible, change in terms and conditions, change in coverage, change in exposure etc. thus giving a true measure of the amount the underwriter has been able to charge, all things equal, for a particular contract.

In essence, the RARC calculation involves calculating the price that would have been charged for the same risk in the previous insurance period, given the current coverage. The risk-adjusted rate change calculation is:

$$\frac{(\text{Price charged this year} - \text{Price charged for this year's coverage last year})}{\div \text{Price charged for this year's coverage last year}}$$

The weighted average rate change across a portfolio of contracts is typically calculated and combined with the rate changes for historic years of account to form a rate index. The change in rates over time illustrates the underwriter's view of the underwriting cycle and the movement from hard to soft market. Monitoring of rate change on the current book of business being written is vital in order to understand where the business is in relation to the cycle so that appropriate management decisions can be made to manage the business through the cycle.



Rate indices are commonly produced at the class of business level and are used to on-level historic loss ratios to the current rating environment. This information can then be used within a number of processes across the business including reserving, profitability monitoring and business planning.

It is widely known that, for London Market business, the degree to which rate change calculations can be automated is limited. The use of subjective judgement is prevalent, particularly in the Marine and Energy markets. As part of this paper, a survey has been undertaken to determine current market practices, focussing on the Marine and Energy classes, to identify best practice so that this can be applied more widely (see later in this section for Marine and Energy specific examples of the challenges faced when calculating the RARC.)

## The Regulatory Reporting Requirements for Rate Change

Lloyd's have certain requirements of managing agents in relation to rate monitoring for their syndicates. Lloyd's set out their Minimum Underwriting Standards on their website:

[http://www.loyds.com/the-market/operating-at-loyds/performance-framework-of-minimum-standards/underwriting\\_management](http://www.loyds.com/the-market/operating-at-loyds/performance-framework-of-minimum-standards/underwriting_management)

However, non-Lloyd's Marine & Energy Insurance and Reinsurance companies are not required to report rate change information to regulators, though will calculate rate change for their internal reporting purposes.

## Suggestions for Best Practice Rate Change and Rate Monitoring

### **New vs. Renewal Business and Lapsed Business**

Our survey of current practices (see later section "Use of Actuaries in Marine and Energy Pricing") indicates that rate change is calculated for all Marine and Energy renewal business across the market. However, limiting the view of rate change/profitability to just the renewed business has its limitations and analysis of new as well as lapsed business can provide insightful Management Information ("M.I."). Indeed, with the trend towards the soft market continuing, increasing numbers of market participants are recognising the benefits to be gained from also monitoring rate changes for new and lapsed business to help manage the cycle (25% respondents reported that rate change is monitored for new business and 10% for lapsed business).

Provided the data is available, calculating rate change on new business should be encouraged. If, for example, business was not written in the preceding insurance period but

the business was quoted for and the actual price charged recorded, then this would allow the (re)insurer to calculate a rate change despite the business being recorded as “New”. Alternatively, if expiry information is available, this can be used as the basis of the rate change calculation. This would complement the rate change information derived from the renewing business and allow for the monitoring of any trends in new versus renewal business which can then be acted upon.

Management will be interested in understanding the quality of any new business written, particularly if the business is a competitor’s declined renewal business or indeed business declined by the underwriter in the previous insurance period. As such, the monitoring of rate changes split by renewal and new business would provide M.I. to aid understanding of the pressures faced by both the new business and renewal markets.

The initial view of the profitability of such new risks can also be monitored against emerging experience to validate (or otherwise) those initial assumptions. Again, this MI will help to shape the book of business written with the declined worst performers acting to improve the loss ratio of the class as a whole.

Extending the view of rate change even further from the universe of contracts actually written is equally, if not more, insightful. If a contract has been declined as it is perceived to be paying too little, recording the rate change on that business can provide evidence to support the business decisions made by the underwriters and management. Equally, if a renewing contract is quoted for, but the placement goes elsewhere, this is important for underwriters and management to be able to monitor.

This enables management to understand more about the competitiveness of the market and to assess any trends prior to taking any action. Collecting and recording the terms on the lapsed business is required for this calculation and not all underwriting systems are set up to deal with non-written contracts. Collaboration with the IT department/actuarial team to find an alternative means of recording this information can be worth the additional investment, especially in the soft part of the cycle when profitability of the business written is under increasing scrutiny and underwriters have to justify the decisions made even more than normal.

There is no “ideal” solution to the issue of data capture as this will depend on the systems in place, the resources available and the objectives of management, but the solution doesn’t have to be overly complicated or sophisticated. A simple Excel file with a database sitting behind it can be just as effective as an all-singing, all-dancing quotation system. (In this context the quotation system may well be more useful for other purposes!) The key is that the underwriters understand the objectives, can use the tools available and can appropriately interpret the MI produced.

If data is not available for calculating rate change for new and lapsed business, another alternative may be to consider how the renewal rate change compares to broker estimates. However, it may be difficult to establish whether the broker estimates represent ‘pure’ risk adjusted rate changes.

# Enhanced RARC Calculation

Although it is common for the pure rate change to be monitored by contract and by class, the monitoring of the various elements of the rate change can also provide useful M.I. The Lloyd's guidance can be taken one step further and the rate change calculation broken into additional elements which can still be aggregated for Lloyd's reporting purposes. This could provide greater insight into the conditions prevailing in the market as well as any trends with assured's behaviour and thus assist with strategic decision-making for the business.

Breaking out the following elements of the rate change calculation can all go some way to enhancing the existing calculations:

- Exposure
- Limit
- Excess
- Deductibles
- Terms and Conditions (e.g. Wordings, Brokerage, Profit Commission, NCBs, and other Conditional Credits)
- Separate Nat cat and non-Nat cat rates (GOM Energy contracts)
- Territory

As an example, separating change in deductible from change in attachment point (as grouped together by Lloyd's) can be useful for analysing how in the Marine Hull market deductibles have not been changing in line with ship values over recent years, meaning that larger claims can be expected with the assured retaining a smaller overall proportion. Isolating the individual elements making up the overall rate change is required if the data is intended to justify such statements.

An underwriter may sense there is an emerging trend for assureds to retain a greater proportion of the risk and he may have a view on what this has done to the premium charged for the portfolio as a whole. The suggested M.I. capture set out above could provide the evidence to back up these statements by making the premium attributed to the change in excess point more readily available for calculations.

The more granular the calculations, the more insightful the M.I. and the more appropriate the strategic decisions taken can be.

As a guide, the majority of Lloyd's syndicates appear to record the components of rate change mandated within the Lloyd's guidance if relying on subjective underwriter judgement. Non-Lloyd's entities and Lloyd's syndicates basing rate change calculations on rating model calculations, however, tend to record more components of the rate change (typically 5-10 components). For most entities (90% of those sampled), the components of rate change are standardised across the Marine and Energy classes within a particular organisation.

# Binders/Lineslips

Common practice for a binder/lineslip is for the underwriter to predict the rate change for the entire contract at the outset, before any risks have been bound. This means that the underwriter has to rely on information provided by the broker as well as knowledge of the current market conditions.

The challenge with updating this figure, as risks are written under the binder/lineslip, is having the data available to calculate the rate change in a user-friendly format so that a weighted average rate change calculation can be made across all renewing risks. The input of declarations data is manual and labour intensive. However, carrying it out does mean that an enhanced data set will be available from which rate changes can be calculated and these can be used to validate the rates in the rating model. In a softening market, the rate change predicted at the start of the year can look very different to the rate change at the end of the year. If the contract makes up a large part of the account, an out-of-date rate change can distort the overall rate change which is then relied upon for a variety of purposes as outlined in the section above.

While the majority of market participants do not currently update the prospective rate change estimate for binders and lineslips as declarations attach, some are now capturing declaration data and updating the rate change accordingly for a limited number of classes.

## Rate Monitoring and Controls

An effective rate monitoring process enables management, underwriters and actuaries to make well-informed decisions. Indeed, regulators suggest that better performers in the market tend to report more credible and robust rate changes. But what does an effective and robust rate monitoring process look like? It is important that there is a clear governance structure surrounding the rate monitoring process.

Responsibility for the rate change calculation should be clearly allocated and that those responsible for the calculation are equipped with the knowledge and understanding of the requirements so that a consistent approach can be taken across the organisation.

Guidance should be formalised in a written document that can be accessed by all in the organisation. It should outline how the calculation should be performed. Responsibility for the creation of such a document would typically fall to the Head of Pricing or equivalent.

In most entities, underwriters tend to calculate the rate changes, often based on subjective judgement. However, when pricing models are used to calculate rate changes, actuaries may be responsible for reviewing underwriters' rate change assumptions.

This ownership and responsibility is distinct from the responsibility for the reporting of the rate change/rate index which may fall to Finance/M.I./the Head of Pricing/the Chief Actuary or a combination.

It is also important that sufficient controls are in place surrounding the rate monitoring process. The underwriting system itself may have data entry error flags for nonsensical numbers, but errors can still slip through the gaps and so it's worth considering a process for

the best way to identify these and rectify them. Typically, underwriters provide sign-off on the rate changes recorded. However, a wide range of validation processes have been adopted across the market. In some entities, underwriters are responsible for reviewing and correcting any outliers. For rate changes above a certain threshold or for larger risks, a review system may be triggered with the divisional head or active underwriter.

Alternatively, an independent reviewer may randomly sample contracts to validate the rate change recorded or only the rate change for larger risks or outliers may be reviewed (by the actuarial team, for example). Rate changes may be subject to regular peer review by other underwriters, with summaries sent weekly or monthly to the head of each class or division and the process may be subject to an annual audit.

Across the market, rate changes tend to be calculated as soon as the contract is bound and recorded directly on the underwriting or associated system. Typically, rate change is reported internally to management and class/divisional meetings monthly (Lloyd's also require monthly reporting of rate change). An awareness of the importance of getting the calculations "right" (although the Pitfalls section will demonstrate how there is no true "right" or "wrong" answer!) should encourage organisations to place more focus on this area, making the process more robust and the decisions made based on the outputs more credible.

## Example Rate Change Calculations

Depending on who is responsible for rate change, the methods used for the calculation may differ. If the underwriter is responsible for determining rate change, the focus may be more on expert judgement rather than a series of calculations assessing overall changes to exposure, limits, excess, breadth of cover and overall terms and conditions. This latter approach would typically be preferred and adopted by Actuaries where possible.

The reporting requirements for rate change may also impact how the calculations are carried out. Some companies may focus on capturing one single figure for rate change, whereas others (including Lloyd's syndicates) are required to estimate and record a number of different elements of rate change.

Below are a selection of different example scenarios which highlight the various approaches that could be taken, the types of issues that may be faced, and demonstrates that it can be possible to produce different answers to the same scenario. However as discussed earlier it is important to be consistent and ensure the approach is agreed and understood by all stakeholders

### **Example 1**

A fleet of 5 tankers are being renewed. The premium last year was £10k and the renewal premium is also £10k. The vessels have not changed at all since last year and the deductible remains unchanged at £50k.

Rate change calculation 1:

This contract could be viewed as having an overall rate change of 0%, as the risk has not changed since last year and nor has the premium.

Rate change calculation 2:

If the rate change is calculated directly from a pricing model, there may well be a change in the premium calculated by the model and therefore a non-zero rate change. In this example, if the pricing model adjusts the premium for the age of vessels and the vessels are now all a year older, then the model premium will have increased since last year. If we assume that the impact of the vessels being a year older was to increase the model premium by 3% then the calculated rate change would be 2.9%; i.e. the premium the company believes they need to charge has increased by 3% but the actual premium achieved has not changed, so the rate change would be  $\text{£}10\text{k}/\text{£}10.3\text{k}-1$ .

Rate change calculation 3:

Due to a change in the economy, the value of the vessels has plummeted to half of their previous value. As vessel value is one of the main exposure measures used, the rate change may show a significant increase.

For example, if the exposure is assumed to have reduced by 20% (as vessel value may be used in combination with DWT which will not have changed due to the economy!) the rate change calculation may be:

Expiring premium =  $\text{£}10\text{k}$

Change in exposure = -20% (Last year's premium assuming this year's exposure is  $\text{£}8\text{k}$ )

Renewing premium =  $\text{£}10\text{k}$

Rate change = 25% i.e.  $\text{£}10\text{k}/\text{£}8\text{k}-1$

This first example is a very simple case, and already by considering the risk in slightly different ways and taking into account different information, the final answer arrived at can vary hugely.

## **Example 2**

A large offshore energy contract covering a large number of locations around the world is due for renewal. The contract has incurred a number of large claims during the year and therefore the renewal premium is higher to provide an element of payback to the insurers. Some of the locations are no longer covered, some new locations have been added, and the values of some of the existing locations have changed significantly. The overall policy limit has increased from  $\text{\$}800\text{m}$  to  $\text{\$}1\text{bn}$ , but the insured is now also covered under OIL (Oil Insurance Limited) so the Property Damage (PD) element of the risk is partly protected under the OIL policy, which covers  $\text{\$}300\text{m}$  XS  $\text{\$}10\text{m}$ . The total premium for the contract has increased from  $\text{\$}30\text{m}$  to  $\text{\$}40\text{m}$ .

Rate change calculation 1:

Due to the significant changes made to the policy, the risk does not bear much resemblance to the risk in the previous year and therefore comparison of the premium for rate change purposes is not deemed to be of much value. The renewing risk is treated as non-comparable and no rate change information is recorded.

Rate change calculation 2:

A sophisticated pricing model exists, that gives a model premium and expected loss ratio given the price charged for the risk by the market for both the previous year and the prospective year. The expected loss ratio calculated by the model for last year was 70% and for this year is now 80%.

The rate change is assumed to be  $70\% / 80\% - 1 = -12.5\%$

### **Example 3**

A cargo risk is being renewed and has storage cover added this year to the existing transit cover, increasing the total sum insured from \$100m to \$150m. The premium has increased from \$100k to \$120k (split \$80k for transit and \$40k for storage).

Rate change calculation 1:

It may be decided to consider only the Transit element of the contract for the rate change calculation and in the absence of any other changes to the policy, the rate change would be recorded as  $\$80k/\$100k - 1 = -20\%$ .

Rate change calculation 2:

The rating model in the previous year priced the contract at \$90k in order to achieve the class target loss ratio of 70%. Since the risk was written at \$100k, the ELR for the risk was 63%. This year the rating model prices the risk at \$130k in order to achieve this year's class target loss ratio of 68%. The expected loss ratio for the risk this year is therefore 73.7% and the rate change is

$(63\%/73.7\% - 1) = -14.5\%$ .

Rate change calculation 3:

Expiring premium = \$100k

Effective (or Perceived?) increase in exposure = \$10k (as the cargo is metal, so has a lower risk attached to it when in storage, whereas when in transit overseas it is at risk of oxidation...)

Rate increase = \$10k

Renewing premium = \$120k

Therefore, assumed rate increase is  $(120-110)/110 = +9.1\%$

As demonstrated in the examples above, there are a variety of different ways to calculate rate change, some of which may give quite different results. It is always worth considering the purpose of the calculation as well as the information available when deciding on which approach to take. The section below highlights some considerations when determining rate changes.

### **1. Dealing with the challenges and pitfalls of rate change**

There are a number of issues to consider when attempting to capture rate change data. Some of these are:

- Deciding what is included within the rate change calculations: For example, if the premium has doubled since the previous year due to poor claims experience, would you want this to be shown as a rate increase? This partly depends on whether the claims experience over the previous year has led you to change your view of the risk,

or whether you can put the claims experience down to “bad luck”. If a rate increase on a large contract does distort the rate index for a class of business for this reason, it is important that the spike be explained so that anyone relying on the information understands the basis of the calculation. Consistency of approach is also important within a class and across an organisation (further details on this included below). It can often be useful for management to see these spikes as it draws attention to the larger contracts and the market reaction to loss experience.

- Who calculates rate change: If it is calculated by Actuaries, they are less likely to be able to make judgements on how any changes to policy wordings impact the premium and therefore the rate change calculations. Equally, if it is an Underwriter that determines the rate change, then the impact of a change to the limit or deductible may not be captured consistently across different risks if the change is estimated using judgement rather than applying the same Increased Limit Factor (ILF) or first loss curve to quantify the change.
- Consistency of rate change calculations over time: In order for the information captured to be used as a rate index, there ideally needs to be consistency in the calculations over time so that rate changes are just that, rather than the impact of changes in the methodology.
- Improving data quality: Particularly in light of the point above, as data quality improves, it is likely that this will have an impact on rate change. If there is more (or more reliable) information that can be used within the rate change calculations this is likely to improve the accuracy of the rate change estimates. It may be necessary to consider how historic rate change is then dealt with and if any adjustments are needed.
- Changes to pricing models: How rate change is impacted by changes to pricing models is an interesting consideration. If a pricing model has been updated to better assess the level of risk the (re)insurer is exposed to, then this should not impact rate change, other than perhaps enhancing the assessment of rate change. However, views on this point do vary.
- Additive or multiplicative rate change: Depending on how rate change is calculated and the elements recorded, consideration should be given to whether the changes are additive or multiplicative. For example, if it is assessed that due to changes in terms and conditions there is a 5% increase in premium, but a lower limit means a 5% reduction in premium, would you expect the overall rate change assuming everything else remains unchanged to be 0%?
- What the rate change figures are being used for: Some rate change calculations for a single risk could take a long time to accurately calculate, especially for some complex Marine or Energy risks where there are significant changes from the previous year. It is likely that the Underwriter will have a feel for how the price compares with the previous year and this figure may not differ too much from a more “actuarial” figure that takes considerably longer to calculate. It may be necessary to apply proportionality to any calculations of rate change and focus more on the larger premium contracts that have more impact on the overall rate change for the class of business as a whole.
- A pricing model is unlikely to be sophisticated enough to capture all elements of a risk, particularly in Marine & Energy where non-modelled perils may be considered in the rating or more subjective and qualitative factors will be taken into account, such as non-standard terms and conditions. If the model is used to calculate rate change



(using the information and rating factors that the model does capture) then it is likely that the rate change calculations will not be capturing all relevant information and therefore the calculated rate change will not fully reflect the true underlying rate change.

The determination of rate changes can be tricky, especially for Marine & Energy classes where considerable judgement is involved in pricing the risk and comparing the premium to the price achieved the previous year.

With areas such as terms and conditions, as well as the impact of layering having a huge impact on the premium, standard rate change calculations may not take into account certain elements of the contract or be less accurate than Underwriters' "gut feel".

As a result, it is important to keep sight of the purpose of the work and let this be a guide to the method employed. If rate change is used as a key indicator for whether to renew individual risks, as accurate information as possible will be required. If rate change is being used only to provide an overall indication of rate index for a given class of business then a higher level, less precise methodology may be appropriate. In reality, it is likely that rate change will be used for a number of different purposes and therefore a balance will need to be struck between the need for accuracy and proportionality.

# E. Requirement for Quality Data

As Actuaries get more involved in Marine & Energy pricing, there is more of a focus on the need for good quality data to validate base rates, analyse experience, and monitor market conditions and movements. Historically, less information would be recorded as the benefits of recording such data may not have been appreciated. Much of the business being carried out is done by exchanging paper copies of policy details, or PDF copies that do not readily lend themselves to being transferred into a mass storage system. As good quality data can give an advantage over competitors, it is beneficial to make it easy to use. To some extent there is work needed to educate Underwriters as to the importance of capturing accurate and complete data and the benefits this can have for the future.

In Marine & Energy pricing the policy wording and conditions play a big part in the price, and the quantity of data may never reach the volumes of commercial and personal lines. For example, there were only 204 offshore energy rigs under construction in the world (as at 31/7/2013), so even if you had the data for all of these, this would still not be enough to get significant information from.

Part of the trouble with capturing quality data is that it is not immediately useful. It takes years to build up data for use for certain analyses, especially within Marine & Energy where data can be sparse and volatile, so when the benefits will not be seen immediately it does sometimes mean that people don't bother.

## Importance of Understanding your Data & Communication

While data can provide a lot of useful information, if it is not fully understood it can be dangerous. For example, a key issue that may be overlooked is whether claims data provided are claims from ground up or after deductibles have been applied. If claims are not from ground up there may be issues finding information on smaller claims that are below the deductible.

With Underwriters and Actuaries filling different roles, there is a need to be fully joined up and communication is key (see results from our interviews in later section "Use of Actuaries in Marine and Energy Pricing").

Due to the heterogeneity and scarcity of data, it is likely that expert judgements will need to be made. The area of judgement will have an impact on who makes the judgement or assumptions. For example, it is likely the Underwriter will have a greater appreciation of the impact of different wordings on the slip, but the impact of a different first loss curve on the price of higher layers may be better understood by the actuary.

## Data Sources

There are a number of different data sources available to aid Marine & Energy pricing. Internal data will be most relevant, but due to the heterogeneity of risks, the volume of data may not be sufficient to provide useful information, and may have an inherent bias due to the particular aspects of the book(s) of business being written. For example, if an analysis of claims is being attempted, a large volume of data across a number of years will be needed to get anything meaningful from the analysis.

Depending on the company, the quality and quantity of the data may vary hugely. There may be internal data sources that could be used.

- Pricing model data

Potentially if each individual risk is priced using pricing models then the database back-end functionality may have a wealth of data available, including information not just on bound risks but those also not taken up. This data may also reveal useful information on areas of the portfolio of business where the model is not working well or give useful information on rate change.

- Internal Claims Data

While claims are likely to be sparse and variable, claims data is useful for a variety of different areas. Claims data can be used to validate or calibrate the overall rates within pricing models, validate the adjustments made for certain rating factors, or even carry out personal lines type GLM analyses.

There are a number of external data sources which may be available and of use to Pricing Actuaries when pricing Marine & Energy risks, including:

- Willis Energy Loss Database (WELD)

Historical energy losses over \$1m dating back to 1972, both upstream and downstream.

- LMA Risk Code Data

Dating back to 1993, Lloyd's has signed premium, paid and outstanding claim amounts recorded quarterly for each individual risk code, submitted by all Lloyd's syndicates. This information provides information on the claims development as well as historical Lloyd's loss ratios.

- IHS Marine Fairplay

Contains list of vessel details

- London market marine hull insurance claims

Quarterly database of hull claims provided quarterly to subscribing syndicates.

- Market Reports from CEFOR

Annual update on the Nordic Hull Insurance Market.

# F. Pricing Within a Control Cycle Environment

It is useful to not consider Pricing as an isolated function, but instead as one of the key areas that feeds into underwriting and hence the entire organisation's key strategic objectives. Therefore when formulating pricing models / decisions / calculations one should ensure that they meet the overall objectives of the organisation.

From an actuarial control cycle perspective, the key areas within any insurance organisation could be regarded as:

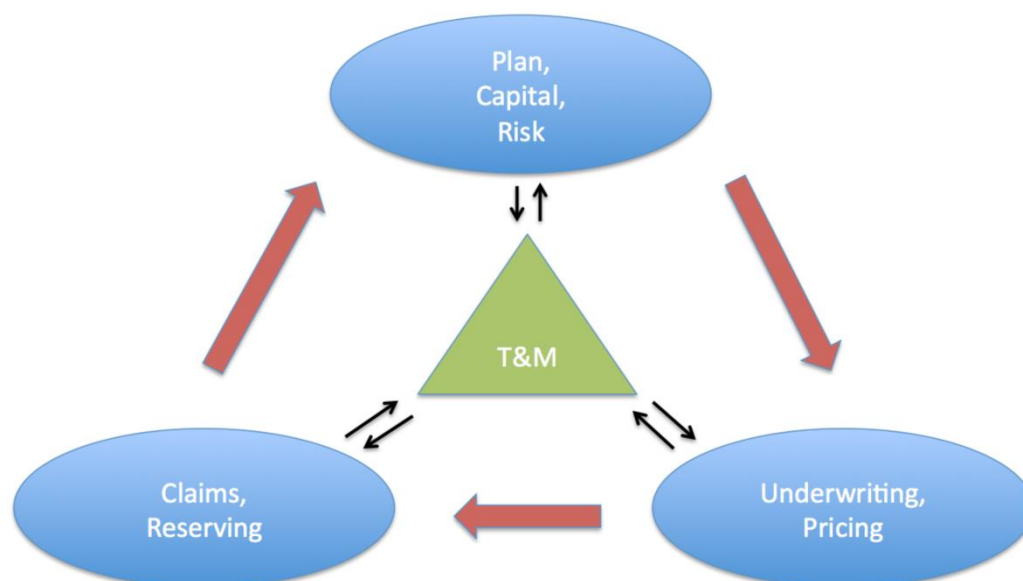
1. Operational planning, capital modelling and risk
2. Underwriting and pricing
3. Claims management and reserving

1. Sets out, formulated by executive management, the operational plan that will meet the organisation's strategic objectives in the short, medium and long term.

2. Implements the key action of the plan, that is, to write business within pre-defined constraints (profitability, aggregate exposures, risk profiles etc) in order to meet the plan.

3. Through the use of emerging experience, combined with prior assumptions, will ensure that sufficient premium income is retained in order to meet policyholder obligations by the payment of valid claims for any given period (usually underwriting or accident year).

These areas are necessarily interlinked and can be expressed through the following diagram:



# Tracking and Monitoring (T&M)

In the simplest terms, business plans are achievable if they are followed through by carefully laid out underwriting strategies and appropriate reserving for claims. A T&M suite can act as the control centre of the cycle to help achieve these objectives. Each of the three key areas can take from and add to the T&M suite.

From a pricing perspective the following inputs and outputs should be considered within the T&M suite:

## Benchmark Models

Exposure and pricing information should be collected through the benchmark model. Examples of such information will be (these are covered more extensively in the Methods section):

- Exposure measures
- Sums Insured
- Pure rate change
- Rating factors used as part of the benchmark premium calculation
- Risk factors collected
- Premium amounts
- Signed lines
- Commission levels and types

Exposure data can be collated and summarised to generate KPIs to determine whether underwriting plans are being met or whether an inter-year change is required. The following are examples of exposure based KPIs that could be tracked and monitored:

- Mix of business by segment; risk mix indices
- Layers written; limit profile
- Aggregate exposures by segment
- Priced loss ratio based profitability assessment by segment
- Marginal cost of capital by segment
- Loss ratio distributions by segment

It is usually acceptable that the business should be written if the relevant class underwriter / actuary believes that the priced loss ratio is greater (or sometimes less) than the target loss ratio. However, this is feasible if the following constraints are met:

- A (positive) balance of over and under-priced business
- Volume targets are met
- Mix of business, risk appetite and capital requirements are met

Information for non-incepted business should also be maintained and monitored as far as possible. Such data can provide valuable insight on, for example, price elasticity, market conditions, market mix profiles and proxies to market profitability.

## Case Pricing

Case Pricing may be carried out for a number of reasons, in these circumstances the following information could be used within the T&M suite:

- Best estimate priced loss ratios
- Exposure and rating information can be collated in the same way as per benchmark rated policies
- Where suitable a blended benchmark and case priced loss ratio may be used

For experience rated case pricing, loss development factors (LDFs) could be sourced from the reserving teams for the following reasons:

- Can provide as benchmark patterns; material deviations should be justified
- Weighted average LDFs can be developed for clients that have cross class cover but grouped claims data e.g. an energy client with E&P, Liability and Construction exposure
- A consistent approach is used within the organisation
- Actual LDFs used in the pricing exercise should be fed back to the reserving team to help refine their portfolio level factors

## Claims Experience and Reserving

As claims emerge, analysis can be performed to validate whether parameterisation of the pricing model requires adjustment. The extent to which actual claims experience can be used re-parameterise the model will depend on how the pricing model was parameterised in the first place. In general, the greater the frequency of claims within the underlying class the more sophisticated the approach.

An informative way to understand the business being priced is to understand the nature of the claims that, typically or atypically, are being covered. Reviewing individual claims files can be an invaluable source of information to both the pricing actuary and the class underwriter.

## How Practical is the Application of the Control Cycle for Marine and Energy Classes?

Classes that have the following characteristics are more likely to benefit be being managed within a control cycle environment:

- Those that lend themselves to technical modelling
- Those that have a relatively high frequency of attritional and / or large claims experience
- Those that have more homogeneous risks

Therefore a degree of expert judgement needs to be applied when using the control cycle for Marine and Energy classes.

# G. Use of Actuaries in Marine & Energy Pricing

## Introduction

In order to gauge the perception and involvement of actuarial activities in the pricing of Marine and Energy business, the working party interviewed a number of class underwriters, senior underwriters, divisional managers and chief actuaries at a variety of insurers, reinsurers, Lloyd's syndicates and brokers. The group also obtained a statement from the Prudential Regulation Authority (PRA) on this subject. The results, below, include a separate section on views of the future outlook for pricing in the marine and energy markets. A full copy of the interview questions with key survey statistics is provided in Appendix C.

### Interview methodology

Interviewees were sourced via the Working Party and were mostly, if not entirely, colleagues of its members. This was not a random sample and so is not representative of the market as a whole. The findings are, nevertheless, representative of organisations that use Marine and Energy pricing actuaries. To assist in general facilitation of each interview, usually one of the interviewers was from the same organisation as the interviewee. It is noted that in some cases this may have limited the freedom of the responses.

The interviews were structured around a questionnaire, distributed in advance, with closed and open questions on topics including organisation; relationships and interaction; use of and reliance on actuaries; level of actuaries' expertise; price monitoring; interviewees' view of the future. Ten underwriters, five chief actuaries and one regulator were interviewed.

The interview responses have been collated and are summarised below.

## Participants' views

### Organisation of actuaries

A variety of set-ups was found. In some organisations, most actuaries have cross-functional roles. In other organisations (including the majority in our sample), actuaries with pricing responsibilities do nothing other than pricing. In some of these, pricing actuaries regularly have input into planning/reserving/capital work; in others this is the case only for some departments; and in yet others pricing actuaries have no formal link at all.

The majority of pricing actuaries report to actuarial management, a minority to the underwriting head. The majority of underwriters believe an actuarial reporting line is preferable, in order to maintain independence. Actuaries have the same view, and also cite the advantage of gaining access to more alternatives via peer review. Some underwriters feel an underwriting reporting line is best, particularly where actuarial management is

centralised and continuity of allocated resources cannot be guaranteed. Many underwriters and actuaries note that the reporting line is not as important as the working relationship, for example by seating the actuaries alongside, or within, the pricing team. Across the board, the size of the actuarial pricing team is driven by the underwriters or brokers who use the work of the pricing actuaries.

### **Underwriters' use of actuaries**

In the organisations in the sample, actuaries are increasingly involved in pricing contracts before the quotation stage, albeit in some cases limited to particular cases or only via rating tools. Organisations vary in their approach to conducting post-bind reviews. All the re/insurers interviewed involve actuaries in the development of benchmark models. Most also use actuaries for individual case pricing, particularly on large or complex accounts – almost all of the sample have hard or soft criteria based on premium income; some also have criteria based on complexity of risk and/or sufficiency of data. Practices vary regarding outward reinsurance or retrocession.

### **Interaction of actuaries and underwriters**

In the interview sample, underwriters interact with actuaries at least monthly in formal meetings, most at least weekly, some daily. The frequency of interaction can depend on the time of year, the extent of case pricing and the stage of development of benchmark models. Actuaries see their interaction with underwriters as very regular – this may be because there are more underwriters than actuaries, so each actuary spends more time with underwriters than each underwriter does with actuaries.

Underwriters most value the pricing actuaries' input in statistical analyses where data is good, e.g. portfolio analyses, trend analyses, benchmarking. This is often incorporated into pricing models or tools. Another widely cited example occurs in individual case pricing for complex exposure. Another theme is actuaries' knowledge of the cover provided, particularly for new business classes. Conversely, underwriters least value actuaries' input when there is little data, or in the limited cases when the actuary is merely performing a gatekeeper role. Generally, high reliance is placed on the output of benchmark models, whereas reliance on the output of individual case pricing runs the gamut of responses.

The vast majority of underwriters are happy with the outputs provided by pricing actuaries, often because they have been involved in their specification.

Re/insurers vary in the way the actuarial price is factored into the final decision-making process of individual accounts. Underwriters responded that they apply adjustments to the pricing actuaries' outputs, mainly upwards at quotation; in some cases the adjustments reflect the credibility of the actuarial price. There may be a referral process. Actuaries believe their actuarial numbers are left unadjusted, albeit organisations vary in the discretion allowed to underwriters.

Those re/insurers who answered the question 'What proportion of your business is technically priced by a model developed by an actuary?' generally indicated proportions of 80%-100%.



## **Necessity of actuaries to business success**

Underwriters were asked how necessary pricing actuaries are to the success of their business, plans and objectives. 80% of the sample believes it is essential to have actuaries. While one respondent believes you can get by without an actuary in a subscription market, another notes that without an actuary the re/insurer would lose sight of the technical/walk-away price. A third goes further and says you can't even get into the business of insurance without an actuary, as you can't get capital without having an actuary on board.

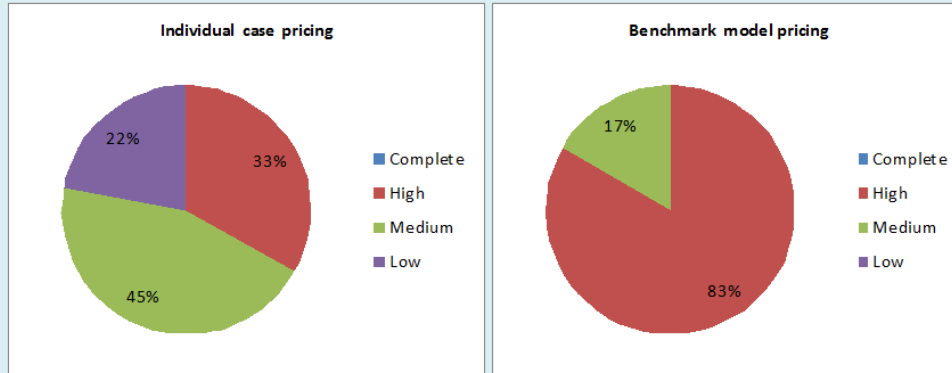
## **Comparison of underwriters' and actuaries' views**

For a number of the questions asked, it was possible to compare the underwriters' responses to the actuaries', as shown on the next page. Two interesting conclusions can be drawn. Actuaries believe that underwriters place more reliance on actuarial work than underwriters actually do. On the other hand, underwriters believe that actuaries understand Marine/Energy business better than actuaries believe they actually do.

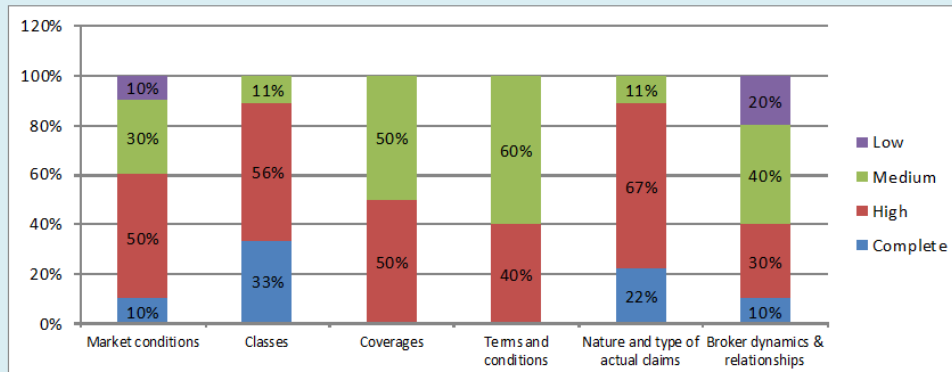
A summary of the results is shown on the next two pages.

## Underwriter + Broker Responses

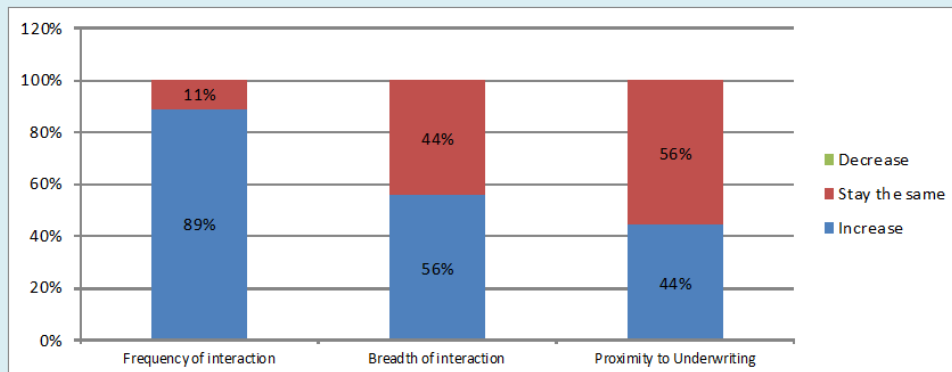
**Q. How much reliance do Underwriting place on the pricing actuaries outputs:**



**Q. How well do you think your pricing actuaries currently understand Marine/Energy business?**

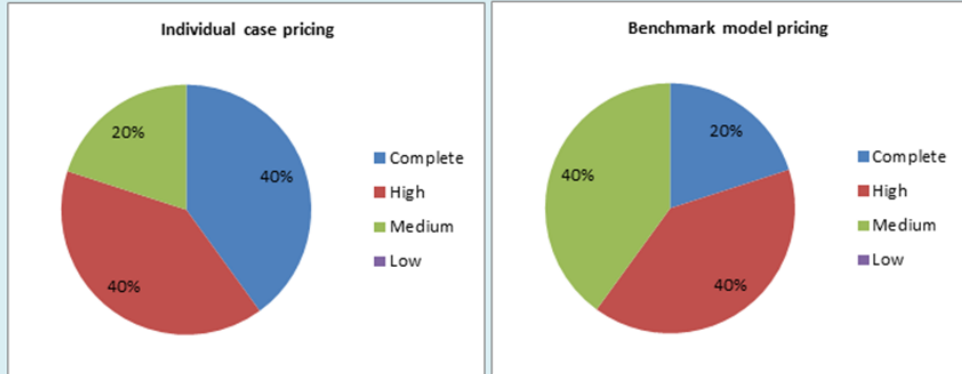


**Q. How do you see the role of Underwriting and pricing actuaries evolving in the future?**

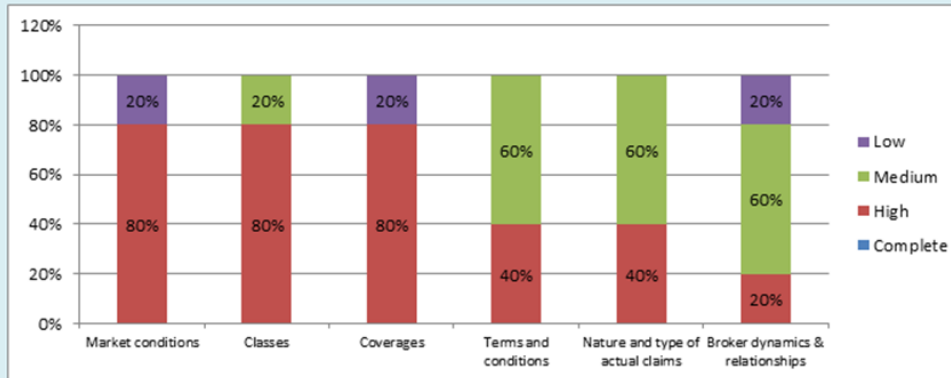


## Actuary Responses

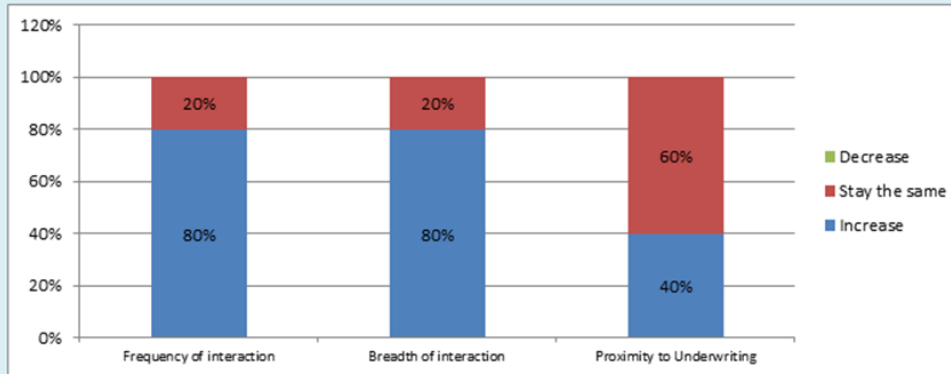
**Q. How much reliance do Underwriting place on the pricing actuaries outputs:**



**Q. How well do you think your pricing actuaries currently understand Marine/Energy business?**



**Q. How do you see the role of Underwriting and pricing actuaries evolving in the future?**



# Participants' views on the future of the Marine and Energy markets

As part of the survey, participants' views of the future of the marine and energy markets were explored; in particular their views on future trends, market dynamics, emerging risks and any product evolution that may emerge. The majority of responses reflected a view of current trends which were present to some degree in these markets and were expected to continue to be an important driver of pricing or product evolution in the near and medium term.

## **Issue 1: Overcapacity leading to a soft market in both marine & energy**

This was the primary issue noted by several market participants. A period of low average claims activity during the noughties has impacted rates adversely and the impact of losses such as Hurricane Sandy and the Costa Concordia shipwreck (both 2012) was not sufficient to correct this trend. New capacity is coming from the expansion of existing players as well as the entry of new start-ups. It is considered that the market had a short term view of events (e.g. the impact of the 2005 & 2008 Hurricanes has been quickly forgotten after a few benign cat seasons). Participants noted that overcapacity will continue to be an issue in the near term.

## **Issue 2: Increases in marine and energy exposures**

Participants indicated a number of drivers leading to continuing increases in insured exposures over time. These include: significant increases in limits of liability, higher asset values at risk (e.g. container ships getting bigger which impacts the potential for cargo aggregations), new sources of potential loss (e.g. cyber attacks on energy assets) and the complexity of contract structures has in some circumstances led to "hidden covers" where the insuring organisation is not aware it is on risk. It is not clear from the responses that participants feel these increased exposures are being priced for adequately by the market. One participant noted that there had been an unwitting tendency by some players to insure owners' research and development as a significant amount of new exploration is being undertaken in the energy markets.

Some of these increases represent potential future increases in exposure for the market. A considerable number of organisations have exclusions currently in place against cyber risk, and this might be a mechanism to spread capacity across more segments of business.

## **Issue 3: Increasing claims costs**

Participants also note a number of drivers leading to increasing future claims costs. These include impacts of climate change, increased frequencies of more severe natural and man-made catastrophes (Hurricane Sandy, Costa Concordia, Deepwater Horizon oil spill), factors giving rise to increased claims severity inflation over the last decade e.g. costs related to larger vessels and increased costs anticipated for the removal of wreck as the remoteness and use of relatively less accessible shipping routes increases. There were also a number of human factors cited including political influence on court awards, geo-political

developments (e.g. recent political instability in the Niger Delta region leading to various energy losses) and trends in large loss handling (e.g. use of Italian firms for Costa Concordia removal of wreck) which have led to increasing claims costs recently. One participant noted that anticipating further loss causes and drivers of future claims inflation is very difficult to model.

#### **Issue 4: Increasing claims volatility and delays to settlement**

A few participants identified drivers which are leading to increased claims volatility; these include the tendency to write larger shares which had the potential to be magnified by the trends towards increased exposure identified above. Also climate change is noted as a driver which was expected to lead to increased claims volatility. One participant noted the recent claims environment had led to more questioning of losses which inevitably delayed full and final settlements being reached.

#### **Issue 5: Changing market dynamics**

Many participants noted that price was key in the current market environment with an expectation that fewer participants would be willing to accept the leader's price without challenge going forward. One participant noted that brokers' increasing ability to place business anywhere around the globe was also driving this phenomenon. There was a split of views between the relative importance of the actuarial versus the market / broker price in setting prices and terms and conditions.

#### **Issue 6: Difficulties in modelling**

The actuarial responses highlighted the difficulty of constructing a technical price in a situation where the underlying exposures are changing in an unforeseen manner, there are new sources of loss and increases in limits. One participant noted that the human errors which led to the Deepwater Horizon and Costa Concordia losses were difficult to anticipate and were not well reflected in the underlying claims history

Finally one participant indicated that there was more to do in terms of accumulation modelling.

#### **Issue 7: Trends in Product evolution**

There were mixed views on product evolution going forward. Some participants noted pressures to commoditise products (both from a cost and a simplification perspective) and that reporting and compliance pressures may reduce innovation.

Other participants anticipate new packages of risks covering multiple classes of business and new parametric deals in the energy and natural catastrophe markets. New product development is also anticipated as a result of demand for solutions to protect renewable energy assets and other changing technologies including the potential for cyber related losses. In terms of existing technologies – one participant noted that there may be extensions in terms and conditions as oil well depths increase. Finally one participant noted that new international conventions and amendments to existing conventions sometimes require product change in the P&I market.

Regarding the future, other responses from the surveys include:

- Pollution
- War – but less of an issue than a few years ago (e.g. Somali pirates)
- Legislative changes
- Long term policies

## H.PRA Statement

The following statement on the involvement of Pricing Actuaries in Marine and Energy business was provided by the UK's Prudential Regulatory Authority:

*“The PRA’s role with respect to insurance firms is defined in terms of two statutory objectives. These are to promote the safety and soundness of the firms we regulate and to contribute to the securing of an appropriate degree of protection for policyholders. The ability to meet these objectives will be in part dependent on the quality of a firm’s systems and controls and we believe the technical and professional competencies of actuaries will have a role to play here. We do not examine specific lines of business in isolation, but more the viability of individual firms we supervise as a whole.*

*The PRA believes that the judgement about the use of actuaries in marine & energy pricing is one for individual firms to make. We are conscious that pricing actuaries have become more involved in these lines over the last 20 years and welcome the statistical rigour and alternative challenge they can bring. We would not, however, advocate an optimal split of responsibilities between underwriters and pricing actuaries. Our focus is to ensure that firms have robust governance structures, which allow them to effectively assess and price risks and ensure risks taken on are in line with their risk appetite. Amongst other aspects we would expect that as part of an effective pricing process firms have robust exposure management processes, which lead to a proper understanding of their risk profile and aggregations, effective rate monitoring tools and underwriting controls.”*

# Appendix A

## A Brief History of Hull & Cargo Insurance

(Source “Dictionary of International Trade” by Edward G. Hinkelman)

Marine Insurance is thought to be the oldest form of insurance. The following are some key moments in the history of marine insurance:

<b>3,000 BC</b>	Chinese Traders redistribute cargo across several vessels to limit potential loss due to a single vessel's sinking
<b>1,750 BC</b>	Ancient Babylonia, The Code of Hammurabi codifies a system whereby a merchant receiving a loan to fund a shipment of goods may pay the lender an additional fee in exchange for the lender's promise to cancel the loan should the shipment be stolen.
<b>1750 BC?</b>	An early form of bottomry (loans or bonds) is developed whereby a loan is made to a ship's owner or master using the vessel itself (the bottom or keel) as collateral. These loans are repaid with interest only when and if the vessel arrives safely at its destination. This combines investment with insurance.
<b>750 BC</b>	Merchants and lawmakers in ancient Rhodes (Greece) invent the concept of “general average” whereby a number of merchants shipping goods at the same time pay a premium into a fund which is used to reimburse any merchant whose goods are intentionally sacrificed for the safety of the vessel and remaining property. The concept of general average survives today.
<b>1200-1300</b>	Respondentia (loans or bonds) are developed in Italy whereby a loan is made to a ship's owner or master using a vessel's cargo as collateral. These loans are repaid (with significant interest) when and if the cargo arrives safely at its destination. This is a form of both investment and insurance.
<b>Mid-1300s</b>	Separate insurance contracts, not bundled with loans or other contracts are developed in Genoa. For the first time, this separates insurance from investment.
<b>1343</b>	The earliest known marine insurance contract, found in the state archives of Genoa, Italy, dated 13 February, 1343, is made between Amigueto Pinello and Tomaso Grillo, agent for Aveducto Guillelmo, a merchant from Panorno.
<b>1601</b>	England establishes a specialised chamber of assurance separate from other courts.
<b>Mid-1600s</b>	Coffee houses become important centres of the social and business life of London. Insurers, merchants, ship owners and ship captains congregate in coffee houses near London docks to meet and to conduct business, as well as exchange gossip, news and shipping information.
<b>1650-1700</b>	England becomes the world's preeminent maritime, commercial and financial and insurance power, combining growth of a powerful navy, merchant fleet, financial institutions, and marine insurance into the world's greatest trading and colonial power.
<b>1688</b>	Lloyds of London is founded at Edward Lloyd's coffeehouse near the Royal Exchange at the London docks on the Thames River. Lloyd's becomes the premier meeting place for insurers, merchants, ship owners, ship captains and other parties wishing to insure cargoes and ships as well as those willing to underwrite maritime ventures. In time, Lloyds of London becomes the world's largest market (no insurance company) for insurance, especially marine insurance.
<b>1693</b>	More than 100 British merchantmen (merchant vessels) in convoy are captured or destroyed in the Bay of Lagos by the French. Many marine insurance underwriters in London go bankrupt.

<b>1720</b>	With the help of £600,000 bribe to King George I, The Bubble Act of 1720 (the Royal Exchange and London Assurance Corporation Act of 1719) is passed. The act forbids the formation of any joint-stock company not authorised by Royal Charter. As a result, only the Royal Exchange Assurance Corporation and the London Assurance Corporation have charters to write marine insurance. All other marine insurance is underwritten by wealthy individuals. The Act is repealed in 1825.
<b>1890</b>	The York Antwerp Rules codify the concept and practice of “general average” originally developed in ancient Rhodes. US companies follow suit in 1949.
<b>1906</b>	The English Marine Insurance Act (21 December 1906) is passed, codifying the previous common law “Law Merchant” or Lex Mercatoria with regard to marine insurance. This Act sets the standard worldwide for marine insurance.
<b>1924</b>	The Hague rules define the rights and liabilities of a carrier.
<b>1968</b>	The Hague-Vigsby Rules provide an update of the Hague Rules to include containerised shipping.
<b>1978</b>	The Hamburg Rules define the United Nations Convention on “Carriage of Goods by Sea”.
<b>1982</b>	The Institute of London Underwriters establishes the Institute Cargo Clauses A, B and C, thus standardising marine insurance contract clauses.



# Appendix B

## Cargo INCOTERMS

Understanding the responsibilities for buyers and sellers for carriage, risks and costs will be critical to the pricing process. The most widely used terms in International trade are INCOTERMS (International Commercial Terms) and were developed by the International Chamber of Commerce, Paris, France in 1936. The current version is INCOTERMS 2010. The most common contracts are:

- Free On Board (FOB)
  - The seller clears the goods for export and is responsible for the costs and risks of delivering the goods past the ship's rail at the "named port of shipment". This includes transportation from the seller's warehouse, possible storage, and the actual loading of the shipment past the ship's rail.
  - The buyer assumes risk the moment the goods pass the ship's rail.
  - Neither the seller nor the buyer have an obligation to the other party to provide insurance.
  
- Cost and Freight (CFR)
  - The seller clears the goods for export and is responsible for delivering the goods and associated costs past the ship's rails at the port of shipment (not destination).
  - Once the goods pass the ship's rail at the port of shipment, the buyer assumes responsibility for risk of loss or damage as well as any additional transport costs.
  - Neither the seller nor the buyer have an obligation to the other party to provide insurance.
  
- Cost Insurance Freight (CIF)
  - As per CFR except the seller is obliged to provide insurance to the named port of destination (110% of contract value). Insurance coverage typically includes War Risk coverage.
  - Once the goods pass the ship's rail at the port of shipment, the buyer assumes responsibility for risk of loss or damage as well as any additional transport costs.
  - Only CIP (see below) requires obligatory insurance coverage.

Additional types can be found on the INCOTERMS website.

# Appendix C

## Market Survey Interviews

The following is a collective, anonymous summary of responses to the question sets for underwriters/brokers and for actuaries.

### Underwriters and brokers

#### Organisational Facts:

**1 Are actuaries involved in pricing your contracts?**

Increasingly so and generally yes, albeit in some cases limited to particular cases or only via rating tools.

**a. If so, at what stage of the process are they involved, i.e. is this before or after the quotation stage?**

Almost all pre-quote; a subset also involved in later stages of review.

**b. How are they involved, e.g. benchmark models, parameters and studies, individual case pricing, reinsurance purchase?**

All the re/insurers interviewed involve actuaries in the development of benchmark models. Most also use actuaries for individual case pricing, particularly on large or complex accounts.

**2 Do you have certain criteria for when you are required to engage the pricing actuary? Does this vary by:**

**a. Premium income of the contract to your organisation?**

**b. Contract type – facultative, direct, reinsurance?**

**e. Complexity – aggregation clauses, loss sensitive conditions, etc.**

**d. Territory/country?**

**e. Other**

Almost all have hard or soft criteria based on premium income; some also have criteria based on complexity of risk and/or sufficiency of data.

**3 Do the pricing actuaries report direct into Underwriting or into Actuarial Management or Other areas (e.g. Finance, Risk Management)?**

The majority report through actuarial but a substantial minority report to the underwriting head.

**a. Which do you believe is best? Why?**

Split. The majority believe an actuarial reporting line is preferable, in order to maintain independence. A number noted that the reporting line is not as important as the working relationship, for example co-locating the actuaries with the pricing team. Some feel an underwriting reporting line is best, particularly where actuarial management is centralised and continuity of allocated resources cannot be guaranteed.

**Marine/Energy Pricing:**

**1 When do you most value the pricing actuaries' input?**

Four themes in order of decreasing importance:

- In statistical analyses where data is good, e.g. portfolio analyses, trend analyses, benchmarking
- Complex cases
- Knowledge of cover
- New business.

**2 When do you least value the pricing actuaries' input?**

When there is little data. Also in limited cases when the actuary is merely performing a gatekeeper role.

**3 Do you believe the outputs provided by pricing actuaries to Underwriters meet their needs, and are they involved in specifying these outputs?**

The vast majority are happy with the outputs provided, often because they have been involved in their specification.

**4 How much reliance do Underwriting place on the pricing actuaries' outputs:**

**(Scale: Complete, High, Medium, Low)**

**Individual case pricing vs Benchmark model pricing**

Generally high reliance is placed on the output of benchmark models, whereas reliance on the output of individual case pricing runs the gamut of responses.

See charts in main body of report comparing to the actuaries' responses.

**5 Where the actuarial price is factored into the final decision-making process of individual accounts, do Underwriting apply any adjustments to the pricing actuaries' outputs?**

Yes. Adjustments are mainly upwards. In some cases the adjustments reflect the credibility of the actuarial price. There may be a referral process.

- 6 ONLY FOR UNDERWRITERS WITH PORTFOLIO OVERVIEW: What proportion of your business is technically priced by a model developed by an actuary? Please give proportions by sub-line (e.g. hull, cargo, liability etc.) where possible.**

Those re/insurers who answered generally indicated proportions of 80%-100%.

## **Relationships:**

- 1 How often do you interact with your pricing actuaries?**

At least monthly in formal meetings, most at least weekly, some daily. Can depend on the time of year, the extent of case pricing and the stage of development of benchmark models.

- 2 How well do you believe your pricing actuaries currently understand Marine/Energy business?**

**(Scale: Complete, High, Medium, Low)**

**Market conditions**

**Classes**

**Coverages**

**Terms and conditions**

**Nature and type of actual claims**

**Broker dynamics and relationships**

See charts in main body of report comparing to the actuaries' responses.

- 3 How necessary are pricing actuaries to the success of your business, plans and objectives?**

80% said essential. One respondent said you can get by without an actuary in a subscription market.

- 4 How do you believe your role would be different if there were no pricing actuaries in your organisation?**

Revert to the way Marine was underwritten 20 years ago before evolution of actuarial support. Respondents couldn't see it happening to market as a whole, but felt they would be disadvantaged if they were the only ones to lose their actuaries.

- a. How would you benefit?**

No benefit in losing actuaries.

- b. Where would you lose?**

Various. Can't get capital without actuaries on board. Lose sight of the technical / walk-away price.

## Future:

### 1 How can pricing actuaries improve their awareness of the specifics of the Marine and Energy markets?

Most respondents suggested spending more time with surveyors, claims adjusters, underwriters, brokers, clients, London Market lectures and committees, etc. One respondent thought differently, that it is better for the actuaries to focus on the facts and figures and stay removed from the commercial aspect, to avoid being influenced by what the broker is saying, as it's good to have a bit of independence.

### 2 How would you like to improve the current interaction with pricing actuaries in Marine/Energy and what is the optimal nature and level of involvement of pricing actuaries?

Many respondents thought their situation already more or less optimal. A number made suggestions, including: collective responsibility for risk-level decisions between UW and actuarial; actuaries helping the junior underwriters to understand the models better; actuaries spending more time with the UW team when large case pricing is taking place; actuaries developing into hybrid UW/actuary roles.

### 3 How do you see the role of Underwriting and pricing actuaries evolving in the future?

**(Scale: Increase, Decrease, Stay the same)**

**Frequency of interaction** 7 increase, 2 stay same

**Breadth of interaction** 5 increase, 4 stay same

**Proximity to Underwriting** 4 increase, 5 stay same

See chart in main body of report comparing to the actuaries' responses.

### 4 Marine/Energy markets:

#### a. What do you see as the major issues for these markets? (e.g. large losses that drive the market such as Costa Concordia, disputes regarding Removal of Wreck)?

- Over-capacity from expansion of existing competitors and new start ups – most quoted

#### Drivers leading to increases in claims costs

- Political influence on court awards;
- Large loss handling e.g. use of Italian firms for Costa Concordia ROW;
- Costs related to the larger vessels i.e. class containers
- Removal of wreck (as remoteness and difficult nature of locations increase)
- High asset values – increases loss severity. Container ships getting larger increases cargo aggregations e.g. up to \$2bn
- Climate change
- Increased commission

#### Drivers leading to increases in volatility

- Increases in exposure
- Tendency to write larger shares

#### Other issues

- Pollution
- War – but less of an issue than a few years ago e.g. Somali pirates
- Need to be sure that we are not insuring owners' R&D?
- Legislative changes
- Emerging risks e.g. fracking
- Long term policies
- Complexity of contract structures leading to some hidden covers (e.g. coverage of US risks in non US contracts)

#### Drivers of less innovation

- Reporting and compliance in London increasing
- Increased commoditisation

#### Changing market dynamics

- Brokers can place business everywhere – increasing verticalisation
- Service is important but price is king
- Less likely that a leader is one that just prices and others follow
- Actuarial price becoming even more important – see the actuarial issues section
- Others view as less technical underwriting and market and broker dominance – robustness of broker models needs to be examined

#### **b. In your view can pricing actuaries assist in dealing with them?**

The majority feel that actuaries can help in assisting with these issues. One noted that pricing actuaries can assist but are unlikely to develop a game changer approach. Another noted that the biggest issues are legal matters. If the whole market is under-pricing due to overcapacity, the individual actuary can only be of limited help.

#### **c. Are there wider market issues that affect the pricing of Marine/Energy business?**

Combined with responses to 4a as overlap.

#### **5 How do you believe the products of the Marine and Energy markets might develop going forward?**

- Commoditisation of products – simplification of products for IT and for the buyer
- New packages of risks covering multiple classes of business
- Composite covers coming back e.g. aviation & marine, property direct and fac
- New parametric deals in energy and nat cat markets

- Cyber – has led to some PD losses in energy and marine
- Geo-political developments, particularly for energy, will lead to product and pricing evolution (e.g. Nigeria and off-shore oil pressures)
- Renewable energy
- Significant increase in limits of liability
- Changing technology
- Increased well depths

New international conventions and amendments to existing conventions sometimes require product change in the P&I market.

**6 Looking to the future, do you envisage any change in regulators' requirements whether general or specific regarding pricing for the Marine and Energy markets (e.g. reporting on pricing models, feedback cycle, submission of more data to regulators)?**

Lloyd's already highly regulated, will stay the same if nothing market-changing happens.

## Chief Actuaries

### Organisational Facts:

**1 In many organisations, actuaries have cross-functional responsibilities. What proportion of your organisation's actuaries has mainly /only pricing roles and responsibilities?**

For the majority of organisations in our sample, actuaries with pricing responsibilities do nothing other than pricing, though in others the majority of actuaries have cross-functional roles, albeit dominated by pricing.

**2 Do you believe your organisation has the right balance of pricing and non-pricing actuaries?**

Opinion is mixed. Most believe the balance is correct, though some identify shortages in some areas while others would like to see more focus on pricing.

**3 Is the size of the actuarial pricing team mainly driven by Senior Actuarial Management or by Underwriting? Is there any drive to increase this; if so, from where is this drive coming?**

Across the board, the drive is coming from the underwriters or brokers who use the work of the pricing actuaries.

**4 Is there a formal link between the pricing, capital, reserving, reinsurance purchasing and planning roles within your organisation?**

Quite a mix of responses here. In some organisations actuaries have cross-functional roles, in others pricing actuaries regularly have regular input into

planning/reserving/capital work, in some places this is the case only for some departments, and in yet others pricing actuaries have no formal link at all.

## **Marine/Energy Pricing:**

### **1 Are actuaries involved in pricing Marine/Energy contracts?**

Yes. (But this is a biased sample as we only interviewed employers of actuaries on the marine and energy working party)

#### **a. If so, at what stage of the process are they involved, i.e. is this before or after the quotation stage?**

See answer to question 3 first. Where actuaries are not involved before the quotation stage, it is often the case that the underwriters will have used actuarial models. Organisations vary in their approach to conducting post-bind reviews.

#### **b. How are they involved, e.g. benchmark models, parameters and studies, individual case pricing, RI purchase?**

Generally actuaries are involved with all of these with the exception of outward reinsurance or retrocession, where practices diverge.

### **2 Are there certain criteria for when pricing actuaries are required to be engaged? Does this vary by:**

- a. Premium income of the contract to your organisation?**
- b. Contract type – facultative, direct, reinsurance?**
- c. Complexity – aggregation clauses, loss sensitive conditions, etc.**
- d. Territory/country?**
- e. Other**

Half of the organisations have fixed criteria, which include premium income; the other half has no fixed criteria.

### **3 What proportion of Marine/Energy business is technically priced by a model developed by an actuary? Please give proportions by sub-line (e.g. hull, cargo, liability etc.) where possible.**

The responses to this question tend to reflect the maturity of actuarial involvement in each organisation. Where actuaries have been involved for some time, the majority if not entirety of the book is priced using models that have been developed by actuaries.

### **4 Do the pricing actuaries report direct into Underwriting or into Actuarial Management or Other areas (e.g. Finance, Risk Management)?**

The majority of pricing actuaries report to actuarial management, a minority to underwriting.

#### **a. Which do you believe is best? Why?**

Reporting to actuarial management is valued for two reasons: supporting independence of thought and giving access to more alternatives via peer review.



Geographical location is often considered more important for interaction than the reporting line is.

**5 How regular is the interaction between pricing actuaries and underwriters?**

Very regular, daily interaction during renewal if not all year round.

**6 How well do you believe your pricing actuaries currently understand Marine/Energy business?**

**(Scale: Complete, High, Medium, Low)**

<b>Market conditions</b>	Generally high
<b>Classes</b>	Generally high
<b>Coverages</b>	Generally high
<b>Terms and conditions</b>	Less well understood
<b>Nature and type of actual claims</b>	Less well understood
<b>Broker dynamics and relationships</b>	Least understood

See charts in main body of report comparing to the underwriters' responses.

**7 Do you believe the outputs provided by pricing actuaries to Underwriters meet their needs, and are they involved in specifying these outputs?**

Yes and mostly, respectively.

**8 How much reliance do Underwriting place on the pricing actuaries outputs:**

**(Scale: Complete, High, Medium, Low)**

**Individual case pricing vs Benchmark model pricing**

Individual case pricing	Generally high
Benchmark model pricing	Generally high

See charts in main body of report comparing to the actuaries' responses.

**9 Where the actuarial price is factored into the final decision-making process of individual accounts, do Underwriting apply any adjustments to the pricing actuaries' outputs?**

The actuarial numbers are left unadjusted. Organisations vary in the discretion allowed to underwriters.

**Price Monitoring:**

**1 Who is responsible for monitoring profitability on a contract basis?**

Where this is monitored on a contract basis, the underwriters do it.

- 2 **How is this done? e.g. monitoring against technical /actual price?**  
Some organisations compare actual to technical price; others compare both to target ROE.
- 3 **Do the reserve estimates feed into this process?**  
No consistency in the answers.
- 4 **For how many back years is contract performance monitored and does this vary by sub-line (e.g. hull, cargo, liability etc.)?**  
Answers varied.

#### **Future:**

- 1 **Do you believe the role of pricing actuaries will change in the future?**
  - Improved data will increase role of pricing actuaries
  - Deeper analysis of inflation: separate out into exposure, frequency and severity inflation components
  - Growth in number of pricing actuaries
  - Expect the roles of uw and actuary to merger – this is already apparent in Europe where most of the product uw are actuaries or have a strong technical background
  - More involvement; especially in less mature organisations.
- 2 **How would you like to improve the current interaction with pricing actuaries in Marine/Energy and what is the optimal nature and level of involvement of pricing actuaries?**  
For this sample, the majority feel that the level of interaction in their own organisations is near-optimal. Some expect to see increasing interaction between actuaries and clients / brokers, while others see this as compromising the independence of the actuarial view.
- 3 **How do you see the role of Underwriting and pricing actuaries evolving in the future?**  
The majority of participants felt that across the market the frequency and breadth of interaction would increase.

#### **(Scale: Increase, Decrease, Stay the same)**

**Frequency of interaction:** The majority of participants felt that across the market the frequency of interaction would increase.

**Breadth of interaction:** In our sample the proximity to underwriting was already quite close, with little room for improvement. Those who indicated increasing proximity in the future may be anticipating increasing interaction with clients and brokers.

**Proximity to Underwriting:** The majority of participants felt that across the market the proximity to underwriting would increase.

#### **4 Marine/Energy markets:**

- a. What do you see as the major issues for these markets? (e.g. large losses that drive the market such as Costa Concordia, disputes regarding Removal of Wreck)?**
- b. In your view can pricing actuaries assist in dealing with them?**
- c. Are there wider market issues that affect the pricing of Marine/Energy business?**

These are mostly in common with underwriting issues

- Removal of wreck
- Rapid claims inflation over last decade
- Reducing values leading to an increase in attritional loss ratios
- Increasing frequency of severity of catastrophes and ability to model them (non-modelled perils and territories) Hurricane Sandy, Costa Concordia, Deepwater Horizon
- Limits are increasing – for which not knowing how to model exposures makes pricing difficult
- Period of low claims impacting rate adversely
- High capacity in energy
- Too much capacity driving soft market (e.g. Lloyd's writing in Asia)
- Costa Concordia did not impact rating environment enough
- Market has a short term view of events (e.g. 2005, 2008 Hurricanes are quickly forgotten after a few benign cat seasons).
- Cyber attacks on energy assets
- Environmental aspects
- More questioning of losses – will they ever be full and final.

Actuarial specific issues

- Limits are increasing – for which not knowing how to model exposures makes pricing difficult
- Accumulation modelling- more to do
- Increasing frequency of severity of catastrophes and ability to model them (non-modelled perils and territories) Hurricane Sandy, Costa Concordia, Deepwater Horizon – anticipating further loss causes is very difficult in modelling

#### **5 Looking to the future, do you envisage any change in regulators' requirements whether general or specific regarding pricing for the Marine and Energy markets (e.g. reporting on pricing models, feedback cycle, submission of more data to regulators)?**

Nothing conclusive to include here

# Appendix D

## Glossary of Terminology

Terminology	Meaning
AAD	Annual Aggregate Deductible
ADS-DTV	Standard German Hull Insurance Clauses
AFE	Authorisation for expenditure
AMD	Additional Machinery Deductible
ATL	Actual Total Loss
Average	Type of loss (either General Average or Particular Average)
BI	Business Interruption
Binder	An agreement to write all insurance policies for a defined period subject to pre-determined criteria
Blowout	An uncontrolled release of oil or gas from a well
Bluewater	Ocean-going vessels
Bottomry	An arrangement in which the insured of a boat borrows money using the boat as credit
Brownwater	Coastal waters
CAR	Construction All Risks
CEFOR	The Nordic Association of Marine Insurers
COW	Control of Well used within OEE (operators extra expense)
CSL	Combined Single Limit
CTL	Constructive Total Loss
D&O	Directors and Officers
DWT	Deadweight Tonnage
E&P	Exploration and Production
EL	Employers Liability
ELR	Expected Loss Ratio (aka Model Loss Ratio)
Fac	Facultative
FAI	For Assured's Interest
FFO	Fixed and Floating Object (i.e. collision with stationary object)
FGU	From Ground Up
Flag	Country a vessel is registered
FLNG	Floating Liquefied Natural Gas operations used in the Offshore Energy industry
FPSO	Floating Production Storage and Offloading oil and gas vessel used in the Offshore Energy industry
General Average	A loss arising from the reasonable sacrifice at a time of an insured peril of any part of a ship or its cargo for the purpose of preserving the ship and the remainder of its cargo
GOM	Gulf of Mexico
GT	Gross Tonnage
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study - method for hazard identification
HTHP	High Temperature High Pressure
IBNER	Incurred But Not Enough Reported
IBNR	Incurred But Not Reported
IBNYR	Incurred But Not Yet Reported (i.e. IBNR=IBNER+IBNYR)
ICC	Institute Cargo Clauses
IELR	Initial Expected Loss Ratio
ILF	Increased Limit Factor

<b>Terminology</b>	<b>Meaning</b>
IMO	International Maritime Organization
Inchmaree Clause	Extension of cover to include damage or loss due to latent causes
ITC	Standard English Hull Insurance Clauses
IV	Increased Value Insurance
Lineslip	An agreement to write selected insurance policies for a defined period subject to pre-determined criteria on a case-by-case basis
LMA	Lloyd's Managing Agency
LNG	Liquefied Natural Gas carrier
LOH	Loss of Hire Insurance
LOPI	Loss of Production Income
LPG	Liquefied Petroleum Gas carrier
MI	Management Information
MII	Mortgagees' Interest Insurance
MIU	Marine Intelligence Unit - a risk management 'score' provided by Lloyd's Intelligence
MPL	Maximum Probable Loss (also known as "PML")
Nat Cat	Natural Catastrophes
NCB	No Claims Bonus
NP	Norwegian Plan
OEE	Operator's Extra Expense (aka Control of Well)
OIL	Oil Insured Limited (an Energy mutual company)
OIL Wrap	An Energy PD & BI policy which includes property protection provided by OIL; thus the policy "wraps" around the OIL cover (which does not cover BI)
P&C	Property and Casualty
P&I	Protection and Indemnity
Particular Average	A partial loss of a ship or its cargo caused by an insured peril and which is not a General Average loss
PC	Profit Commission
PD	Physical Damage
Perils of the Sea	Fortuitous accidents or casualties of the seas, but does not include ordinary action of the wind and waves
PML	Probable Maximum Loss (also known as "MPL")
RARC	Risk Adjusted Rate Change
RDC	Running Down Clause (i.e. collision with another vessel)
RDS	Realistic Disaster Scenario
RMS	Risk Management Solutions (a catastrophe risk modelling vendor)
RV	Replacement Value
Salvage	The estimated cash amount that would be received if damaged property were to be sold
Shore Clause	Provision in marine insurance listing onshore perils covered
Spud date	Very first date of drilling of well
Subrogation	The right of an insurer which has paid a claim to step into the shoes of the insured so as to exercise in his name all rights to recover that loss from other insurers
Sue and Labour	Allows the insured to recover expenses incurred when taking reasonable measures to reduce losses
T&Cs	Terms and Conditions
TAS	Technical Actuarial Standards that have replaced the guidance notes of the past
TEU	Twenty-foot Equivalent Unit; describes the capacity of container ships and container terminals
Time policy	A policy that covers all voyages, shipments etc over a period (e.g. 12 months)
TIV	Total Insured Value
TLO	Total Loss Only
TPL	Third Party Liability