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Analyzing the Disconnect Between the Reinsurance Submission and Global Underwriter's Needs

Property Per Risk

by the IFoA / CAS International Pricing Research Working Party

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1. Abstract

Purpose and Intended Result: This research paper is intended to fill the void in the currently available actuarial literature related to information required by the reinsurance underwriter but often lacking when pricing property per risk coverages worldwide. Results from surveys of members in the UK, European and US actuarial communities, as well as others in the related insuring communities, clearly indicated a distinct disconnect between the information desired by reinsurers and the information commonly included within a cedent's submission. Underwriters are unable to refine the pricing of a contract because of this disconnect. Complicating the matter is the fact that this disconnect can occur in one or several steps in the transaction, beginning with the retail agents and/or brokers up through any level of reinsurer.

Primary insurance carriers use the information collected by their retail agents or the insured's broker for their own underwriting purposes. The insurance carrier then decides what and how much of that information is provided to the reinsurer. Assumptions are made at each level. The agent or broker assumes it has provided the information wanted and needed by the primary insurance carrier because a policy is offered. Likewise, the primary insurance carrier assumes it has provided the requisite information to the reinsurer because a contract is offered. These assumptions affect pricing.

Rather than allowing such assumptions to continue (that the information provided is sufficient and correct), this research paper attempts to specify what information is important to the reinsurer. When primary insurance carriers know what is important to the reinsurer, they can gather that information from the agent or broker. This paper results in a top down approach to improved property underwriting and pricing. When assumptions don't have to made, pricing reflects the true exposure. Every level wins: the insured gets the best pricing available from the insurance carrier because the primary insurance carrier gets the best pricing from the reinsurers.

Methodology: To support this research paper a survey was prepared and administered by the Institute and Faculty of Actuaries and the Casualty Actuarial Society. This survey was used to identify the information that is commonly included in submissions compared to the information that is desired by pricing practitioners. The survey information, along with input from a wide ranging insurance and reinsurance industry Working Party, was used to produce this research paper and to offer observations and make suggestions in many different facets of the pricing process.

The main sections of the paper describe various primary and reinsurance company considerations, and a ranked importance of the main exposure and experience pricing data elements. Each of the main exposure data elements of amounts of insurance definitions, exposure submission types, ground-up loss ratio estimation methods, the usefulness of historical profiles, and granular importance of each of the main elements of construction, occupancy, protection, and exposure is described in detail. Similarly, information related to experience rating such as large claim information including the link to exposed values, various price monitors, and using property cat submissions are reviewed in detail. Lastly, an introduction to some regional differences is included.

Results: The main results of the research paper are:

- Show the importance of each data element requested by either the primary or reinsurance company;
- Provide a reference document to enable a deeper understanding of how each of these elements fit together

Since much of the information presented here may extend to other property or casualty lines such as property catastrophe, crop insurance, motor, employers liability, cyber, and other emerging markets, hopefully this research may help provide a framework for additional expansion into these other lines of business.

Information presented here is recommended for use as a reference document for anyone involved in the pricing of property per risk, and the extensions to other lines of this information can be explored.

1.1 Keywords

Property Per Risk Pricing; Reinsurance submissions; Actuarial benchmarking; COPE

1.2 Key Contact

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2. Introduction

This paper is intended to provide the reader with practical pricing resource information that is typically included, or should be included, in various property insurance and reinsurance submissions for property per risk exposures around the world. It is not our intention to give advice, nor to be seen to give advice, but rather to offer observations and make suggestions that we hope the reader will find useful and interesting.

The following types of entities may find the information included in this resource document useful for day-to-day data collection and analysis activities:

- primary insurance operations
- excess and surplus lines operations
- reinsurance companies
- initial primary insureds
- agents and brokers, including reinsurance and retrocessional brokers

This resource material can be used when preparing information to be used in pricing and underwriting property per risk contracts and treaties. It is understood that primary insurance carriers do not always have access to the most desired and relevant information for their initial pricing. However, reinsurers who must rely on this information from the primary company, either granularly or in some rolled-up aggregated form, are dependent on, and limited by, its accuracy. Lacking the needed information, primary and reinsurance underwriters must make underwriting assumptions. Such assumptions directly affect reinsurance pricing – usually increasing either the reinsurance premium paid by the ceding company, or the direct premium paid by the insured, or both.

Increased reinsurance premium translates into increased primary insurance pricing. The lack of credible information could result in higher insurance premiums for commercial property insureds. Understanding what information the reinsurer needs benefits all parties involved in an insurance transaction – from the main street buyer to the agent to the primary insurance carrier.

2.1 Joint International Pricing Research Working Party

Toward the goal of making suggestions for improving primary and reinsurance submissions, the UK Institute and Faculty of Actuaries General Insurance Research Organization (IFoA-GIRO) and the US Casualty Actuarial Society's Casualty Actuaries in Reinsurance (CAS-CARe) formed a working party to study the gaps between property reinsurance submissions and the information preferred and needed by property reinsurance underwriters. The information gathered from property reinsurers may create a compelling framework for future property reinsurance submissions.

2.2 Survey preparatory work

Identifying what potentially makes the most beneficial reinsurance submission was the initial aim of the working party. Accomplishing this goal required establishing the current submission quality compared to the needs of pricing practitioners. This first goal was accomplished through use of a survey. As detailed in Appendix A, we had 44 respondents in this initial survey: 86% were from actuaries, and 14% from other areas such as actuaries turned underwriters, etc. Most respondents had significant experience, with 71% pricing reinsurance more than 5 years and most geographic regions were well represented. The results were presented in total across all actuarial organizations, as well as split between CAS members, IFoA members, and all others. The initial results and observations emanating from this survey were presented at the annual CAS CARe (Casualty Actuaries in Reinsurance) Conference in June 2015 in Philadelphia, USA.

A follow-up presentation was made at the annual GIRO Conference in October 2015 in Liverpool, UK. At this conference, additional survey questions related to information typically collected in property per risk contracts was presented to a mix of primary and reinsurance pricing practitioners. As detailed in the Appendix, we had 41 respondents in this follow-up GIRO audience survey after presenting the CARe survey results and follow-up analysis.

These presentations and survey results are summarized in this research paper. Drawing from these surveys, this paper provides a broad overview and describes important aspects of the many technical details found in an underwriting submission. r A careful review of survey results, presentations and follow-up interviews and conversations reveals what granular information supplied by the initial buyers of property risk insurance is considered most critical, and ultimately presented to the reinsurer. The result is a practical set of suggestions, guidelines and/or framework for producing that information. This paper emphasizes the advantages to the primary insureds by amassing and providing the granular and rolled up information required for properly pricing reinsurance submissions. It is hoped that this paper can be referred to by interested parties on all sides of the primary and ceded reinsurance transactions so all can understand the need for, and the benefits obtained from producing the information provided in a high quality submission.

2.3 Anticipated audience

The intermediate or advanced level actuary or underwriter who is already familiar with basic insurance and reinsurance pricing concepts, but who now wants to have a deeper understanding as to how/why certain data elements are requested is the intended audience for the paper. This includes primary and reinsurance pricing practitioners, actuaries, underwriters, front-line insureds, agents and brokers or reinsurance purchasers in various global settings.

In 2015, the focus is on Property Per Risk. The information presented here may extend to other property or casualty lines such as e.g. property cat, crop insurance, motor, employers liability, cyber or other emerging issues, perhaps augmented by additional research and surveys in these other lines of business.

3. Primary Company Considerations

This section provides an overview of the relevance and benefits to primary companies and related parties due to the careful collection and aggregation of relevant property per risk underwriting information. Such information provides benefit to both the primary actuaries and underwriters in their initial pricing, as well as allowing for better connection between what the primary companies collect and what the reinsurers need in the reinsuring transaction.

3.1 Relevance / benefits to primary markets including agents and brokers

A direct correlation exists between the underwriting information gathered by the primary insurance carrier and subsequently provided to the reinsurer, and the ultimate premium paid by the buyer. When the primary insurer both collects and provides the reinsurer the most important underwriting information, the best pricing can be offered.

However, primary insurance carriers do not always provide the underwriting information considered necessary and most relevant to property reinsurers. . Lacking needed information, reinsurance actuaries and underwriters must make underwriting assumptions that can directly affect reinsurance pricing – often resulting in higher reinsurance premiums.

As detailed below, an important example of the information that should be supplied, but often is not, is the existence and adequacy of sprinkler systems at primary insured locations. Proper evaluation of a sprinkler system by a qualified professional may result in significant savings in the ground-up premium charged to the primary insured, as well as potentially additional credits being given by the reinsurer. Agents and brokers are key in collecting the required information for these and many other attributes, and summarizing it for primary insurance companies and reinsurers in a manner that does not sacrifice critical detail. *(see Section 10.4.1 for a discussion of Sprinkler Systems and their importance along with many other protection and other measures of the iconic "COPE" analysis framework)*

Increased reinsurance premium generally translates into increased primary insurance pricing. The result, potentially higher insurance prices for commercial property insureds. Understanding the reinsurer's information needs benefits all parties involved in the property insurance transaction – from the main street buyer to the agent to the primary insurance carrier.

3.1.1 The Beginning

Ultimately, the process of property reinsurance pricing begins during the primary insurance underwriting process. The primary property insurer must gather the information it deems most important, and subsequently pass along the portions of that information the reinsurer deems most important.

Information judged important by the primary insurer may or may not be considered important by the reinsurer. Likewise, information the primary property insurer sees as unimportant may actually be exactly the information the reinsurer needs to properly underwrite and generate the most appropriate pricing for the risk or risks.

This research paper details the information global property reinsurers want and need in order to provide the best pricing. Primary insurers who gather this information during their underwriting process, and provide it to the reinsurer, may gain a market advantage as a result of better pricing and possibly improved underwriting.

3.1.2 The Details

Reinsurance pricing can be significantly affected by the details provided by the primary insurer. Gathering and providing information deemed critical by reinsurers can be beneficial to the primary insurer. However, more benefit can be gained when pertinent details are provided.

Consider the following “details” example. The subject building is protected by a sprinkler system; however, the primary insurance carrier is not crediting the insured for having the sprinkler system. There are many reasons such credit may be withheld ranging from the system not being adequate for the operation to the lack of a main drain test.

Because no explanation is given to the reinsurer beyond, “no sprinkler system credit,” an assumption must be made. The reinsurer has to assume that the system is not adequate, is turned off, or something else.

If the only reason no credit is given is because there is no main drain test, the reinsurer needs this detail. Even though the primary insurer does not and cannot give credit, the reinsurer can make a different pricing decision based on the details.

With these kinds of details, the reinsurer can make a better and sometimes preferred pricing decision. Without details, assumptions must be made that could result in higher reinsurance costs. .

3.2 Impact on Primary Actuaries and Underwriters

Providing the reinsurer the information they want, with the necessary details they need, results in more trust, better decisions, and often better pricing. This gives the primary insurer a market advantage. Plus, when the primary insurers gather the information and details desired by the reinsurer, they may arrive at better underwriting decisions for themselves.

As such, the information detailed in this research paper could potentially benefit primary insurers as much or maybe even more than reinsurers.

4. Reinsurance Company Considerations

This section provides an overview of the relevance of property per risk underwriting information provided by ceding companies, and the benefits to reinsurance companies and related parties when such information is provided in sufficient detail. This information allows both the reinsurance actuaries and underwriters to make better informed decisions in their pricing, and provides a degree of transparency that helps to engender trust that leads to stronger, longer term relationships between the primary company, the reinsurance broker and reinsurers.

4.1 Relevance / benefits to excess and reinsurance markets including reinsurance brokers

As noted in the previous section, a direct correlation exists between the underwriting information gathered by the primary insurance carrier and provided to the reinsurer, and the ultimate premium paid by the buyer. When discussing the "best pricing" for a risk, this generally represents the price where no explicit or implicit loadings are required to compensate for a lack of suitable data. This "best price" can therefore be thought of as the most appropriate price for the given risk taking all features into account.

If upon receiving the underwriting submission, reinsurers are able to produce what they consider the best price for the risk, they can be confident that, from a pricing perspective, they have done everything possible to evaluate the business in a rational manner. This means they have produced a price at and above which they would be happy to write the business and below which they would never be happy to write the business. Without obtaining the optimum information, reinsurers will make assumptions which are likely to cause their price to be, on average, higher than it would be if the optimum information was available. Therefore, one would expect that on average the best price for a risk where incomplete or inadequate data is provided is below the price the reinsurer produces. This means that reinsurers cannot be confident that they are maximizing their opportunity to obtain the business. They can only be confident that they are doing what they can to not write poor quality business. The focus of the analysis will be on protecting the firm's capital rather than on acquisition of profitable business. In other words, they are forced to adopt a defensive rather than an offensive strategy with regards to acquiring business.

An important feature of the reinsurance market is the relationship between ceding company, reinsurance broker and reinsurance company. One way to maintain these relationships is to have reinsurance pricing over a period of time which consistently and fairly reflects the risk transferred from the ceding company to the reinsurer. A quality data submission allows reinsurers and brokers alike to demonstrate to the ceding company that the reinsurance premium charged represents a fair price for the risk. It is less likely to be necessary to explain that the price appears high because of loadings that result from assumptions required due to poor data quality. From the broker point of view this means the cedant is less likely to look to other brokers to provide a better price and for the reinsurer it means the cedant is less likely to look to other markets for a better price.

We can also consider the benefits not only to a fair price but also to a smooth price over time i.e. one that does not move significantly in case of loss. A properly blended or credibility weighted result generated by the exposures presented in the submission, with the loss experience generated by those exposures, is sought for this smooth price balancing. With sufficiently detailed submission data, a price should reflect exposure in a manner that adequately includes a realistic expectation of loss. That is, a loss would have been considered within the pricing such that there would not need to be significant change of price post loss. The reinsurer is less likely to have an unexpected or shock loss and the reinsurance broker is less likely to have to deal with an unhappy ceding company receiving a post loss price hike.

4.2 Impact on Reinsurance Actuaries and Underwriters

Receiving required information in sufficient detail allows the actuary and underwriter to produce pricing within which they have maximum confidence. Additionally, a quality reinsurance submission will reinforce the softer information that has been obtained from the company through meetings, discussions and general market information.

The above means that reinsurers are able to enhance their ability to acquire and maintain business over and above what would be possible with sub-standard reinsurance submissions.

5. Exposure and Experience Data Elements

As detailed in the following sections, to properly underwrite any primary contract, or reinsurance treaty, the accompanying submission should include information sufficient to allow a practitioner to produce both Exposure rating and Experience rating results. The process of performing these analyses requires the input of data and selection of a variety of factors, curves, data sets, and even methods. Much of this information is either provided directly by the ceding company, must be judgmentally selected from various proprietary analyses a reinsurer may possess, or needs to be calculated based on other information provided in the submission. Under any of these circumstances, the submission must supply information necessary for an analyst to gain an understanding of the ceded business that is clear enough to enable proper selections and inform good judgment.

The results from the Experience and Exposure analyses will typically be weighted together using some form of credibility to produce a blended point estimate for pricing. Implicitly or explicitly, the amount of credibility given to either of the estimates is strongly influenced by the credibility of the individual elements used to produce each estimate. A list of important elements that are typically sought by reinsurance actuaries or underwriters is detailed below. Although a somewhat different element set would be required by primary practitioners, many of the same concepts would apply.

5.1 Exposure Elements

To properly produce credible **Exposure** indications, a practitioner must typically provide a number of data inputs and make a number of informed selections. Inputs usually include a projected premium and an expected attritional (non-catastrophe) loss ratio. The Exposure Rating process also requires some type of risk profile, or data that describes how much exposure to risk is being ceded in terms of policy limits, premium, or perhaps both. Selections that must be made may include methods for handling loss adjustment expenses, occupancy types, and loss severity curves that describe the probability of seeing losses of various sizes. Universally among all survey responders (*Figure 1* below), the four items ranked most useful are:

- **In-Force Risk Profile (banded)**
    - This key exposure information, presented as a banded Amount of Insurance exposure profile for all exposures, was shown to be the number one requirement for reinsurance pricing. Unsurprisingly, it was also the item shown to be provided most often, in 86% to 93% of submissions.
- **Individual risk listing (all cat/non-cat exposures)**
    - Among CAS and IFOA members polled, this was the second most important data item that can be provided with a reinsurance submission. Providing information in this level of detail would never have been possible, and indeed was rarely requested until recently. It has only been made possible by the development of inexpensive memory and high-speed data transmission systems capable of transmitting large quantities of data both within and between networks.
    - Catastrophe models typically require this type of granular data, and as their use has become more widespread among reinsurers, it has become more common to request this information. The significant risk to property posed by natural and man-made disasters may account for the second-place rank awarded to this item. The fact that it is shown to only be provided between 24% and 33% of the time may be due to the fact that not all property reinsurance contracts are catastrophe-exposed. It is not uncommon for per-risk contracts to exclude "named storms".
    - This item was also ranked significantly lower in importance by non-CAS/IFOA responders, presumably from other regions where catastrophe models do not

exist, or where catastrophe losses do not typically make up a large proportion of "insured loss".

- **Historic loss ratios**
  - Shown as the third most important data element by CAS and IFOA responders, and third among other responders, historic loss ratios provide much insight into how well a company has managed their property portfolio in the past, and form a basis for an estimated loss ratio for the projected coverage period, which is required by most exposure rating models. The prior historical loss ratios will often be presented, split between attritional and various forms of catastrophe loss measures
- **Written explanation of risk**
  - Ranked fourth in importance among all responders, this information can typically include a narrative section often found in the submission, and often includes more qualitative information that can inform judgmentally selected analysis modifiers described in the basic underwriting elements of COPE (Construction, Occupancy, Protection, Exposure).

5.2 Experience Elements

A standard **Experience** Rating indication requires many pieces of information, all of which require thoughtfulness and judgment on the analyst's part. The required inputs include a listing of large losses, historic premiums, historic rate change information, trend factors, and loss development factors. *Figure 2* table below shows poll responses indicating the importance of these data elements and the percentage of responders who would describe each item as one commonly found to be present in property risk submissions.

- **Large loss listing**
  - All those who responded to the poll agreed that the large loss listing is the single most important piece of information needed for an experience rating exercise. This is reflected in the fact that it is the only item that 100% of responders reported commonly finding in submissions. However, in spite of the fact that poll results show that receiving historic loss listings ranks either second or third in overall importance, only one quarter to one third of responders reported that this information is commonly included in the submissions they receive.
  - There may be several factors why historic loss listings are not included in most property per-risk submissions, not least of which is that the loss history is used primarily for the calculation of loss development factors. Loss development is normally not as significant in property (and other short-tail lines) as it is for longer tail lines such as General Liability and Workers' Compensation.
- **Historic Premium**
  - Those who responded ranked Historic Premium as either second or third in importance. A very high percentage of poll responders also reported that this information is commonly included in the submissions they receive.
- **Large Loss Claim Description**
  - Responders rated this item as fourth in importance, and 73% to 96% of them said that this item is commonly found in property risk submissions. Because an experience rating is typically preformed to produce a non-catastrophe loss estimate, the cat/non-cat indicator is important. It allows the analyst to filter out catastrophe losses. It also gives the analysis the ability to compare actual catastrophe losses to estimates provided by catastrophe models.
- **Historic Rate Change**
  - This information can be presented granularly by exposure, or as an aggregated price monitor, and is required to bring the historical loss experience to the level expected for the forthcoming policy period. It is interesting to note that while poll responders rated this item similarly in terms of importance, CAS actuaries

indicated that they receive such information 84% of the time, compared to IFoA responders who reported receiving it only 33% of the time.

- **Link of actual losses to amounts of insurance**
    - This information is useful to assess the AOI definition and their impact on the actual types of losses that can occur, and to help in aggregated benchmarking size-of-loss curves across various market segments. Responders may have considered this sort of information to be included in Item C. "Large Loss Claim Description", but the amount of insurance associated with each claim was not specifically mentioned in the questionnaire.

5.3 Survey Importance of Exposure and Experience Elements

To gain an initial sense as to how important each of these items is for the reinsurance practitioner, various UK, US, and European actuaries and underwriters were surveyed. The survey asked the participants to rank how often each of these exposure and experience elements are received. Survey participants were also asked to rank the elements as to what is most important in their pricing exercises. Each of these is discussed in more detail in the following sections, but Figures 1 and 2 provide a summary of the results. For example, receiving a banded profile is not only most often received (93 percent) but also ranked as most important (Rank #1) for Exposure rating.

Figure 1 - Survey Importance of Exposure Rating Elements

	All		CAS		IFOA		Other	
	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank
a. In-force risk profile (banded)	93%	1	92%	1	87%	1	86%	1
b. Historic risk profiles (banded)	23%	5	8%	6	60%	4	29%	3
c. Individual risk listing (all cat/non-cat exposures)	30%	3	24%	2	33%	2	43%	6
d. Individual risk listing (above certain threshold)	48%	7	48%	7	53%	5	29%	8
e. Historic from ground up loss ratios (cat and non-cat)	57%	2	68%	3	40%	3	71%	2
f. Written explanation of risk profile	25%	4	20%	5	27%	5	29%	4
g. Risk profile detail	34%	6	32%	4	40%	7	29%	5
h. Link of claims to risk profiles	7%	8	4%	8	7%	8	29%	7

Figure 2 - Survey Importance of Experience Rating Elements

	All		CAS		IFOA		Other	
	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank
a. Large loss listing (no triangle)	100%	1	100%	1	100%	1	100%	1
b. Historic large loss listing (triangle)	30%	3	24%	3	33%	2	29%	4
. Large loss claim description including cat/non-cat indicator	82%	4	96%	4	73%	4	71%	3
d. Historic premium	93%	2	96%	2	87%	3	100%	2
e. Historic exposures (# of risks, # of exposures / risk)	30%	6	20%	6	40%	5	57%	5
f. Projected rate change	43%	7	56%	6	27%	7	29%	7
g. Historic rate change	59%	5	84%	5	33%	6	57%	6
h. Rate monitor (renewal policies)	18%	8	24%	8	20%	8	0%	8

5.4 Blended Combination

The ideal account level pricing relies exclusively on observed, fully credible, account specific data that was not subject to random fluctuations. Additionally, these historical patterns should repeat in the future contract period. However, in practically all cases, the credibility of the account's experience is too low to be used as the exclusive measure of future expected results. Also, the older years are less relevant due to either modest or significant reengineering of the book of business through time. These impacts are magnified for accounts that have larger amounts of insurance, significant changes in various COPE characteristics, unstable past experience, significant changes in deductibles and policy limits, etc.

To help offset these experience limitations, some measure of exposure-based loss estimates using company or industry benchmarks is required. Credible large loss industry scales (property "First Loss Scales") are required to help assess expected experience from larger amounts of insurance, etc.

Working with actual losses and their link with the AOIs can help understand the difference between the methods.

Reviewing the pricing of any account, using both the Exposure and Experience methods, typically yield the following major questions:

- If the exposure and experience indications are different, how are they different?
- Which factors are causing the difference?
- Should any adjustments be made to help reconcile the results?

By inspection, the practitioner wants to compare the Exposure and Experience results by layer and/or year to detect any patterns (*Figure 1*). That is, are the expected exposure results always higher or lower by layer than the experience results? Further, the practitioner should look to see if there are any reversals by layer or year. The practitioner should apply forensic actuarial techniques to identify the causes of any of these differences (*Figure 2*). For example, are there any material occupancy or AOI mix changes during the historical experience periods? And lastly, the practitioner should look to see what adjustments they might want to make to either the underlying data or the assumptions to improve the comparison. For example, does the profile presented accurately represent the true exposed amounts of insurance under potential large loss or multiple exposure conflagration situations.

Full reconciliation of the Exposure and Experience methods is beyond the scope of this paper. The main points to be gathered are:

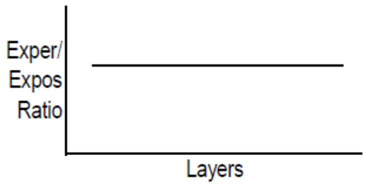
- The traditional naïve approach to pricing generally involves:
  - estimating an Exposure rate: X
  - estimating an Experience rate: Y
  - combining as w(X)+(1-w)Y
- As tempting as it may be to think the next step is to refine the estimate of w; this is not easy, but fortunately, not the right next step
- The practitioner should consider using a specific organized blending method for pricing, analogous to the Bornhuetter-Ferguson blending method commonly used for reserving *(Figure 3)*

A blended ("Hybrid") method[1]

- Looks for common drivers between the two traditional methods:
  - use the Experience results of the layer, and adjacent layers to examine the Exposure rating assumptions
  - use the Exposure rating assumptions to help distinguish noise from signal in the Experience rating
  - use claim counts to emphasize signal over noise
  - use the forensic actuarial techniques to bring the Exposure and Experience models closer together
- Apply the Hybrid method to the adjusted Exposure and Experience results to arrive at the blended result.
- Optionally, weight this result with the Exposure indication. Ideally, the indications are now much closer, so the exact value of the weight is less important. Since the Hybrid method is an exposure-adjusted experience method, you should optionally weigh the Hybrid results with the Exposure method, not the Experience method.
- Aggregate the results across experience accounts to help drive the next iteration of adjusted exposure curves.

[1] The above combined approach was described at the CAS Seminar on Ratemaking in Boston 17-18 March 2008 (Solving the Puzzle: Reconciliation of Exposure and Experience Rating - Steve Philbrick). An application to Reinsurance treaties was described at the CARE conference in London 16 July 2007 (Solving the Puzzle: The Hybrid Reinsurance Pricing Method - John Buchanan).

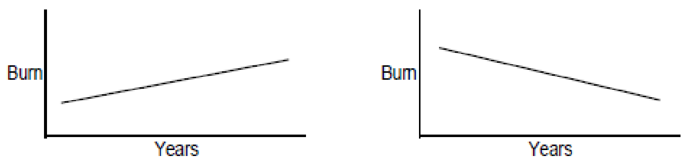
Figure 3 - Comparing Exposure and Experience Results by Layer



Ideal Situation

- No noticeable slope to ratio of Experience/Exposure
- Random fluctuation around mean

Figure 4 - Forensic Analysis of the differences between Exposure and Experience Results



Upward slope pressure indicators:

- Not enough trend
- Too much LDF
- Too much later year rate change
- Too much earlier year rate change

...

Downward slope pressure indicators:

- Too much trend
- Not enough LDF
- Not enough later year rate change
- Not enough earlier year rate change

...

Figure 5 - Analogy of Reserving to Pricing and Reconciling Exposure and Experience Results

	Responsiveness	**Mix**	**Stability**
Reserving	LDF	BF	ELR
	Older Years	---->	Newer Years
Pricing	Experience	***Hybrid***	Exposure
	Lower Layers	---->	Upper Layers

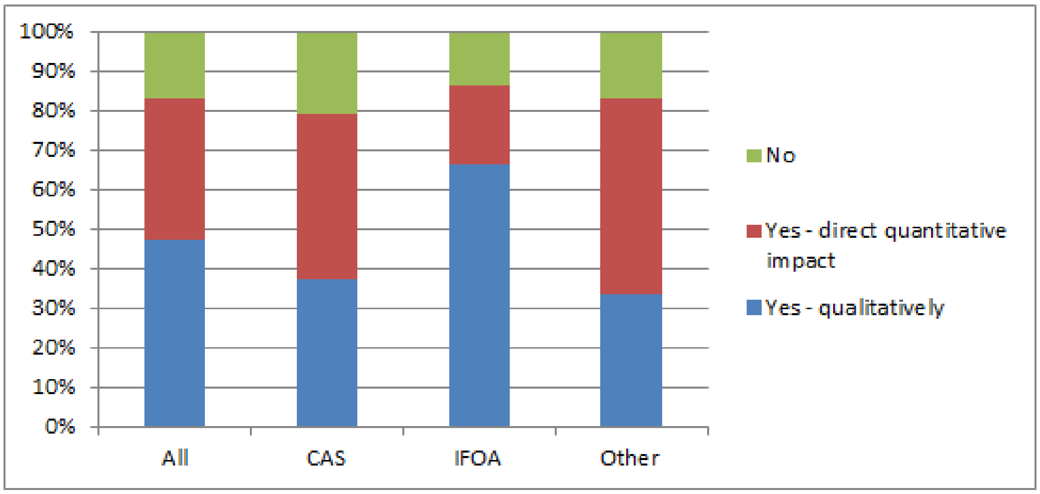
In summary, account pricing should involve solving one puzzle, not two. The weighting of alternative methods should be viewed as the actuarial equivalent of crying “uncle.” **Weighting should not be viewed as a positive approach to developing an answer. But a concession that there are influences or pressures going on that have not been modeled.** Weighting is perfectly acceptable if the only remaining differences are noise. If not; the practitioner should improve any or all of the:

- values used from the submission,
- assumptions made about the submission,
- various exposure and experience benchmarks selected,
- exposure and experience models used.

6. Amount of Insurance Definitions

Initial survey results indicated that a well-defined, in-force risk profile is the most important item for exposure-based pricing. Per the survey results of all the Actuarial organizations, a quantitative representation of the property exposures is received more than 90 percent of the time. However, a written explanation of the risk profile containing information such as: how is sum insured defined, what is meant by a risk, usage of facultative etc. is only usually received 25 percent of the time. From eight commonly used items in exposure rating, this written explanation was ranked the fourth most important. Additionally, as the below question shows, a vast majority of the time (82 percent) the inclusion of a written explanation of the risk profile has either a qualitative or quantitative impact on price.

Figure 6 - Does a written explanation of the risk profile construction affect your pricing?



Based on these survey observations, cedents benefit when they describe, in detail, how their risk profile is constructed, especially if they wish the information to be properly applied in the pricing. Assuming that most pricing actuaries apply some form of first loss scale to the risk profile in exposure-based pricing, knowing how the risk profile is constructed is highly important. For example, a given exposure curve applied to a risk profile which shows sum insured per policy irrespective of single risk exposure on the policy generally gives a higher excess of loss price than that same curve applied to a risk profile showing sum insured per single risk. Similarly, if the profile is on a top location basis, but the pricing actuary is unaware of this, the exposure curve may overstate the excess of loss price. Along similar lines, if probable maximum loss (PML) is used in the profile, a description of how PML is estimated may well affect how and which curve the pricing actuary applies. A ceding company using a cautious PML policy may be hit by an overstated price if the pricing actuary is unaware of the policy.

At first glance, the term "Amount of Insurance" (AOI) appears fairly straightforward. The term refers to an insured's exposure to loss, and for the insurance or reinsurance professional the term AOI may bring to mind other terms, such as "Policy Limit," "Total Sum Insured" (TSI), or "Total Insured Value" (TIV). Interestingly, what might be considered such a simple concept can be quite complicated. Whether one looks at the concept of "Amount of Insurance" from the perspective of the primary insurer or the reinsurer, all parties must clearly understand exactly how each party defines the term. When insurance and reinsurance professionals interact, the need for a clear and transparent definition of this and any exposure measure becomes critical, as failure to clearly communicate this definition leads to a host of difficulties.

In application, a key is consistency between the basis of the exposure profile and the basis of the curves (e.g., TSI, PML, key location, perils, attachments, deductibles, business interruption coverage, occupancy, risk size, fire protection, schedules of risks, etc). For example, if the basis of a profile matches the basis of a curve (based on historical claims data) but the original policy attachment levels have shifted dramatically, the curve won't provide accurate excess layer pricing (in other words, the curve assumes some level of deductible associated with the historical claims used to build the curve – so it will apply to exposures with similar levels of deductibles).

6.1 What Does AOI Really Represent?

For both the insurer and the reinsurer, the most common reason for measuring exposure is to estimate an expected loss cost **-** the amount of loss an insured exposure is likely to produce. For the primary insurers and reinsurers alike, this expected loss cost becomes the basic building block for determining the price at which coverage is to be sold. The Amount of Insurance may also serve as one of many catastrophe model inputs, again with the goal of determining an expected loss figure.

Across a wide variety of possible examples, whether a primary insurance agent calculating the premium required for coverage on a single building, a reinsurance actuary estimating the loss potential of a large portfolio of policies, or a government regulator tasked with ensuring that insurers have adequate capital to support their policyholders, the exposure value is meant to represent the upper bound of the risk transferred, or the largest payment that the insurer or reinsurer would be required to make in response to a covered loss. However, the concept of AOI can represent many different amounts. The manner in which the exposure value is represented often depends on how it is being used and on what questions are being investigated.

6.2 MPL, PML, MFL, EML, TIV – A rose by any other name may not be the rose you think it is.

"Policy limit" is intended to mean the maximum loss an insurer is obligated to pay in the event of a loss. The amount of information contained in that one, single value is extremely limited. Without a clear and precise definition, even exposure information can be confusing or misleading because the terminology used to describe insured property exposures has been used in so many different ways, seemingly interchangeably, for so long. To properly analyze, report on, or otherwise describe the property exposure(s) on an insurance company's books requires more than writing a number down and referring to it as the "Policy Limit," "Exposed Limit," or some other title. No label provides any insight into the nature of the risk to which a policy is exposed unless meanings are clearly defined.

When the term "Policy Limit" is used, some explanation of just what the limit applies to is required. Does policy limit mean just the building, the contents, business interruption expenses, or any combination of the three? Perhaps the policy was issued to an entity that operates out of leased quarters and only contents coverage is provided. Likewise, the insurance policy held by the building owner may not include the contents. By itself, the policy limit value contains little data that informs any estimate of the losses a policy might be expected to pay, or what premium an insurer needs to charge for the protection. For example, two insurance policies are issued with identical limits, but one is issued to the building owner while the second is issued to a tenant, the loss characteristics of the two policies are somewhat different. Clearly, if an accurate measure of the exposure is to be communicated, then some additional descriptive information must be included for the measure to be understood.

For single location policies and full value coverage, the meaning of policy limit is readily understood without much needed clarification. But when a policy is issued to an entity with multiple locations, "policy limit" can have several possible interpretations: the amount of coverage required to cover the largest of those locations (Key Location - the assumption being that a loss would not occur at more than one location at a time); or the sum of all individual location values.

The number of ways to calculate an exposure measure is seemingly endless. And in the end, the measure that is selected depends on the nature of the task at hand. Included in the collection of terms commonly used to describe property exposures are “Total Insured Value” (TIV) and “Total Sums Insured” (TSI). Through the years, these terms have been used in so many ways it may be nearly impossible to know what any value presented under these headings might mean without obtaining confirmation and clarification from the person who created the exhibit. In some cases, these terms could refer to the sum of separate insured limits for various components of coverage, such as building, contents and business interruption. In other cases, the same phrase could refer to the full value of the building(s) and contents insured, regardless of the limit on the insurance policy. For example, if a $10 million policy was issued on a $15 million risk, then the term “TIV” might be used to describe either one of these values. Thus, clarification is required.

Another measure commonly used is Probable Maximum Loss (PML). This term is typically understood to refer to the largest loss that might be reasonably *expected* to occur, given the coverage provided by a policy and the property (or properties) covered by that policy. A PML value may be judgmentally determined or based on a “rule-of-thumb” such as “80 percent of the combined building and contents value”. Yet another commonly seen exposure measure is “Maximum Foreseeable Loss” (MFL), which can be larger than PML because the term is generally understood to refer to the *largest* loss one could possibly imagine a policy might have to pay.

Other terms often encountered are Maximum Possible Loss (MPL), Maximum Probable Loss (MPL again), Expected Maximum Loss (EML). Different meanings can be attached to each of these, depending upon the companies involved, and practices in various geographical areas. Investigating what is actually meant by any values presented in a **Statement of Values** (SOV), is important to understanding the nature of the risk. And the potential for any claim to go beyond any of these stated values. Further complicating matters is that compiling exposure information for shared & layered policies. Typically, full building values are not recorded in such circumstances, which makes excess pricing difficult (see section 7.3 for information on handling profiles with underlying attachment points and limits). Another complication would be the existence of Valued Policy Statutes in particular geographic regions. These statues can alter the definition of insured value (see section 14.1 for information on this additional complexity).

Primary insurers may find these measures useful when calculating the aggregate risk to which the company is exposed. Because these values are generally not compatible with the methods that reinsurers and catastrophe models typically use, they are generally not appropriate measures to use when reporting exposure values to a reinsurer.

6.3 Business Interruption Exposure

In the U.S., Business income/interruption coverage is a function of time and limit. Business income policies pay the loss of “business income” (as defined in the policy) during the “Period of Restoration” (also a defined term). And the policy pays until the limit is exhausted. The insurance policy may include language to the effect of, “Business expenses will be covered for a period of up to XX month/weeks.”

The “Period of Restoration” is the time factor within business income. This term defines the time period the business income policy pays the loss of business income. Generally, this period begins some specified number of hours following the business-closing loss (usually 72 hours, but can be endorsed down) and ends when the business should return to “operational capability.” “Operational capability" is not synonymous with pre-loss business income levels; this is simply the point at which the business can operate at the same level of service as existed prior to the loss. Prior to a loss there is no way to estimate what any specific period of restoration might be; but an estimate of the "worst-case" period of restoration is possible (though not exact).

Only the maximum at risk can be known prior to a business-closing loss. This is the policy limit. The insurance carrier pays no more than the business income limit purchased. Knowing how the business income limit was developed is key. Did the insured complete a standard or proprietary business income worksheet, or was the limit simply a guess?

Two types of business income coverages are commonly found: 1) indemnity coverage; and 2) non-indemnity protection. Indemnity contracts pay the actual loss of business income sustained by the insured up to the policy limit. Non-indemnity agreements pay a specified amount on a monthly basis or over a specified time period. Reinsurers should know which is being used as the rates differ in the underlying coverage.

The MPL is the key factor in business income, even if the direct loss' PML is less than the total limit. Factors that affect rebuilding time can cause the period of restoration to be much longer than anticipated.

Businessowners' Policies (BOPs) are the exception. BOPs provide business interruption coverage for up to 12 months of business closure with no specific limit. The potential amount of loss can only be estimated because no limit is purchased.

6.4 Shared, Layered and Ventilated Policies

For large risks, property coverage may be divided among primary and several excess policies creating a situation where policies are "layered." This layering is also known as "syndication". Furthermore, multiple insurers may provide coverage on a single layer, with each one assuming a "share" of the risk. In these instances, a single insurer may write different shares of each layer. An insurer may skip a layer and then provide coverage for some percentage of a higher layer. When these gaps exist, the policy is said to be "ventilated."

6.5 Detailed Exposure Information – Knowing the Business That You Write

Each exposure measure discussed above is useful for various purposes. Regardless of that purpose, clearly communicating the definition of the terms used is essential. For the primary insurance professional to have a clear understanding of the risk it carries on its books, detailed information must be available regarding both the coverage offered in the insurance policy and the property to which that coverage applies.

For property reinsurance to be properly and accurately priced, the reinsurance analyst also needs a clear picture and a thorough understanding of the reinsured exposure. Both the primary insurer and the reinsurer must be able to answer to following questions about the exposures for which they provide coverage:

- Policy Limits and Coverages:
    - Does reinsured business include single location policies, multiple location policies, or both?
    - Are limits provided based on Key Location Value, the sum of all location values, or, possibly, an average location value?
        - Is location level data provided for multi-location policies?

- If multiple locations are proximately close to each other, and can potentially be affected by a single occurrence (catastrophe, explosion, conflagration), does the policy limit represent an aggregate total limit, or is the full limit available to each location?
    - Does coverage include building, contents, BI, or only a subset of these?
    - Are coverage limits listed separately or as a single limit? If a single limit is shown, is it the largest coverage limit, or the sum of coverage limits?
    - How is BI limit calculated? Is it an estimate or a firm limit set by policy language?
- Perils and Exposures Covered
    - Does the policy exclude loss caused by wind (hurricane), earthquake, terrorism, or other perils?
    - Are there sub-limits for certain perils?
- Deductibles and Self-Insured Retentions
    - Where does coverage begin? Policy language generally states that the deductible is subtracted from the total loss, so the possibility exists that the entire policy limit could be paid.
- Shared and Layered
    - Are there primary and excess policies covering a single account or location?
    - Do policies cover 100 percent of each layer or are there partial participations?
    - If there are partial participations, do they differ by layer and what are the differences?
    - If coverage is layered, are all layers written or is there ventilation?
    - Can it be deduced from the information provided which layered policies are "stacked" and apply to the same location or account?
- Total Value of the Risk
    - Regardless of limit, deductible, and participation of insurance policy, what is the total value of the risk underlying each coverage?
- Occupancy
    - Is information provided on either the occupancies present at each location, possibly the predominant occupancy, or the occupancy perceived as constituting the greatest source of risk?
    - Is it possible to distinguish the difference in the mix of occupancy classes between smaller exposures and larger exposures?

6.6 The Impact of PML on Reinsurance Pricing

Rarely is the total value of the insured property damaged by a covered peril, so the concept of PML (Possible Maximum Loss) is generally used by insurers in countries such as Japan.

When submissions are sent to reinsurers, ideally the risk profiles would not only include the information on insured values but also on PMLs, as shown in the figure below.

Figure 7 - Relationship of Sum Insured and PMLs

Band of Sum Insured	Number of Risks	PML ratio	Total Premiums	…
$100M to $250M	33	15.0%	$5.60M	…
$250M to $500M	18	20.0%	$1.90M	…

When the exposure rating method is utilized to price the reinsurance treaty, the information on PML ratios should be taken into account. Otherwise, the price of the reinsurance treaty may be underestimated if the reinsurance layer sits below the sum insured values but above the PML values, as sum insured values are usually much higher than PML values. The opposite may occur as well, depending upon the position of the reinsured layer to both the sum insured and PML ratios. This is due to the fact that any layering exercise simply apportions a fixed set of total losses amongst various layers.

First, the sum insured value should be multiplied by the PML ratio to obtain the PML value. Then the PML values, instead of the sum insured values, should be used in the exposure rating formula.

For example, the sum insured value of a property is JPY 50 billion and the premium is JPY 50 million. In addition, the expected loss ratio of the insured property is 50 percent. The structure of the excess-of-loss reinsurance treaty is JPY 10 billion excess of JPY 5 billion, and the assumed formula for the exposure curve is $\mathrm{g(x)} = \sqrt{x}$.

If the sum insured value is used directly in exposure rating, the reinsurance pure premium is

$$Reinsurance\ Pure\ Premium = \text{JPY } 50\ million\ \times 50 \text{ percent } \times \left[g\left(\frac{10\ billion + 5\ billion}{50\ billion}\right) - g\left(\frac{5\ billion}{50\ billion}\right)\right] = \text{JPY } 5.787\ million$$

However, also known is that the PML ratio of the insured property is 60 percent, which means that the PML value of the insured property is only JPY 30 billion (JPY 50 billion×60 percent). Therefore, the correct amount of the reinsurance pure premium should be

$$Reinsurance\ Pure\ Premium = \text{JPY } 50\ million\ \times 50 \text{ percent } \times \left[g\left(\frac{10\ billion + 5\ billion}{30\ billion}\right) - g\left(\frac{5\ billion}{30\ billion}\right)\right] = \text{JPY } 7.471\ million$$

As is illustrated in this example, using insured value directly in exposure rating leads to a biased result which is usually lower than the correct number. Further, in this example “assuming 100% PMLs” and “applying the (PML) exposure curve” produces 5.787m pure premium. But adding the information that PML ratios are 60%, increases the pure premium to 7.471m. So the PML ratios must be taken into consideration[2]

[2] Note that Limit Profiles are commonly provided based either on policy level data or location level data. If a reinsurance contract responds on a per-location basis, then the profile should outline exposure data at the location level of detail. However, even if a reinsurance contract responds on a per-policy basis, the inclusion of a policy level limit profile in a submission to reinsurers may lead the reinsurers to an overstated estimate of expected loss. This is because most limit profiles include a measure of the premium collected on exposures in each exposure band. There are often a significant number of smaller locations covered by multi-location policies that only partially expose the limit of the policy covering them, and because they have a portion of the policy premium assigned to them, the premium associated with the largest locations is only a portion of the total policy premium. The consequence is that, with only a portion of the policy premium fully exposing the policy, a smaller expected loss value may be generated than the larger value that comes from a policy level profile, where the total premium for the policy would be counted as fully exposed by the full policy limit.

7. AOI Submission Types

Reinsurers receive critical Amount of Insurance information in three basic ways: Banded Limits Profile, Individual Risk Listing, or a combination such as banded limits supplemented with Individual Risk above a certain threshold. The survey suggested the following for these different types of submissions:

- **In-force risk profile (banded)** – normally received by 93 percent, ranked 1 in exposure rating importance
- **Individual risk listing (all cat / non-cat exposures)** – normally received by 30 percent, ranked 3
- **Individual risk listing (above a threshold)** – normally received by 48 percent, ranked 7

The respondents found the individual listing important, ranking it third behind only in-force banded profiles and ground up loss ratios (discussed in Section 9). The banded profile could be assumed as the absolute minimum required data for exposure rating in property per risk. A banded risk profile can normally be created from an individual risk listing (or from a cat submission discussed in section 13).

Further, the common format provided to a reinsurer of a banded profile can be further given as either a **Banded Limits Profile**, or a **Banded Attachment / Limits Profile**.

7.1 Individual Risk Listing

Primary companies and Excess & Surplus Lines writers most often want or require an individual risk listing. This individual risk listing could include many different types of information, some of which is required and other information that is useful. (See Figure 6). Sometimes dozens of items are required for a thorough granular underwriting of the individual exposures:

- AOIs related to each of the coverages such as Buildings, Contents, and Business Interruption (Time Element),
- Deductibles either exposure or policy level as applicable,
- Location including region, state, zip code, street address, and latitude/longitude if available
- Occupancy description or code
- Protection classifications including various sprinkler system indications
- Construction measures for fire and wind perils,
- Layering attributes such as when insuring portions of the exposures as opposed to the entire structure (e.g. covering a 50 percent share of all losses that are excess of $2.5M but less than $10M).
- Many other items desired or required by different insurers such as distance from fire hydrants, fire stations, highways, and other insureds, etc.

Most useful to a reinsurer, due to its granularity, is some version of this individual risk listing. Many characteristics that make the exposures attractive to the primary company also help the reinsurer understand the risk that is presented to them. Providing the reinsurer with similar information with the necessary details can result in more trust, better decisions, and often better pricing.

Figure 8 - Sample Individual Risk Listing

Orig Sort	Country - Region	Description/Record Index	BUILDING AOI	CONTENTS AOI	TOTAL B&C AOI	TIME ELEMENT AOI	Deductible	State/ Country Region	Zip or Postal Code	Occupancy Code (or description)
1	United States	1 - Apartments with Mercantile Occupancies - Over 30 Units	40,500,000	4,050,000	44,550,000	2,000,000		Alabama		0323
2	United States	2 - Residential Condos without Mercantile Operations	38,000,000	3,800,000	41,800,000	2,000,000		Alabama		0331
3	United States	3 - Non-Governmental Offices and Banks	35,500,000	3,550,000	39,050,000			Arizona		0702
4	United States	4 - Non-Governmental Offices and Banks	33,000,000	3,300,000	36,300,000			Arizona		0702
5	United States	5 - Churches and Synagogues	30,500,000	3,050,000	33,550,000			Connecticut		0900
6	United States	6 - Buildings under Construction	28,000,000		28,000,000		50,000	Connecticut	06928	1150
7	United States	7 - Bakeries	25,500,000		25,500,000	1,125,000	25,000	Illinois	62999	2200
8	United States	8 - Multiple Occupancy Mercantile	23,000,000		23,000,000	450,000	5,000	Illinois	62999	0582
9	United States	9 - Waste and Reclaimed Materials, including Yard	20,500,000	2,050,000	22,550,000	1,215,000		Wisconsin	54990	1400
10	Australia	10 - Motels and Hotels with Restaurant - Up to 10 Units	2,000,000	500,000	2,500,000	100,000		Sydney		0742

PPC	Sprinkler?	BG1 Construction	BG2 Symbol	Actual Premium	Account GULC Scalar	PSOLD: Syndication Entry Point	PSOLD: Syndication Exit Point	PSOLD: Syndication % Share
				80,000				
				70,000				
				50,000				
				40,000				
				15,000				
1	Full	MODIFIED FIRE RESISTI	SUPERIOR WI	15,000				
5	Full	NON-COMBUSTIBLE	WIND RESIST	12,500				
8B	Part	NON-COMBUSTIBLE	ORDINARY	10,000				
10	Part	JOISTED MASONRY	SEMI WIND R	2,500		2,500,000	10,000,000	50%
	None	FRAME		5,000				

7.2 Banded Limit Profile

Banded Limit Profile (*see Figure 9*) is the most common means of reporting exposure information within a reinsurance submission. A Banded Limit Profile typically shows various summarized statistics regarding policies that fall into various bands of increasing value, also providing information regarding the properties covered by those policies.

Common statistics typically include: 1) a count of locations and/or policies that fall into each band, 2) the premium associated with those exposures, 3) the sum of the limits insured, and 4) the sum of value of the property covered by those insured limits.

Figure 9 - Sample Banded Limit Profile-test

Commercial					Industrial				
Sum Insured (EUR)		Total Sum Insured	Number	Premium	Sum Insured (EUR)		Total Sum Insured	Number	Premium
-	500,000	58,904,000	290	172,642	-	500,000	15,744,000	82	50,236
500,001	1,000,000	75,591,000	108	180,483	500,001	1,000,000	30,373,000	41	79,046
1,000,001	2,000,000	174,873,000	122	332,542	1,000,001	2,000,000	34,853,000	24	69,499
2,000,001	5,000,000	287,917,000	92	447,804	2,000,001	5,000,000	157,877,000	40	208,191
5,000,001	7,500,000	150,015,000	24	209,515	5,000,001	7,500,000	191,957,000	31	218,303
7,500,001	10,000,000	103,247,000	12	130,705	7,500,001	10,000,000	115,248,000	13	125,692
10,000,001	12,500,000	168,046,000	15	170,971	10,000,001	12,500,000	56,236,000	5	60,856
12,500,001	15,000,000	273,308,000	20	254,471	12,500,001	15,000,000	81,742,000	6	65,495
15,000,001	20,000,000	449,610,000	26	416,152	15,000,001	20,000,000	37,532,000	2	24,933
20,000,001	25,000,000	287,708,000	13	177,028	20,000,001	25,000,000	43,364,000	2	25,836
25,000,001	50,000,000	818,160,000	24	401,052	25,000,001	50,000,000	82,110,000	3	43,547
50,000,001	100,000,000	265,495,000	4	106,635	50,000,001	100,000,000	69,258,000	1	28,366
Total		3,112,874,000	750	3,000,000	Total		916,294,000	250	1,000,000
Total Comm'l + Industrial		4,029,168,000	1,000	4,000,000					

Note: Sum insureds are total of Building + Contents + Time Element (Business Interruption) - per policy

The various base metric or validation tests typically performed by a reinsurer when presented with a Banded Limit Profile are:

- **Review the average sum insured (AOI) in the band -** these values should fall within the bands noted. If they don't, this could be an indicator of, for example, various facultative placements that are not reflected in the banded process.
- **Review the average premium per exposure -** you typically see amounts increase as the bands advance
- **Review the average premium per AOI -** these are typically shown as per $100 (or £100, or €100) AOI and typically decrease as the bands advance to reflect the potential for less than full losses in the first loss scales
- **Compare the average insured limit to the average value of the property that is insured -** the reinsurance analyst looks to confirm that most exposures are insured at or close to their full value. These ratios may help identify whether PMLs or other definitions are being used in the preparation of the profiles.
- **Compare the values presented to those from other submissions -** typically done within a country or across countries to help identify outlier pricing

Any of these metrics may help identify issues with the data presented. Unusual values in these metrics can create either additional questions back to the broker or ceding company, or cause additional conservatism to be placed in the benchmarks or assumptions.

7.3 Banded Attachment / Limit Profile

Reinsurers commonly see two profiles listed in a submission, the first being a profile that shows premium, exposure, and counts by limit band. The second profile again shows premium, exposure and counts, but adds banded by deductible or attachment point.

A more useful profile would include a field showing the average deductible or attachment point of the policies in each band. This submission type is a Banded Attachment / Limit Profile. When a separate attachment point profile is provided, it may be nice to know that a certain number of policies attach between $1 million and $1.5 million, but if there is no way to tell which policies they are, then the additional information is not terribly useful.

The most useful way to organize exposure information into a limit profile is to organize it in a grid format that shows how the value, counts, and premium in each limit band are spread across various deductible or attachment point groups as shown in the first two grids. The second set of grids shows the total insured values and share percentages if applicable. The share percentage would be values other than 100%, in the case of a policy being issued to just cover a portion of the exposure. For example, if a policy with an attachment point of $25M, covering a 10% share of a $25M limit produced a $100,000 primary premium, then entries would appear below in the $20-30M attachment band and $2-3M limit band in the 4 grids of Figure 10 below of $100,000, 1, $2,500,000, and 10%, respectively.

When exposure data is presented in this grid format, the information presented can dramatically alter a reinsurer's calculations and pricing. For example, while presenting exposure information in the grid format allows a reinsurer to more easily recognize the differences between, say, a $5M policy with a $5,000 deductible and a $5M policy that attaches at $10M. Also, a limit profile of this form allows for differentiation between a $5M policy that is purchased to provide protection for the first $5M of a $20M building and a $5M policy that covers a 25 percent share of a $20M building. Presentation of the information like above, including true underlying ground-up attachment points, limits, and participation shares if used, can substantially affect the primary or reinsurer expected excess layer loss calculations.

Figure 10 - Sample Banded Attachment / Limit Profile

		Limits						
		0 - 1,000,000	1,000,001 - 2,000,000	2,000,001 - 3,000,000	3,000,001 - 4,000,001	4,000,001 - 5,000,001	5,000,001 - 7,500,000	Grand Total
Attachments	0 - 1,000,000	100,000	200,000	300,000	400,000	500,000	600,000	2,100,000
	1,000,001 - 2,000,000	0	50,000	0	0	0	0	50,000
	2,000,001 - 3,000,000	0	50,000	0	0	0	0	50,000
	3,000,001 - 4,000,001	0	0	50,000	0	0	0	50,000
	4,000,001 - 5,000,001	0	0	0	100,000	0	0	100,000
	5,000,001 - 7,500,000	0	0	0	150,000	0	0	150,000
	7,500,001 - 10,000,000	0	0	0	0	200,000	0	200,000
	10,000,001 - 15,000,000	0	0	0	0	400,000	0	400,000
	15,000,001 - 20,000,000	0	0	0	0	0	160,000	160,000
	20,000,001 - 30,000,000	0	0	0	0	0	80,000	80,000
	30,000,001 - 50,000,000	0	0	0	0	0	40,000	40,000
	Grand Total	100,000	300,000	350,000	650,000	1,100,000	880,000	3,380,000

Number of Policies

		Limits						
Attachments	0 - 1,000,000	20	40	60	80	100	120	420
	1,000,001 - 2,000,000	0	10	0	0	0	0	10
	2,000,001 - 3,000,000	0	10	0	0	0	0	10
	3,000,001 - 4,000,001	0	0	10	0	0	0	10
	4,000,001 - 5,000,001	0	0	0	20	0	0	20
	5,000,001 - 7,500,000	0	0	0	30	0	0	30
	7,500,001 - 10,000,000	0	0	0	0	40	0	40
	10,000,001 - 15,000,000	0	0	0	0	20	0	20
	15,000,001 - 20,000,000	0	0	0	0	0	8	8
	20,000,001 - 30,000,000	0	0	0	0	0	4	4
	30,000,001 - 50,000,000	0	0	0	0	0	2	2
	Grand Total	20	60	70	130	160	134	574

Total Insured Value

		Limits						
Attachments	0 - 1,000,000	10,000,000	60,000,000	150,000,000	280,000,000	450,000,000	750,000,000	1,700,000,000
	1,000,001 - 2,000,000	0	15,000,000	0	0	0	0	15,000,000
	2,000,001 - 3,000,000	0	15,000,000	0	0	0	0	15,000,000
	3,000,001 - 4,000,001	0	0	25,000,000	0	0	0	25,000,000
	4,000,001 - 5,000,001	0	0	0	70,000,000	0	0	70,000,000
	5,000,001 - 7,500,000	0	0	0	105,000,000	0	0	105,000,000
	7,500,001 - 10,000,000	0	0	0	0	180,000,000	0	180,000,000
	10,000,001 - 15,000,000	0	0	0	0	360,000,000	0	360,000,000
	15,000,001 - 20,000,000	0	0	0	0	0	200,000,000	200,000,000
	20,000,001 - 30,000,000	0	0	0	0	0	100,000,000	100,000,000
	30,000,001 - 50,000,000	0	0	0	0	0	50,000,000	50,000,000
	Grand Total	10,000,000	90,000,000	175,000,000	455,000,000	990,000,000	1,100,000,000	2,820,000,000

Share Percentage (or PML Percentage)

		Limits						
Attachments	0 - 1,000,000	100%	100%	100%	100%	100%	100%	
	1,000,001 - 2,000,000	100%	100%	100%	100%	100%	100%	
	2,000,001 - 3,000,000	100%	100%	100%	100%	100%	100%	
	3,000,001 - 4,000,001	100%	100%	100%	100%	100%	100%	
	4,000,001 - 5,000,001	100%	100%	100%	100%	100%	100%	
	5,000,001 - 7,500,000	100%	100%	100%	100%	100%	100%	
	7,500,001 - 10,000,000	100%	100%	100%	100%	100%	100%	
	10,000,001 - 15,000,000	25%	25%	25%	25%	25%	25%	
	15,000,001 - 20,000,000	25%	25%	25%	25%	25%	25%	
	20,000,001 - 30,000,000	25%	25%	25%	25%	25%	25%	
	30,000,001 - 50,000,000	25%	25%	25%	25%	25%	25%	
	Grand Total							

8. Loss ratio information

Respondents to the CARe survey ranked receiving ground up loss ratio information as the second most important exposure rating item behind risk profiles. Despite this perceived importance, loss ratio indications are normally received by only 57 percent of the actuaries (68 percent in CAS, 40 percent in IFOA and 71 percent in Other).

Establishing a loss ratio is critically important to using an exposure based method. Key to exposure rating is establishing an expected total ground-up loss estimate then distributing those losses to various excess layers by usage of a First Loss Scale curve. To the extent that these total ground-up losses are too high or low, any of the excess layers will also be too high or low in the same proportion. So if, for example, the expected loss ratio selection is 40 percent, while the actual loss ratio is 60 percent, any of the layer loss estimates will also be too low by 50 percent (subject to nuances such as layer caps, etc.).

There are two basic methods that either primary or reinsurance practitioners use to estimate the **ground-up losses** needed for the exposure layering exercise. They are:

- **Premium x Expected Loss Ratio (ELR)** – this common method takes the premium that is presented, from either individual exposures or the banded profiles (see Figures 6, 7 or 8), and multiplies the premiums by an expected loss ratio. The resulting ground-up losses are then fed into the layering model in whatever detail is available or desired (by occupancy, region, individual exposure, etc.).
- **Extended exposures -** this alternate method uses the individual exposures, or the banded exposures, in a somewhat different way. This method takes the exposures, in whatever detail is given, and applies a benchmark set of expected loss costs. The exposures are extended by using all the details that is provided or assumed - e.g. occupancy, postal or zip code, protections, constructions, etc.

8.1 Premium x Expected Loss Ratio Method

For the Premium x ELR method, the expected loss ratio component is typically derived after reviewing the total historical ground-up premium and loss information from the insured or ceding company for the last seven, 10 or more years. This loss ratio information generally needs to be split between non-catastrophe (attritional) and catastrophe loss ratios. The number of years needed depends upon the size of the company, how long the company has been in existence, and the relevance of that old history. Actuarial methods are then used to take that information, perform the appropriate development, trending, and on-leveling (adjusting for mix and other changes if necessary) and estimating a set of loss ratios by year. Various weights between the years are selected to produce loss ratio indications for the rating year. A loss ratio or sets of loss ratios is/are then selected for each of the business categories to generate the expected ground-up losses. These ground-up loss ratios are then applied to the expected rating year premium to yield the ground-up losses for layering.

A few of the potential issues related to using the Premium x ELR method to estimate total ground-up loss costs include:

1. The client's own history or projections of ultimate results are very helpful but rarely provided, with proprietary reasons cited for non-provision.
2. Determining the cat element of ground-up loss ratios (for subtraction) can be challenging - modeled outputs may be unreliable or incomplete, experience limited.

3. Cat loss ratios can be significant and so resultant "non-cat" loss ratios (which is what pricing actuary requires for analysis) can be low - which is plausible if not a little odd-looking.
4. Treatment of cat losses in risk business also differs significantly e.g. in Europe large risk losses from cat events are included but often with one limit of coverage. Caribbean - often not covered at all. Latin America - only covered if one loss - two loss warranty passes multiple risk losses to cat cover. Chinese risk and cat covers increase complexity in apportionment of large losses / events. All these affect "loss ratio" selection for exposure rating.
5. Use of comparative industry loss ratio benchmarks can be difficult if market data is on revenue year / GAAP basis i.e. claims incurred in year divided by earned premium. Pricing actuary really needs underwriting year data, split by relevant class e.g. property (by line), engineering, theft, etc.
6. Allow for large historical large losses impacting overall loss ratios e.g. market events like SK Hynix or Panamanian free trade zone losses can be difficult

8.2 Extended Exposures Method

For the Extended Exposure method, the expected losses are alternatively estimated by taking the individual (or banded) set of exposures and multiplying them by a benchmark loss cost. The loss cost selected includes many of the individual components used in granular pricing such as amounts of insurance, occupancy, region, peril (fire, wind, other), etc. that is enumerated in Section 7.1. An illustrative example of the Results and Details of this method are shown in Figures 11 and 12 respectively. An example of using the Extended Exposure method to generate consistent loss costs for a rate monitor is shown in Section 12 (Figures 22 and 23).

Figure 11 - Sample Extending Exposures Results

Property Risk Exposure Inputs — 2,000,000 — Results

Orig Sort	PSOLD Country - Region	Description/Record Index	BUILDING Amount of Insurance ($)	CONTENT Amount of Insurance ($)	TOTAL B&C Amount of Insurance ($)	TIME ELEMENT Amount of Insurance ($)	State/Nominal Region	Zip Code	CSP Class Code	Coverage (Bldgs/Cont)	PPC	Sprinkler System Type	BG1 Construction	BG2 Symbol	Actual Premium	IRV Total Gross Loss Costs
1	Canada - M	Forestry Mill (SIC 2421)	180,000,000	18,000,000	200,000,000	20,000,000			3809	Both	5	None	MODIFIED FIRE F	ORDINAI	559,250	260,296
2	Canada - M	Office Bldg (8721)	157,500,000	15,750,000	175,000,000	17,500,000			0702	Both	5	None	MODIFIED FIRE F	ORDINAI	156,418	72,803
3	Canada - M	Metal manufacturing (6810)	135,000,000	13,500,000	150,000,000				6810	Both	5	None	MODIFIED FIRE F	ORDINAI	217,109	101,050
4	United States	Warehouse (4225)	135,000,000	13,500,000	150,000,000		Connecticut	06928	1212	Both	5	None	MODIFIED FIRE F	ORDINAI	138,876	64,638
5	Canada - M	Forestry Mill (SIC 2421)	90,000,000	9,000,000	100,000,000				3809	Both	5	None	MODIFIED FIRE F	ORDINAI	248,872	115,834
6	Canada - M	Forestry Mill (SIC 2421)	10,000,000	90,000,000	100,000,000				3809	Both	5	None	MODIFIED FIRE F	ORDINAI	402,218	187,207
7	Canada - M	Montreal Mall Outlet (5399)	-	75,000,000	75,000,000	7,500,000			0433	Contents	5	None	MODIFIED FIRE F	ORDINAI	211,940	98,645
8	France - M	Office Bldg (8721)	22,500,000	2,250,000	25,000,000	2,500,000			0702	Both	5	None	MODIFIED FIRE F	ORDINAI	23,572	10,971
9	Canada - M	Parking Lot (7521)	15,000,000	-	15,000,000				0931	Building	5	None	NON-COMBUSTI	ORDINAI	14,502	6,750
10	Canada - M	Bakery (5461)	9,000,000	900,000	10,000,000	1,000,000			0533	Both	5	None	JOISTED MASON	ORDINAI	27,243	12,680

Figure 12 - Sample Extending Exposures Details

A - Exposure Info

Exposure Number	1	Sprinkler Status	Full	Description	1: Office
Building AOI	50,000,000	Construction Type	Frame	Occupancy	0702: Non-Governmental Offices and Banks
Contents AOI	200,000	BG2 Symbol	Ordinary	City, State/Region	Alabama
Time Element	500,000	PPC	7	Zip Code	35004
Deductible	1,000	Prometrix Risk ID		Address	
BG1 Circular	LI-CF-2015-058			Latitude/Longitude	
BG1 Circular Date	10/1/2015			Conflagration Potential	TBD

B - LC Details

	BG1 (Fire et al) Building	BG1 (Fire et al) Contents	iHU BG2 (Wind et al) Building	iHU BG2 (Wind et al) Contents	SCL (Ice/snow, theft, et al) Building	SCL (Ice/snow, theft, et al) Contents
LC Factor	0.135	0.183	0.087	0.073	0.046	0.141
LOL Factor	0.523	0.782	0.510	0.788	0.408	0.580
Scalar Adjustment	1.000	1.000	1.000	1.000	1.000	1.000
Sprinkler Credit	0.400	0.400				
PPC Factor	1.180	1.180				
Loss Cost	**22,621**	**182**	**19,800**	**104**	**8,550**	**148**

C - LC Summaries

Peril Totals		Coverage Totals	
Total BG1 LC	22,803	Total Building LC	50,971
Total BG2 LC	19,904	Total Contents LC	434
Total SCL LC	8,698	Time Element LC	0
Total LC xTE	**51,405**	**Total LC**	**51,405**

Total Gross Loss Cost - Class 51,405
Attritional Gross Loss Cost 34,486
Attritional Net Loss Cost* 34,486

A few potential issues related to the Extended Exposure method include:

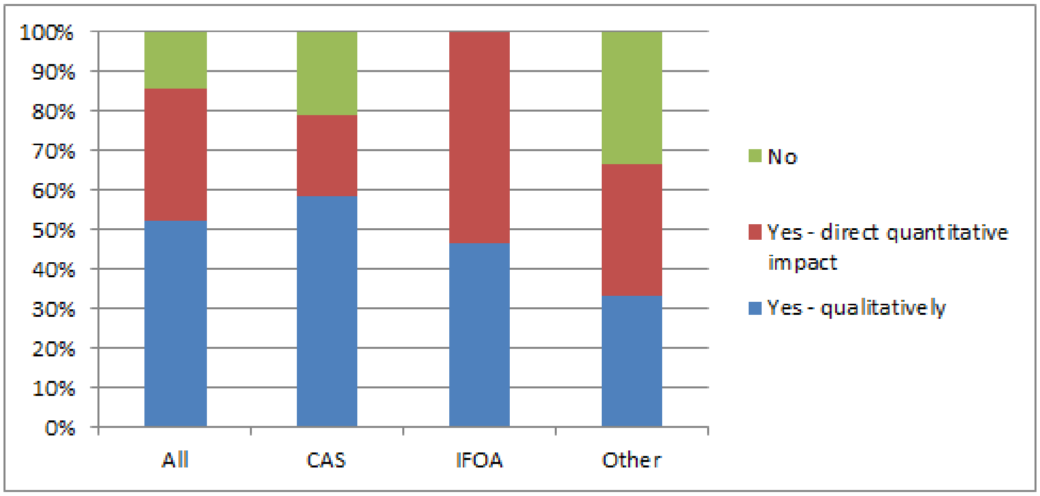
1. This method requires a granular understanding of each rating factor used as benchmarks.
2. Significant adjustments may need to be made to the industry benchmarks used to reflect a company's own unique exposures.
3. The unadjusted (unscaled) method does not make use of any of the actual experience from the company's own experience.
4. A full adaptation of this method requires a listing of all exposures expected in the rating period. Often, not all exposures are included in the submission.
5. The need to remove any cat component of the loss cost factors to enable concentrating on the non-cat expected losses.
6. If only banded exposures are presented, the method requires use of average benchmarks for each of the rating variables.

A comparison and reconciliation of the results between the charged premium and extended exposure methods, can produce meaningful insights into the pricing practices and benchmark parameters selected for each method.

9. Historical AOI Profiles

According to the survey historic risk profiles ranked fifth out of eight in terms of importance for pricing actuaries. CAS members ranked historic risk profiles sixth of eight; IFOA members ranked these fourth of eight; and other members ranked historic risk profiles third of eight. Historical risk profiles are received only 23 percent of the time (8 percent for CAS, 60 percent for IFOA, and 29 percent for other). The historical risk profiles affect how heavily the actuary relies on historic claims experience, as the answers to the question below show.

Figure 13 - Does having historical profiles affect how much you rely on historic claims experience?



This graph indicates that, in general, actuaries use (or would use if received) historical risk profiles to attempt to measure the relevance of historical claims experience. The assumption is that a risk profile which has changed little over time allows for more reliance on claims experience, while a risk profile that has changed materially indicates a lesser ability to rely on claims experience. From the ceding company's point of view this is important. For example, if the primary insurance carrier has had very good claims experience, providing profiles going back a few years showing that there has been little change might be useful for them; this should allow the primary insurer a pricing benefit due to good claims experience. Alternatively, if claims experience has been poor but the primary insurer has made significant changes to the profile of risks being written, demonstrating this through historical profiles may also benefit them in pricing.

9.1 Adjusting experience for changes in exposure

A key reason a reinsurer may give a lower credibility weight (if any) to the experience rate is because of shifts in the mix of business and limits offered over time. Primary insurance pricing is mainly concerned with overall exposure growth, while reinsurance pricing must account for exposure growth by layer.

Most submissions include a limit or AOI (TIV) profile summary (see sections 6 and 7 on Amount of Insurance) of the most recently written business. This profile contains policies written or in-force over the last 12 months and is used for exposure rating each layer. Such a profile provides a snapshot of the latest exposure by layer without accounting for the experience of each layer.

As the survey indicates, reinsurance submissions generally don't include a sample of historical profiles for the previous few years that allow the reinsurer to assess the changes in exposure in the layer. Reinsurance companies that have supported a treaty for a number of years may use previous submissions to compile this information. However, very few property reinsurers take this step.

Reinsurers new to the treaty should request a sample of historical limits profiles from the broker, who should have these from prior renewals. Unless the reinsurer is dealing with a brand new insurance company and/or a brand new treaty, the information generally exists and is often readily available.

Claims experience is largely influenced by the limits exposure in each layer. The more exposed a layer is due to the premium or TIV volume written in the layer, the more likely that layer is to have claims. Therefore, if the limit or TIV profile has significantly changed over time, the experience results for older years lack credibility compared to the most recent years.

Traditionally, in the absence of historical limits profiles, reinsurance actuaries and underwriters have adjusted the claims experience assuming that exposure in the layer is consistent with total exposure. Total exposure tends to be measured using on-level premium (premium adjusted for rate changes) or total insured value. This assumption fails when limits utilization increases/contracts throughout the insurance cycle.

Mata and Verheyen (2005) present a detailed methodology of how to use the mathematics of exposure rating techniques to determine the exposure adjustment by layer. In addition, they go one step further and split the exposure adjustment into frequency and severity, which is useful when the reinsurer separately experience rates frequency from severity. For details of how to implement the methodology, we refer the reader to the paper.

The following example illustrates how having historical limits profile may help smooth the exposure adjustment by layer, potentially resulting in a higher credibility weight to the experience from having additional items of data.

9.2 Practical example

The layer $3m xs $2m is being priced for a risk excess treaty. The submission includes exposure and claims information since 2005 and the total insured value and premiums written by the cedant have grown steadily over the year with 2015 projections twice the amount written in 2005. The following exhibit shows the written premium and TIV by year.

Figure 14 -Sample Historical AOI Profile Summary

Year	Written premium	Written insured value (TIV)
2005	14,875,000	1,250,000,000
2006	15,321,250	1,578,000,000
2007	18,349,500	1,625,000,000
2008	18,815,577	1,680,000,000
2009	19,272,750	1,750,000,000
2010	20,084,133	1,950,000,000
2011	22,472,100	2,050,000,000
2012	23,292,332	2,150,000,000
2013	23,842,031	2,250,000,000
2014	24,538,500	2,420,000,000
2015 (proj)	26,500,000	2,500,000,000

The following exhibit shows the premium and TIV distribution by size of risk and how the average TIV in each band has been changing. Usually reinsurers base their pricing on the average TIV in the band. In this particular example the layer in question ($3m xs $2m) is more exposed for two reasons: the average TIV in each band has been steadily increasing (more noticeable in the highest band) and the proportion of risks by band has been shifting towards the higher bands.

Figure 15 -Sample Historical AOI Profile Details

Low	High	%TIV	TIV in band	Avg TIV	No Risks	% Prem	Premium
			2005				
Low	High	%TIV	TIV in band	Avg TIV	No Risks	% Prem	Premium
0	1,000,000	35%	437,500,000	759,549	576	44.12%	6,562,500
1,000,001	2,000,000	25%	312,500,000	1,554,726	201	24.16%	3,593,750
2,000,001	3,000,000	20%	250,000,000	2,688,172	93	16.47%	2,450,000
3,000,001	4,000,000	15%	187,500,000	3,232,759	58	11.60%	1,725,000
4,000,001	5,000,000	5%	62,500,000	4,166,667	15	3.66%	543,750
Total		100%	1,250,000,000		943	100.00%	14,875,000
			2007				
Low	High	%TIV	TIV in band	Avg TIV	No Risks	% Prem	Premium
0	1,000,000	30%	487,500,000	755,814	645	39.32%	7,215,000
1,000,001	2,000,000	22%	357,500,000	1,588,889	225	21.82%	4,004,000
2,000,001	3,000,000	24%	390,000,000	2,635,135	148	20.19%	3,705,000
3,000,001	4,000,000	17%	276,250,000	3,410,494	81	13.40%	2,458,625
4,000,001	5,000,000	7%	113,750,000	4,375,000	26	5.27%	966,875
Total		100%	1,625,000,000		1,125	100.00%	18,349,500
			2009				
Low	High	%TIV	TIV in band	Avg TIV	No Risks	% Prem	Premium
0	1,000,000	29%	507,500,000	760,870	667	38.71%	7,460,250
1,000,001	2,000,000	20%	350,000,000	1,583,710	221	20.16%	3,885,000
2,000,001	3,000,000	23%	402,500,000	2,630,719	153	19.63%	3,783,500
3,000,001	4,000,000	18%	315,000,000	3,423,913	92	14.06%	2,709,000
4,000,001	5,000,000	10%	175,000,000	4,487,179	39	7.45%	1,435,000
Total		100%	1,750,000,000		1,172	100.00%	19,272,750
			2011				
Low	High	%TIV	TIV in band	Avg TIV	No Risks	% Prem	Premium
0	1,000,000	29%	594,500,000	777,124	765	38.62%	8,679,700
1,000,001	2,000,000	21%	430,500,000	1,630,682	264	21.46%	4,821,600
2,000,001	3,000,000	22%	451,000,000	2,606,936	173	18.66%	4,194,300
3,000,001	4,000,000	18%	369,000,000	3,481,132	106	13.96%	3,136,500
4,000,001	5,000,000	10%	205,000,000	4,555,556	45	7.30%	1,640,000
Total		100%	2,050,000,000		1,353	100.00%	22,472,100
			2014				
Low	High	%TIV	TIV in band	Avg TIV	No Risks	% Prem	Premium
0	1,000,000	27%	607,500,000	778,846	780	35.90%	8,808,750
1,000,001	2,000,000	22%	495,000,000	1,661,074	298	22.79%	5,593,500
2,000,001	3,000,000	23%	517,500,000	2,640,306	196	19.82%	4,864,500
3,000,001	4,000,000	15%	337,500,000	3,515,625	96	11.83%	2,902,500
4,000,001	5,000,000	13%	292,500,000	4,642,857	63	9.66%	2,369,250
Total		100%	2,250,000,000		1,433	100.00%	24,538,500

Using an exposure curve of the Swiss Re type with parameter c = 5, which closely matches the Lloyd's industrial curve (see Bernegger (1997)), we exposure rate the $3M xs $2M layer with each of the historical TIV profiles using the average TIV in each band. For the years where the limits profile was not available, we assumed the profile had the same distribution as the prior policy year.

The following exhibit shows an experience rating summary with various exposure adjustments.

Figure 16 -Sample Impact of Exposure Results Using Historical AOI Profile

Policy year	On-level premium	Inflation adjusted TIV	Exposure rate using historical profiles	Trended ultimate losses in layer	Burn cost	Exposure adjusted losses: With OL Premium	With adjusted TIV	With exposure rate in layer
2005	14,427,641	1,380,777,657	1.327%	1,015,706	7.040%	1,865,600	1,839,011	1,621,911
2006	13,509,518	1,725,835,360	1.327%	0	0.000%	0	0	0
2007	16,343,110	1,759,642,147	1.731%	0	0.000%	0	0	0
2008	17,100,229	1,801,187,392	1.731%	646,389	3.780%	1,001,700	897,170	791,663
2009	18,733,394	1,857,660,264	1.935%	0	0.000%	0	0	0
2010	18,592,448	2,049,469,598	1.935%	736,261	3.960%	1,049,400	898,112	806,487
2011	21,119,854	2,133,238,221	1.943%	1,926,131	9.120%	2,416,800	2,257,285	2,101,777
2012	22,383,158	2,215,147,150	1.943%	957,999	4.280%	1,134,200	1,081,191	1,045,360
2013	23,943,359	2,295,225,000	1.943%	0	0.000%	0	0	0
2014	25,274,655	2,444,200,000	2.120%	0	0.000%	0	0	0
2015 (proj)	26,500,000	2,500,000,000	2.120%		842,513	829,744	774,752	707,466
2015 Projected average loss cost excludes 2014					3.179%	3.131%	2.924%	2.670%

On-level premium is the premium adjusted for rate changes, the historical TIV has been adjusted using 1 percent annual inflation. The exposure rate using historical profiles shows the percentage of the gross premium that falls in the layer according to the curve and the historical profile for that year. This shows a clear increase in exposure in the layer since 2005, but not in line with total exposure.

For example, total exposure change between 2005 and 2015 using on-level premium is a factor of \$26,500,000/\$14,427,641 = 1.837 whereas the exposure rate indicates an increase in exposure in the layer of a factor of 2.120 percent/1.327 percent = 1.597.

The trended ultimate losses in the layer show losses in the layer adjusted for inflation and incurred but not reported (IBNR) losses.

There are various ways in which actuaries could calculate the experience rate in such a case:

1) Convert losses in the layer into a burn cost (losses to premium) and take a premium weighted average. This generates a loss cost rate, which multiplied by the projected premium generates the loss cost amount. Doing so in this example (excluding 2014 from the average) indicates a loss cost rate of 3.179 percent and expected losses of \$842,513.
2) Adjust trended ultimate losses for changes in exposure using on-level premium. This assumes, for example, that the 2005 losses would increase by a factor of 1.837 in 2015 exposure. This method generates an average expected loss of \$829,744 (excluding 2014) or a loss cost rate of 3.131 percent.
3) When historical TIVs are available, actuaries may prefer to adjust losses using historical TIVs instead of premium. This method generates expected losses of \$774,752 equivalent to a loss cost rate of 2.924 percent.
4) The most accurate and fair method is to recognize that exposure growth is not proportional by layer and use the historical exposure rate as a proxy for exposure change in the layer. This method produces an average loss cost of \$707,466 and a loss cost rate of 2.67 percent.

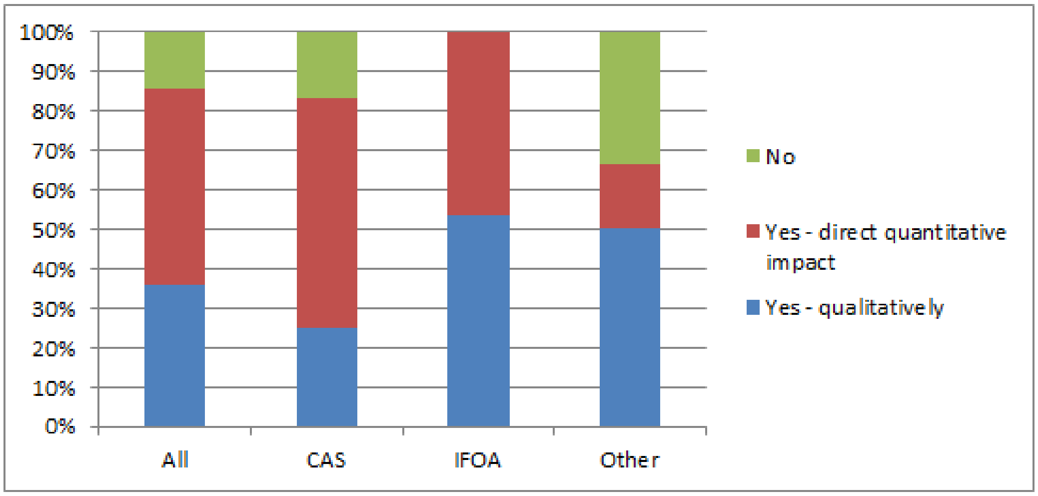
This example shows that providing additional information helps actuaries refine their analysis resulting in a more credible experience rate and overall price.

Also note that if a company is selling any multi-year policies, then in-force is better than written in the last 12 months (which will understate in-force exposure).

10. Traditional COPE and Portfolio Extensions

The survey asked the importance of risk profile (occupancy type, protections including sprinkler, shares/syndication layering, coinsurance, split of physical damage/business interruption, etc.). These details were usually received by only 34 percent of respondents. The respondent ranked this information sixth in terms of importance in exposure rating. CAS respondents ranked it fourth out of eight but only received the information 32 percent of the time whereas IFOA ranked COPE seventh out of eight and received it 40 percent of the time. Given the availability of market exposure curves for US business at quite detailed levels, that this information is not more regularly provided is surprising. As shown by the question below, risk profile detail does impact pricing:

Figure 17 - Does risk profile detail (occupancy type, protection measures, etc.) affect your pricing?



10.1 Properly Utilizing COPE Data to Underwrite Packaged Commercial Property Submissions

Property underwriters have used the same four basic elements of underwriting for nearly 300 years: **C**onstruction, **O**ccupancy, **P**rotection and **E**xposure. Referred to as COPE, each element is important if the underwriter desires to truly understand the property exposures accepted. Commercial property applications completed by retail agents are designed to capture most of the basic COPE underwriting data; but is this same basic information shared with and reviewed by the reinsurer?

If the necessary COPE data is provided to the reinsurer, is it given the necessary attention? Underwriters for both the ceding company and the reinsurer are guilty of skimming over the COPE information without much in depth analysis.

10.2. Construction ("C")

"Construction" is the first real property underwriting element requiring underwriting analysis and review. And construction itself is comprised of three sub-parts:

- Construction materials;
- Square footage; and
- Age of the structure.

10.2.1. Construction Materials

Insurance Services Office (ISO) defines six construction classifications (from "1" to "6") based on the combustibility and damageability of the materials used to construct the "major structural features" of a particular structure. The lower the number, the more susceptible the structure is to damage by fire (the main construction rating factor in this system). The “major structural features” used to determine the construction class codes are the exterior load-bearing walls and the roof/floor(s).

Assigning a construction class code is first a function of the load-bearing wall material and secondarily a function of the floor and roof materials used. Four exterior, load-bearing wall types are considered: 1) masonry, 2) fire-resistive/modified fire-resistive; 3) non-masonry or non-fire resistive; and 4) combustible materials (i.e. wood).

Likewise, there are four floor and roof types considered: 1) concrete; 2) modified fire resistive/fire resistive; 3) non-combustible/slow burning; and 4) wood or materials other than “1,” “2” or “3.”

Combining one of the four wall types with one of the four floor/roof types produces the structure’s construction class. Appendix C illustrates how walls, floors and roof combine to generate a specific construction class. The six construction classes are:

1. Frame (combustible materials)
2. Joisted/Masonry (masonry walls with combustible roof/floors)
3. Non-Combustible (i.e. a metal building)
4. Masonry/Non-Combustible (masonry walls with a metal roof)
5. Modified Fire Resistive
6. Fire Resistive

When assigning a construction class, remember that each “major structural feature” is often an assembly of several parts. When assessing either of the two key structural features (walls or floor/roof), the entire assemblage creating that feature must be considered; no “assembled” feature can be assigned a classification greater than its most combustible or susceptible part (this rule does not apply to masonry, modified fire resistive, or fire resistive load-bearing walls).

Two examples of “assemblage materials” lowering the structural feature’s “classification” are:

- An exterior metal-on-metal-stud wall with plywood or other combustible material attached to the inside of the wall (common in industrial settings). The combination of these two disparate materials requires that the entire section of wall covered with the combustible material be considered a combustible wall. If enough of the wall area is comprised on this assemblage, the entire wall, for rating purposes, may be considered frame (resulting in the assignment of construction class 1 to that building).

- Wood joist roof supports covered with metal is considered a frame assemblage and is thus assigned a frame rating.

Beyond these six construction classes, there are three additional construction classifications relating to Group II Causes of Loss (windstorm, hail, aircraft, riot, civil commotion, etc.). Construction class codes “7,” “8” and “9” modify construction classes “2,” “3” and “4” respectively. The “wind uplift” characteristics of the roof dictate if and when these alternate construction classes are used.

10.2.2. Mixed Construction Problems.

What affect does a combination of building materials and assemblies have on a commercial property’s construction classification? Factually, such mixing can be detrimental to the building’s construction class. Remember, any building with a wall or wall assembly classified as “frame” results in the entire structure being rated as construction class “1” – frame, producing some very expensive property rating results.

Simply, to qualify for a higher construction class rating, the superior construction must equal or exceed 66.67 percent of the rateable structural feature. This “2/3 requirement” applies first to the walls and separately to the combined area of the floors and roofs. (The lowest floor on the ground is not considered when calculating the total floor and roof area.)

Appendix C gives two examples of mixed construction. The first is a one story building combining non-combustible and frame assembly walls all under a non-combustible roof. The second is a partial two story building with masonry walls a non-combustible roof and the second floor constructed of ¾ inch plywood on metal joists – making the second floor a combustible assembly.

10.2.3 Other Construction Material Considerations.

In addition to the “major structural features” highlighted above, underwriters must also review interior construction features that affect the damageability of the structure. Bowling alleys are a good example of this review; a rating charge is generally applied to bowling alleys due to the raised combustible floors making up the bowling lanes.

Beyond the presence of combustible floors, underwriters should consider the potential adverse effects of a large amount of interior combustible walls. The presence of combustible floors and interior walls increases the “fire load” of the building. “Fire load” is a somewhat antiquated term, but one that is still understood in the insurance industry to mean that there is more “fuel” to feed a fire increasing the potential for damage and narrowing the difference between the structure’s maximum possible loss and its probable maximum loss.

10.2.4 Maximum Possible Loss (MPL) vs. Probable Maximum Loss (PML) and Construction Materials.

A structure’s “maximum possible loss” (MPL) is the entire structure; its “probable maximum loss” (PML) is some percentage less than the MPL. These concepts are presented in more detail in another section of this paper, but understanding how construction materials affect the difference between MPL and PML is vital.

The more resistive the structure is to damage (fire damage particularly), the greater the difference between the structure’s MPL and its PML. All other COPE factors being equal, a fire resistive structure has a lower PML than a frame structure. Note that all factors must be essentially the same for this to be true.

10.2.5 International Building Code Considerations.

ISO construction classes are the insurance industry standard. However, a ceding company may provide construction class information using the International Building Code’s (IBC) construction classifications. The IBC construction class codes are essentially the direct opposite convention of those used by ISO.

- IBC construction Type IV is equivalent to ISO construction classes 1 and/or 2 (depending on the specifics);
- IBC construction Type II or Type III is equivalent to either ISO construction classes 3 or 4 (depending on the specifics); and
- IBC construction Type IA or IB is equivalent to ISO construction classes 5 or 6 (depending on the specifics).

10.2.6 Square Footage

The size of a structure influences many aspects of the “construction” underwriting process. Structure size also plays a part in the “protection” section of COPE (i.e. the need for a sprinkler system, etc.); but the main aspect of structure size from the underwriting aspect relates to the difference between the building’s MPL and its PML.

Again, it is "**possible**" that the entire structure may be destroyed in any one loss; thus the MPL is the entire structure. However, the chances that the building will suffer a total loss are inversely proportional to the size of the structure. Basically, the larger the building, the less likely the entire structure will be destroyed in a single event. The larger the building, the lower the PML – all other factors being equal.

If all other factors are equal (same construction type, same occupancy, same protection features, and the same number of stories), an 8,000 square foot building has a higher PML (as a percentage of the MPL) than a 40,000 square foot building. The smaller building has a higher PML because a fire does not have to rage as long to destroy an 8,000 square foot building as it does a 40,000 square foot structure (again, all other factors being equal).

10.2.7 Age of the Structure

Aging structures create concern and questions in the underwriter’s mind. Specifically, underwriters should concern themselves with the building’s major systems (roofing, plumbing, HVAC and wiring) when underwriting an older structure. The older the structure, the more likely a major system will malfunction, leading to a possible claim due mostly to an internal issue rather than caused by an external force.

Have the systems been maintained and updated as necessary? When were the last updates? What was the extent of those updates? Who did the updates? These are questions underwriters should ask regarding older structures.

- Updated as necessary: If the occupancy or use of the building has changed, have the major systems been altered to and are they able to meet the current demands?
- When were the updates made: Are the updates recent or made many years ago?
- The extent of the updates: Was the entire structure updated or just one area?
- Who performed the updates: Was the updates done by a licensed contractor or by someone less qualified?

Other age-related issues revolve around the structure’s compliance with current building codes. How many times and to what extent have the ordinances and laws been added to or updated since the building’s original construction? Any increased cost related to bringing a structure into compliance with local building codes following a covered cause of loss is specifically excluded in the unendorsed commercial property policy? Has the policy been endorsed to account for this increased cost; and if so, has this information been provided to the property reinsurer?

10.2.8 The Importance of “Construction” Information

Taken on its own, “construction” may ultimately be the most important element in property underwriting. Although the second element, “occupancy” (what the insured does), is often seen as primarily important among the four elements; occupancy really is secondary to construction **-** when the risk is a class of business the underwriter normally writes.

Granted, construction and occupancy can each be seen as a function of the other in regard to underwriting decisions, often times the decision comes back to construction. For example, an underwriter may willingly offer coverage to a plastics manufacturing operation in a masonry/non-combustible building (construction class "4"); but may not be willing to offer coverage to the same operation located in a joisted/masonry building (construction class "2") or even a non-combustible building (construction class "3").

10.3 Occupancy "O"

"Occupancy" is comprised of two parts: 1) what the insured does; and 2) how the insured manages the hazards associated with what it does. Determining what the insured does is rather simple; determining how they manage their "hazards of occupancy" requires closer investigation (either by the agent, insurance carrier staff, or independent inspection firm).

10.3.1 Occupancy Classifications: What the Insured Does

ISO divides every occupancy into two primary classifications: 1) Non-manufacturing; and 2) Manufacturing. Every operation fits into one of these two classifications:

- <u>Non-manufacturing</u> operations include: mercantile, habitational, storage or warehouse facilities, service operations, offices, laboratories, and recreational operations.
- <u>Manufacturing</u> operations are loosely defined as: "Operations that assemble, fabricate, repair, or build something within or at an insured's location."

Each class (non-manufacturing or manufacturing) presents its own relative risk of first party property loss. The greater the risk of loss, the more closely the underwriter must analyze the operations (occupancy), and the higher the relational cost of coverage should be. A non-manufacturing operation generally presents less of an operational hazard than does a manufacturing operation; the result - lower property occupancy rate factors apply to non-manufacturing operations.

10.3.2 SIC/NAICS Codes and Occupancy Classes

SIC and NAICS Codes are applied to the overall operation, not necessarily the use of a particular building. In general, this fact does not deviate from ISO's occupancy classifications. However, there are situations where a building may be assigned a non-manufacturing classification by ISO but a manufacturing occupancy code under SIC or NAICS.

ISO occupancy rules state that auxiliary buildings that house non-manufacturing operations and are not directly/physically connected to the manufacturing building are classed as non-manufacturing. Examples of such operations might include (but are not limited to) cafeterias, hospitals/clinics, offices, locker rooms, dorms, garages, or maintenance buildings.

In cases such as these, the individual building's ISO classification may not match the assigned overall SIC/NAICS code. Underwriters must account for any difference such as this in the overall property rate.

10.3.3 How the Insured Manages Its Operations

Beyond merely knowing the insured's operations/occupancy, the underwriter must also investigate how the insured manages those operations (part two of the occupancy review). Similar insureds do not necessarily manage their operations similarly. Since each insured manages its exposures and hazards differently, each has and presents its own "**hazards of occupancy.**" Underwriters must pay special attention to the hazards of occupancy presented by a risk.

To expand upon the importance of understanding a risk's "hazard of occupancy," consider the manufacturing operation referenced above. Assume the underwriter is evaluating three separate, but somewhat similar manufacturing operations. All three have similar construction, location, and protection characteristics; however, each applies a different method for storing the 1,500 gallons of flammable and combustible paint on hand:

- Operation "A" stores the paint in a non-vented, unapproved storage room within the building;
- Operation "B" stores all 150 gallons in several storage cabinets meeting NFPA 30 standards; and
- Operation "C" stores all paint in an appropriately constructed storage building separate and apart from the shop.

Which of these three presents the greatest (highest) hazard of occupancy? Which has the lowest relative hazard of occupancy?

All three shops garner the same basic "occupancy" charge; but shop "A" should suffer the highest "hazard of occupancy" charge due to its poor (and improper) storage methods. Operation "B" has mitigated its hazard by using approved storage containers. Finally, operation "C" has largely removed the paint-related hazard of occupancy by choosing to store its flammable and combustible paints outside the building. The result is that operation "C" should be charged the lowest overall occupancy charge because it better managed its hazard of occupancy.

Paint storage is just one example of a hazard of occupancy; underwriters should review all hazards of occupancy such as:

- Housekeeping (how neat and free of debris is the building and its surroundings);
- The amount of combustible materials within the building;
- The condition of major systems (heating and wiring);
- Dust-collection systems for woodworking and like operations;
- Use of spark-reduction equipment where necessary;
- The condition of cooking equipment (cleaned regularly, the existence of maintenance contracts, etc.); and
- The amount and storage of any other potentially hazardous materials.

10.4 Protection "P"

Underwriters and building code officials are often jointly interested in the property protection aspects of structures, but for different reasons. Property underwriters view property protection measures in regards to their ability to lessen the amount of property damage; building code officials generally view protection from a general public and personnel protection angle.

Sprinkler systems, fire extinguishers, alarm systems, fire doors and fire walls, and public fire protection are the primary protection mechanisms evaluated by underwriters. A particular structure's construction and occupancy may dictate which property protection mechanisms are required or desired by the underwriter.

10.4.1 Sprinkler Systems

The mere presence of a sprinkler system is not, or should not be, sufficient to satisfy the underwriter. To be effective, the sprinkler system must meet the demands created by the hazards specific to the occupancy. A sprinkler designed for an office or warehouse does not provide sufficient protection to a chemical manufacturing operation. Insufficient systems are common when an existing building designed for one type of occupancy is later converted to another use (a warehouse is turned into a manufacturing facility).

Proper evaluation of a sprinkler system requires a qualified professional. These inspectors evaluate the condition of the system and the ability of the system to handle the fire load created by the occupancy. Underwriters can glean important information from the inspector's report, including:

- The type of system (wet pipe, dry pipe, deluge, pre-action, foam, etc.);
- The condition of the system (well-maintained or any deficiencies);
- The system's ability to handle the fire load;
- If the water supply is adequate for the occupancy;
- If the location and number of sprinkler heads is adequate;
- The size and location of any non-sprinklered area; and
- Whether there is adequate sprinkler protection where there is high-rack storage.

10.4.2 Fire Extinguishers

Fire extinguishers, unlike a sprinkler system, require human interaction. To be effective, the extinguisher must be accessible, appropriate for the hazard presented, and ready for use when needed. To garner maximum benefit from and credit for the presence of fire extinguishers, the underwriter needs to know:

- Are there an appropriate number of fire extinguishers for the building;
- Are fire extinguishers properly located (travel distance no more than 75 feet from any point in the building) and at eye level;
- Are fire extinguishers in the path of natural exit (i.e. can the user access one on the way out of the building without having to put themselves in danger to obtain and use one);
- Are fire extinguishers the correct size (too small to do any good or too large to be useful);
- Are the fire extinguishers the correct type:
  1. Class A – Paper, wood, etc. (anything that produces "A"sh);
  2. Class B – Flammable or combustible liquids (anything that "B"oils):
  3. Class C – Electrical fires (anything that has a "C"harge);
  4. Class D – Combustible metals such as shaved magnesium; and
- Class K – Cooking related exposures in the "K"itchen.
- Are the fire extinguishers inspected and, if necessary, charged annually
- Is staff trained in the use of fire extinguishers

10.4.3 Alarm Systems

Fire, smoke, burglar and combination alarm systems are readily available to fit nearly any purpose or need. Before granting any credit or exception based on the presence of an alarm system, key information is required by the underwriter:

- The type of system in use;
- Where does the alarm sound? Is it local only or at an offsite location;
- If at an off-site location, is the monitoring company listed by Underwriters Laboratory (UL);
- What type of external communication is used? (A digital or tape dialer);
- Backup features of the system;
- Any special protection features; and
- Is the system installed properly?

The last question may seem rather simplistic, but planning an alarm system can be done incorrectly. For example, the owner of a restaurant complained that the fire alarm often sounded (on and off site) for no apparent reason. Upon investigation it was discovered that a "rate-of-rise" detector had been installed over an oven. If the oven was open long enough, the sudden rise in heat sets off the alarm. Proper installation of the system is important.

10.4.4 Fire Doors and Fire Walls

"Maximum possible loss" (MPL) and "probable maximum loss" (PML) are directly related to the presence and effectiveness of fire doors and fire walls. Properly constructed and maintained fire walls and doors limit the spread of fire and lower the PML; the lower the PML, the more favorably the underwriter views the property.

Large open buildings, based of course on the contents of the building, allow a fire the opportunity to spread rather quickly with nothing structural to slow its progress. Compartmentalized spaces created by fire walls and doors contain and slow the spread of fire to reduce the overall damage. At least that's the purpose of fire walls and doors.

To qualify as a fire wall (not just a "fire stop") requires certain conditions be met:

- The wall must be one continuous masonry wall;
- The wall must be at least 6 or 8 inches thick (based on the materials used);
- The wall must come into direct contact with fire resistive, masonry, or non-combustible roofs;
- The wall must pierce "slow burning" or combustible (including assembly) roofs;
- If the exterior walls are masonry, fire resistive, or non-combustible, the wall must be in direct contact with the walls;
- If the exterior walls are "slow burning" or combustible, the wall must pierce the exterior wall;
- If there is an opening in the wall, it must be protected by a self-closing, "Class A" (3-hour) fire door or a sprinkler curtain. Class "A" doors are only effective when they close as designed. If the door is blocked open or unable to fully close for any reason, the wall no longer qualifies as a fire wall; and
- Any communications through the wall by HVAC ducts must be protected by at least one 1 ½ hour damper.

Any masonry or non-combustible wall failing to meet these standards is considered a "fire stop" not a fire wall. Slow burning and combustible (including assembly) walls qualify as neither a fire wall nor a fire stop.

10.4.5 Public Protection

Fire districts, often involving many individual fire stations, are inspected and graded by Insurance Services Office or other jurisdictions with authority. The ultimate grade or public protection class is based on response time, personnel, training, equipment, and local water supply. Each district is assigned a number grade from "1" to "10." The lower the number the better the district and the lower the fire rate.

10.5 Exposures "E"

Is the insured property exposed to any external hazards? Not all hazards are related to the insured structure or operation; some come from outside the premises or are simply geographic in nature. A few external exposures relevant to property underwriters include:

- The insured structure's proximity to a high-hazard operation;
- The local wildfire risk;
- The possibility for damaging winds and/or water;

- The structure’s flood zone location (located in or near a special flood hazard area (SFHA));
- The structures earthquake exposure; and
- The jurisdictions building code requirements.

10.6 Finishing Up Underwriting Individual Risks

Understanding COPE allows better planning during the property underwriting process. Knowing what to provide and why to provide specific information makes the process smoother and hopefully quicker. Also, knowing COPE can assist clients when planning upgrades to current structures or constructing new buildings.

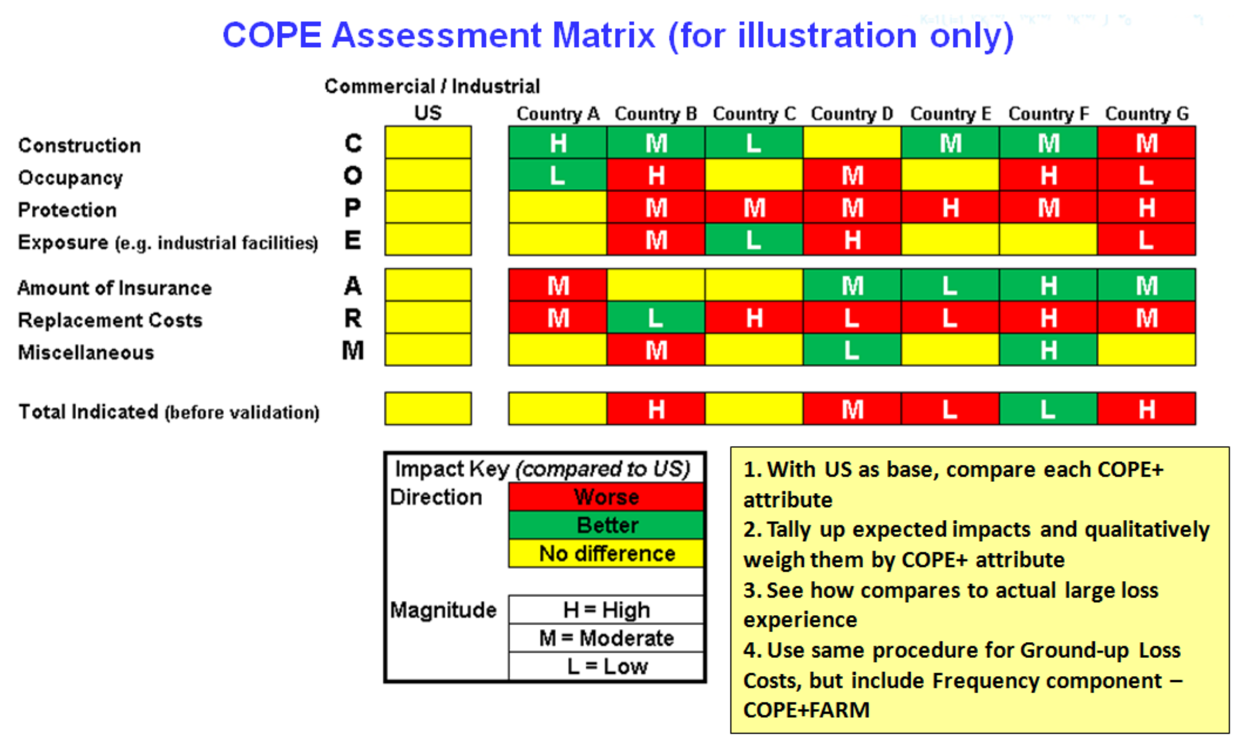
10.7 COPE Expansion to Portfolio Analysis (FARM)

The prior sections all deal with using and applying standard COPE analysis framework for individual exposures. To enable comparison across portfolios, and to help with reconciliation and validation to large loss experience in a portfolio or for a country, a few other measures are useful. These include investigating differences in:

- Amount of Insurance
- Replacement costs
- Other miscellaneous factors such as social and other influences

A detailed description of each factor is beyond the scope of this paper, but the reader can refer to the CAS International Webinar in February 2014 and recording where these were described in more detail.

Figure 18 - COPE Portfolio Analysis Framework



11. Large Claim Information and Link of AOI to Claims

The survey asked respondents about the importance of both large loss information and a link between amount of insurance and claims.

With regards to large loss information, a large loss listing without claims development was always received; information that included claims description inclusive of cat / non-cat split was received by 82 percent of respondents. However, a large loss triangle showing claim development was received only 30 percent of the time. When the respondents were asked to rank 8 experience based items in order of what they want to receive, the large loss listing was number 1 and the claim description ranked fourth. Interestingly, a triangulation ranked third behind only the loss list without development and historic premium income.

This suggests that pricing actuaries want to understand the development of large claims even in what is usually a short tail line of business. If ceding companies have a history of cautious case reserving, triangulation of large losses to demonstrate this may be beneficial to them. The actuary can work more quickly when he/she does not have to construct the triangulation themselves from historic submissions; and under time-pressure, they may not do this.

A link between claims and amount of insurance was usually received only 7 percent of the time and was considered the least important of the 8 exposure items. Nevertheless, if the ceding company believes that they write a portfolio with on average better qualities than might be contained within normal exposure curves that reinsurance pricing actuaries use (i.e. they believe the average risk in their portfolio has less chance of total loss than what is used in exposure curves) then they may like to demonstrate this through linking risk profiles to claims.

11.1 Common challenges in linking claims and exposures

Claims and exposures are notoriously difficult to link, and usually limited information is available for several classes of business, such as those affected by man-made risks. Two recent studies aimed at collecting information on claims and exposures for large commercial risks in the London market and in the Asia-Pacific region offer important insights into the practical challenges presented by data enrichment exercises. The two studies are described in detail in Sections 5.2 and 5.3 below. They share the following difficulties in overcoming data granularity and quality challenges (see Biffis and Chavez, 2014, and Benedetti *et al.*, 2015a,b):

- Data collection: Data sourcing is complicated by the fact that different departments within a company may store different information, or the same information in different format, depending on whether the focus is on pricing, reserving, or claims, for example. Some companies may organize data on a claim basis, some on an event basis, and others on both bases. (Re)insurance companies are concerned with losses directly affecting their business, but proper understanding of risk requires FGU losses, and hence the need to address censoring and truncation issues induced by deductibles and limits. Recovering FGUs is complicated by the fact that such information may be available only to primary insurers or brokers. This means that data sourcing is often not self-sufficient and needs to rely on external inputs (e.g., broker submissions, loss adjuster's reports). Losses have several important dimensions, such as fees, physical damage, business interruption, and third party liability.
- Data quality and granularity: An important proxy for the exposure would be the TIV at location. However, this is often not available, in particular when losses originate from large

policy schedules, which may only report top location TIVs or aggregate TIVs. In some cases, only the TSI is available, leading to underestimation of the exposure. With data sharing, the classification of an exposure into different occupancy types is often heterogeneous, as companies develop internal systems that reflect individual operational and business considerations.

- Small sample issues: The statistical reliability of a claims basis is often undermined by data paucity. The study of large claims and our understanding of extremes, for example, can be severely biased in the presence of small data samples.
- Integration of data sources: there is very limited availability of public data sources that can be used to complement internal companies' information.

Going forward, we envisage that, as data enrichment gets prioritized by insurance companies, and wider sharing agreements are developed, most of the limitations discussed above will become less material. Although competitive pressure and confidentiality issues still represent significant hurdles, and may slow down the process, the returns from data enrichment are becoming more widely appreciated by the industry. These benefits include:

- Validation of pricing tools: pricing actuaries and underwriters rely on rating methodologies based on adjusting baseline curves depending on AOI, occupancy characteristics, etc. Any divergence (in the statistical sense) of such tools from empirical counterparts is often poorly understood, making it hard to pinpoint margins for prudence (if any) applied to different layers and types of exposure. Developing sensitivity analysis helps to understand such divergence, by distinguishing between frequency and severity dimension, and by providing some useful results on the latter.
- Development or testing of industry first loss scales: there are many different industry standard sets of loss scales that have been developed. Some of these scales have been developed many decades ago, such as the Lloyd's, Salzmann, and Ludwig scales. Other scales have been developed by reinsurers and brokers over time based on various internal or external approximations, such as those developed by Swiss Re (See Bernegger 1997 MBBEFD physics approximations) and China Re (See *http://react.cpcr.com.cn*). Other sets have been developed from significant industry based commercial property data such as ISO's PSOLD, which reflects curve differentials by occupancy, amount of insurance, and peril. If significant data sets can be compiled, which link the exposure to the loss amount (often, the "missing link"), then first loss scales can be developed, or compared against industry scales with appropriate scalars produced. Some brokers and reinsurers often have their own compilations of large losses. Often missing from these compilations is the inclusion of all losses from ground-up or above deductibles, to produce true first loss scales.
- Improvement of fire standards: a robust collection of large fire losses related to the original amounts of insurance will help various government and other agencies to get a deeper understanding of the causes of large losses and fatalities, and how better to prevent them. The collection of this type of data, and what is made available publicly to companies, varies tremendously around the world. In the US, the National Fire Protection Association has collected and distributed all fire losses above $5M for over 20 years, while recently the threshold has been increased to $10M. Many other countries collect similar statistics to help in their assessment of fire protection activities.
- Cross country comparisons: further compilation of these fire statistics, can give rise to an understanding of why certain countries' large loss experience can be quite different than others. The COPE portfolio extension framework briefly described in section 10.7 can help in identifying countries and regions for opportunities for enhanced fire loss prevention measures.

11.2 The Imperial-IICI dataset

The discussion of the Imperial-IICI dataset is based on Biffis and Chavez (2014). The dataset contains claim and exposure information obtained from Hiscox and Liberty, two leading syndicates of Lloyd's of London. As the latter is a subscription market, the data span business written by a number of other syndicates. Granular information on claims and exposures was obtained from internal data systems, loss adjusters' reports, and to a large extent brokers' submissions. The latter are documents informing the 'lead' underwriter of any claims occurring under a policy; the information is then shared with the market, in order to allocate the losses to each 'follower', depending on the individual retentions of the syndicates that co-insured the risk underwritten by the 'lead.' Recovering FGU claims from the losses incurred by individual syndicates is, in general, very difficult due to the complex layering and coinsurance arrangements characterizing large commercial property insurance.

All data were anonymized and aggregated by using fictitious claims and policy identifiers. Internal validation of the data was carried out by looking at individual claims narratives and policy schedules (documents listing the asset values insured under a policy). External macro-validation was carried out by using data from fire protection agencies as compiled by ISO Verisk.

The Imperial-IICI FGU claims provide aggregate information on indemnities for physical damage and business interruption, as well as claims assessment and settlement fees. Both claims and exposures are expressed in 2012 USD terms; the normalization is obtained by trending claims and exposures at an average rate of 2.5 percent per annum across the two syndicates. For the purpose of this project, we extrapolated the data to the end of 2014 by using the same trending factors.

In terms of exposure information, in addition to TIV information, Biffis and Chavez (2014) classify occupancy types by developing a classification based on three levels of increasing granularity. The first one broadly classifies exposures into commercial (e.g., offices, banks, stores), manufacturing (e.g., utilities, food processors, mines), residential property (e.g., hotels, hospitals), and energy on shore (e.g., oil refinery). The second level provides some more detail, allowing one to distinguish, for example, a hotel from a hospital, or metals from food producers. The third occupancy level offers a more granular view of the exposures, distinguishing for example between large vs. small hotels, heavy vs. light fabrication infrastructure, and food & drugs vs. chemicals vs. metal & minerals processing plants. Finally, occupancy information is complemented by the claim narrative, which may also provide some more information on the hazard event (e.g., burst of waterpipe, electrical failure, fire from hotel restaurant).

11.3The IRFRC LCR dataset

The discussion of this dataset is based on Benedetti *et al.* (2015a,b). The dataset is the result of the combination of the APAC subset of the Imperial-IICI dataset, and APAC data provided by SCOR Services Asia-Pacific Pte Ltd**.** The database provides information on FGU losses occurred during the period 2000-2013 in the APAC region for commercial, manufacturing, energy on shore, residential and miscellaneous exposures. In line with the information contained in the Imperial-IICI dataset, the focus is on man-made risks, such as fire and explosion, which are often regarded as un-modeled risks. Natural catastrophes, on the other hand, are excluded, as they are typically covered by catastrophe models. In addition to FGU loss information, the dataset provides information on the risk exposure, including location, occupancy type, and TIV. For anonymization purposes, aggregation of the two data sources was carried out by bucketing data into three time periods (2000-2003; 2004-2008; 2009-2013), and replacing original currency and country information with the categorical values “developed country” and “developing country”. To define the latter, the World Bank’s economic development classification[3] was followed. In line with the Imperial-IICI dataset, the IRFRC LCR dataset provides aggregate information on indemnities using granular information on physical damage and business interruption, as well as claims assessment and settlement fees. Both claims and exposures are expressed in 2013 USD terms; the normalization is obtained by trending claims and exposures at a notional rate of 2.5 percent per annum.

In terms of exposure information, in addition to TIV information, Biffis and Chavez (2014) classify occupancy types by developing a classification based on three levels of increasing granularity. The first one broadly classifies exposures into commercial (e.g., offices, banks, stores), manufacturing (e.g., utilities, food processors, mines), residential property (e.g., hotels, hospitals), and energy on shore (e.g., oil refinery). The second level, reported in Table 1 in Section 4, provides some more detail, allowing one to distinguish, for example, a hotel from a hospital, or metals from food producers. The third occupancy level offers a more granular view of the exposures, distinguishing for example between large vs. small hotels, heavy vs. light fabrication infrastructure, and food & drugs vs. chemicals vs. metal & minerals processing plants. Finally, occupancy information is complemented by the claim narrative, which may also provide some more information on the hazard event (e.g., burst of waterpipe, electrical failure, fire from hotel restaurant). Given sample size issues, the IRFRC LCR dataset only uses the first two occupancy classification levels of Biffis and Chavez (2014), and does not allow one to study residential exposures, as they are severely underrepresented in the dataset. Moreover, as TIV information is sometimes not available, the dataset uses the proxy variable TIV*, which relies on Total Sum Insured (TSI), a lower bound for TIV, when the latter is not available.

[3] See www.worldbank.org.

12. Rate Monitoring Information

The survey results for experience rating showed that pricing actuaries consider historic premium income to be the primary measure of historic exposure. This was ranked second of the 8 common items. Behind this was historic exposure in terms of no. of exposures or no. of risks, ranked 6. Historic rate change was ranked 5, projected rate change 7 and rate monitoring for renewal policies 8. Results were reasonably consistent across CAS, IFOA and Other.

With the exception of historic premium which is usually received by 93 percent of respondents, the other items are usually received by 30 percent (historic exposure), 59 percent (historic rate change), 43 percent (projected rate change) and 18 percent (rate monitor for renewals). The conclusion is that pricing actuaries prefer to use historic premium adjusted for rate change as opposed to historic exposure. Ceding companies benefit when they are able to demonstrate rate gains where they get them either via rate monitoring, providing historic rate change, or providing a reasonable measure of exposure for premiums to be compared to over time.

12.1 Why do reinsurers need credible rate change information from the cedant?

The main use of rate change information is for experience rating. Various rate changes on an account basis are rolled up to produce portfolio rate (or price) monitors. The production of rate monitors is typically done by primary companies for their own purposes, as well as summarized in some fashion by themselves or their brokers to potentially be given to reinsurers. Often these internal rate monitors are also compared to outside industry sources to assess where they are in the market place compared to their peers. The rate monitors for primary companies may include components for attritional (Fire) rate changes, as well as cat (Wind) perils if available. Other broad segments such as commercial versus manufacturing versus residential (or more refined categories such as occupancy and state/region), and distributions by premium size may be produced as well. Reinsurers often rely very heavily on the receipt of such monitors in order to get a good sense as to how the particular ceding company compares against their peers.

Reinsurers on their part, also often produce rate change information on their own incoming business on an account by account basis, and then rolled up into a rate monitor for their own purposes, and perhaps then given to retrocessionaires for their retrocessional protection.

When historical written or earned premium is used as a measure of exposure, this premium needs to be adjusted for rate changes over time and be brought to current rate levels. In essence, the “as-if” or “on-leveled” premium for each year represents the amount of premium that would be written or earned by the cedant for that historic year if current rates were charged.

As the figures in the survey indicate, historic rate change information is rarely available for property treaty reinsurance submissions, and often, when they are presented, reinsurers are not clear how the cedant calculates the rate change and how much of their portfolio have been included in the rate change for the year. In addition, the rate change information may only be available for some of the most recent years, which makes its use limited.

12.2 What is/should be included in the rate change calculation?

The definition of rate changes on renewal policies varies widely among companies and therefore reinsurers benefit when the submission includes some commentary from the cedant as to how they calculate rate changes on renewal policies. This is of particular relevance for policies covering multiple locations for which the policy structure may frequently change.

The Lloyd's minimum underwriting standards framework requires each syndicate submit, on a monthly basis, the Performance Management Directive Report (PMDR) which includes the following items for each policy:

1. Expiring premium for all lapse policies (non-renewed);
2. Expiring and current written premium for all renewal policies;
3. Current written premium for new policies; and
4. Risk Adjusted Rate Change (RARC) for all renewal policies. The RARC must be broken down into the following components
   - Change due to Limits/Deductibles/Attachment
   - Change due to Coverage (wording and terms and conditions of the policy)
   - Change due to other factors, which may include
     - Change in experience
     - Change in total insured values or sum insured
     - Change in territorial/occupancy/type of building mix

The RARC should reflect the relative difference between the change in risk exposure and the change in net cash for the policy when comparing the expiring and renewal policy. The key item, yet most commonly misunderstood, to measure in the calculation of rate changes is the overall change in risk exposure for the policy.

Change in risk exposure includes everything that has changed in the insured's risk profile and could therefore lead to a change in expected loss cost for the policy. For property, the most common changes in risk exposure include:

- Change in total insured values in the schedule of properties/locations;
- For excess or layered policies, changes in the policy limit and attachments;
- Change in coverage to add/remove certain types of losses and perils; and
- Changes in risk perception from subjective elements such as changes in risk management, claims prevention practices, and claims experience.

Changes in net premium compares expiring and renewal net written premium after all deductions including brokerage, no claim bonuses, renewal incentives, additional premiums, profit commissions and reinstatement premium. All deductions should be calculated based on how much the deduction or additional premium is expected to be worth at the end of the policy period.

If the change in net premium equals the change in risk exposure (including all components), the rate change is 0 percent, if the change in net premium is less than the change in risk exposure, then we expect to see a rate decrease given that the cash has not compensated for the change in risk and if the change in net premium is higher than the change in risk exposure, we should see a rate increase.

Example: Change in total insured value (TIV) and change in layer

One of the most common issues in property insurance is that the TIV is the policy limit and therefore it is often difficult to distinguish between them. The issue becomes more complicated when a policy covers multiple locations and is an excess policy and both of them change on renewal.

Figure 19 - Sample Multi-Location Policy Renewal Information - 2014 and 2015

The 2014 policy: an excess policy $25m xs $75m covering the following three locations:

Building ID	TIV
1	55,000,000
2	85,000,000
3	125,000,000
Total	265,000,000

Net written premium = $200,000

The 2015 policy: an excess policy $50m xs $50m covering the following five locations (the first three locations are the same ones as in the expiring policy but with reviewed TIV):

Building ID	TIV
1	55,000,000
2	85,000,000
3	125,000,000
4	65,000,000
5	45,000,000
Total	375,000,000

The 2015 policy includes the peril of flood, which was excluded in the 2014 policy and based on the locations and exposures, it is determined that this additional coverage has an expected loss cost of 10 percent of the loss cost excluding flood.

Net written premium = $665,000

We need to determine the rate change of the policy but we also must provide a breakdown of how much of this rate change is due to the additional two locations, the change in layer and the additional coverage.

The key component of the calculation is the (expected) loss cost in the layer from the TIV exposing the layer. To calculate this loss cost, we need the loss cost per unit of TIV, usually a loss cost rate (percent) and an exposure curve or first loss scale that allows us to layer the loss cost for each location exposing the layer.

Note, in this example, the total insured value for the policy increased 41.5 percent, but the new locations do not expose the expiring layer and only partially expose the new layer.

The table below presents the four possible modeling combinations that require consideration in order to break down the rate change calculation into the relevant components.

Figure 20 - Sample Multi-Location Rate Change Components

		Layer	
		2014	2015
TIV Profile	2014	A: Loss cost calculated for 2014 policy	B: Loss cost for 2015 layer using on 2014 TIV profile
	2015	C: Loss cost for 2014 layer using on 2015 TIV profile	D: Loss cost calculated for 2015 policy including flood

From the expiring and renewal pricing records we have A and D. Assuming nothing else has changed in the policy, the overall change in risk exposure (or loss cost) is the ratio of D to A (D/A). This includes all three components, the change in TIV profile, the change in layer structure and the addition of the flood peril.

The figures represented by A, B, and C above exclude the flood exposure. The 2015 loss cost excluding flood in this example is D/1.10 since the loss cost for flood was determined to be worth 10 percent of the loss cost excluding flood.

According to Lloyd's Underwriting Minimum Standards, the change due to policy limit and attachment should be calculated by modeling the 2015 and 2014 layers using the 2014 profile; in the exhibit above this is the ratio of B to A (B/A). However, remodeling the previous year's profile on the new policy structure is often too time consuming and impractical as this would require re-running all the catastrophe models.

From the practical point of view, modeling the expiring (2014) structure on the 2015 TIV profile (in this case C) is more viable and is often the starting point of modeling. The ratio of D/1.10 (to exclude flood) and C would measure the change due to policy layer only.

The following exhibit shows some details of the working using an exposure curve of the Swiss Re type with parameter c = 5, which closely matches the Lloyd's industrial curve. See Bernegger (1997) for further details of the exposure curve.

Figure 21 - Sample Multi-Location Rate Monitor Component - RARC Illustration

	2014 Layer	2015 Layer
Limit	25,000,000	50,000,000
Attachment	75,000,000	50,000,000
Loss cost rate on TIV	3%	3%

CHANGE IN LAYER STRUCTURE

2014 Profile/2014 Layer

Building ID	TIV	% loss in layer	Loss cost in layer
1	55,000,000	0.00%	0
2	85,000,000	1.03%	26,371
3	125,000,000	3.15%	118,109
Total	265,000,000		144,480

2014 Profile/2015 Layer

Building ID	TIV	% loss in layer	Loss cost in layer
1	55,000,000	0.83%	13,686
2	85,000,000	5.41%	138,034
3	125,000,000	8.39%	314,483
Total	265,000,000		466,203

2015 Profile/2014 Layer

Building ID	TIV	% loss in layer	Loss cost in layer
1	55,000,000	0.00%	0
2	85,000,000	1.03%	26,371
3	125,000,000	3.15%	118,109
4	65,000,000	0.00%	0
5	45,000,000	0.00%	0
Total	375,000,000		144,480

2015 Profile/2015 Layer (incl Flood)

Building ID	TIV	% loss in layer	Loss cost in layer
1	55,000,000	0.83%	15,054
2	85,000,000	5.41%	151,838
3	125,000,000	8.39%	345,932
4	65,000,000	2.45%	52,594
5	45,000,000	0.00%	0
Total	375,000,000		565,417

If only interested in the risk adjusted rate change (RARC), calculating the total change in risk exposure as the ratio of the renewal loss cost $565,417, and the expiring loss cost $144,480, yielding a change in risk exposure factor 391.35 percent is sufficient. The net premium change from an expiring premium of $200,000, to a renewal premium of $665,000, a factor of 332.50 percent, indicating a rate reduction of

RARC (%) = 332.50 percent/391.35 percent -1 = -15.04 percent

The breakdown of the components according to Lloyd's minimum standards should be done as follows:

Change due to limits, deductibles and attachments = $466,203/$144,480 = 322.68 percent (or 222.68 percent increase)

Change due to coverage (flood) = 110 percent (or 10 percent increase)

Change due to other factors (TIV) = 391.35 percent/(322.68 percent x 110 percent) = 110.26 percent (10.26 percent increase due to TIV profile)

Although this is the prescribed method within the underwriting minimum standards, each company may slightly deviate from this method depending on how integrated the pricing models are and how much of the calculation is left to the underwriter's discretion.

For non-Lloyd's companies the calculation is less prescriptive and therefore subject to a wider range of considerations that may not be obvious to reinsurers from the way the data are presented in the submission.

Therefore, reinsurers would thoroughly benefit from a brief explanation and even an example of how rate movements are calculated for renewal policies and what risk parameters are used to adjust the expiring premium for changes in risk profile.

12.3 New Business Rate Monitoring

Rate changes tend to be calculated for renewal policies only; very rarely do companies attempt to provide rate change figures at portfolio or class of business level that also include the new policies written. Therefore, the rate change used for business planning, reserving, and capital modeling could be misleading if the volume of new business premium is significant. In the case of reinsurers, the rate change provided in the reinsurance submission is used for experience rating and is applied to the overall premium (including new business). Of utmost importance to reinsurers is knowing whether the cedant has included new business in the rate change calculation.

Rate movements can cause shifts in business mix, leading to inaccurate rate change calculations. Volume tends to grow in classes that received rate decreases and decline for classes receiving rate increases (Bodoff 2009). Additionally, during soft markets underwriters may have an incentive to gain new accounts and reach volume targets, which can result in overstated rate changes (Robbins 2009).

Literature discussing methods for calculating the impact of new business on overall rate changes is limited and often the lack of inclusion of new business in the rate change calculation is wrongly attributed to the lack of expiring policy details and written premium. Methodologies tend to involve comparisons of charged rates for new and renewal business to their respective benchmarks (Mata 2009) and calculating company shift factors, which measure the rate impact produced by moving business between companies with different rate levels (Vaughn 2004).

Ideally, submissions should include the separate impact of both the new business and renewal rate changes on overall rate adequacy along with premium split into new and renewal. An explanation of the calculation of the new business impact should also be included. If new business impact cannot be calculated, this should be clearly stated and the premium split between new and renewal business should be provided along with retention ratios.

Broadly speaking, to sufficiently include the new business premium in the overall rate change calculation, provide an indication of the overall price differential between renewal and new policies or the rate adequacy (charged premium to technical or benchmark price) differences between renewal and new business. This information combined with the rate change on renewal business is sufficient for the reinsurer to calculate an overall rate index for experience rating.

12.4 Rate Changes – Level of Detail

Since rate changes are applied to premium for experience rating, aside from providing splits of new and renewal rate impacts, rate change information should be aggregated by year of account and provided in a manner consistent with that of the historic premium. Rate change information is often provided in a level of detail which is different than the level of detail of the premium provided making aggregation of the rate changes in a meaningful way virtually impossible for reinsurers in the midst of the pricing exercise.

Therefore, as long as the rate change and premium information are provided at the same level of detail, reinsurers have the flexibility to decide how to best aggregate the information for experience rating.

12.5 Rate Monitor - Using Extended Exposures

Another usage of the extended exposure method, described in Section 8, is to produce year on year indications that more properly reflect changes in occupancy mix, amounts of insurance, deductibles, protection and construction differences, etc. An example is shown in Figure 22, with charts produced in Figure 23.

Figure 22 - Sample Rate Monitor Using Extended Exposures- Illustrative Data

	Total Exposure Info		Total Premium & Loss Cost Info		
US - Banded Profile					
Comm'l / Industrial	Total Amount of Insurance	13,654,744,688			ELR
1/1/2015	# of Exposures	3,425	37,044,418	16,927,567	55.1%
Price Monitor Test	Average Exposure	3,986,787	0.225	0.124	

Number of Risks (Banded)	Year	Description/Record Index	TOTAL B&C Amount of Insurance ($)	TIME ELEMENT Amount of Insurance ($)	Actual Premium	IRV Total Gross Loss Costs	ELR (IRV GULC/ Actual Prem)
96	2010	Commercial - Band 1	182,806	20,312	176,165	47,999	27.2%
36	2010	Commercial - Band 2	629,925	69,992	184,166	45,630	24.8%
40	2010	Commercial - Band 3	1,290,047	143,339	339,329	101,554	29.9%
116	2011	Commercial - Band 1	182,806	20,312	205,526	57,998	28.2%
43	2011	Commercial - Band 2	629,925	69,992	214,861	54,502	25.4%
49	2011	Commercial - Band 3	1,290,047	143,339	395,883	124,404	31.4%
145	2012	Commercial - Band 1	182,806	20,312	253,885	72,498	28.6%
54	2012	Commercial - Band 2	629,925	69,992	265,416	68,445	25.8%
61	2012	Commercial - Band 3	1,290,047	143,339	489,032	154,870	31.7%
3	2014	Industrial - Band 11	24,633,000	2,737,000	108,868	103,442	95.0%
1	2014	Industrial - Band 12	62,332,200	6,925,800	70,915	85,023	119.9%

IRV Summary - Total and Detail Loss Costs

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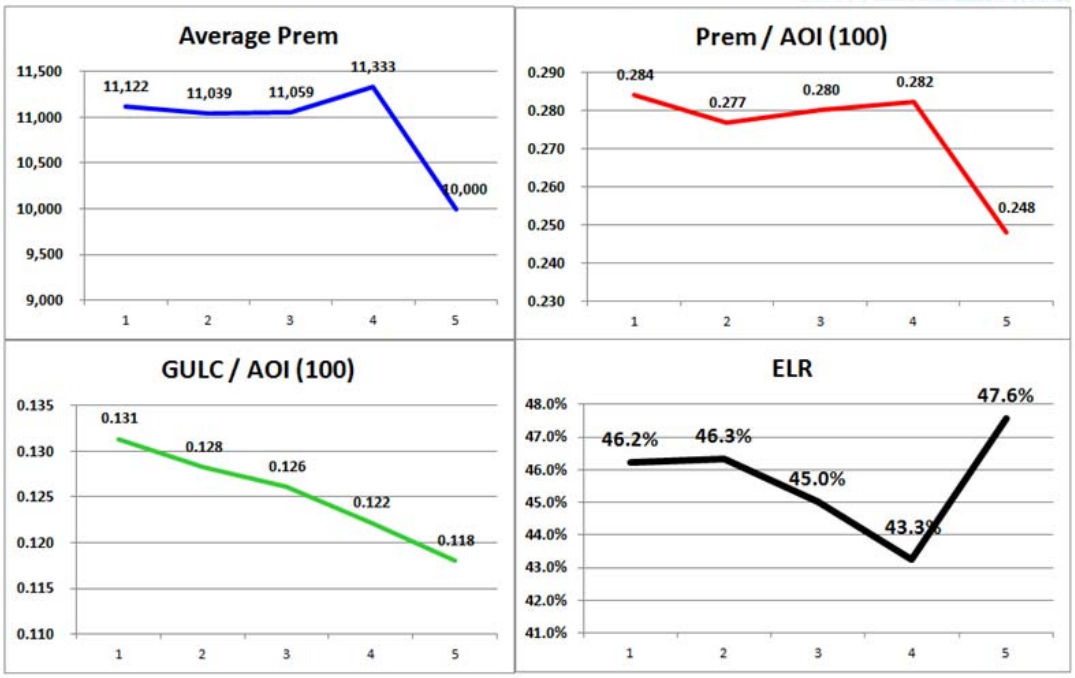
US - Banded Profile Comm'l / Industrial 2010 through 2014 Price Monitor Test

Version 2.0

Year	# of Exposures	Actual Prem	Per Risk Avg AOI	Banded Total AOI	Prem / AOI (100)	IRV - Total Gross Loss	GULC / AOI	ELR	Average prem
2010	500	5,561,224	3,913,640	1,956,819,880	0.284	2,570,494	0.131	46.2%	11,122
2011	550	6,071,429	3,985,727	2,192,149,847	0.277	2,812,599	0.128	46.3%	11,039
2012	625	6,911,765	3,947,627	2,467,266,841	0.280	3,110,693	0.126	45.0%	11,059
2013	750	8,500,000	4,012,453	3,009,340,120	0.282	3,676,410	0.122	43.3%	11,333
2014	1,000	10,000,000	4,029,168	4,029,168,000	0.248	4,757,370	0.118	47.6%	10,000
Grand Total	**3,425**	**37,044,418**	**3,986,787**	**13,654,744,688**	**0.271**	**16,927,567**	**0.124**	**45.7%**	**10,816**

Figure 23 - Sample Rate Monitor Using Extended Exposures - Illustrative Charts



The above charts show the calculation of ground-up loss costs from a portfolio which grows from 500 exposures to 1,000 in a five-year period. The underlying building exposure characteristics are used to generate expected loss amounts for each of the years, and compared to the actual illustrative charged premium during this history. If, for example, all 500 buildings in the first year were of one particular lower hazard occupancy with a $5,000 deductible, and were predominantly un-sprinklered, they would produce a certain expected ground-up loss cost. If over the five-year period those buildings were replaced by much higher hazard occupancies, with much larger deductibles, but the inclusion of robust sprinkler systems, then the loss costs for that year would reflect all those exposing characteristics. Comparing the expected losses for each of these years based on current best estimates of all the rating variables, would produce a sequence of expected loss ratios (ELRs). These ELRs would generally be considered a good way to calculate a rate monitor that responds to all the underlying exposing characteristics.

Rate monitors that might be developed based on average premiums, average premium per amount of insurance, or ground-up loss costs per AOI, may not pick up those distinctions. Rolling up the rate monitors across accounts in such a way can produce a robust rate monitor for internal purposes and as given to reinsurers for their independent assessment.

13. Using property cat submission information

Oftentimes the reinsurer receives both banded profiles from the per risk submission, as well as individual risk information for catastrophe exposed risks. This section describes how best to use the detailed information from the cat submission, as well as typical pitfalls.

13.1 Using and reconciling Property Risk Submissions with Cat Submissions

Given the immense amount of detail that can be coded into catastrophe model input files, looking to these files for information that supplement, augment, or inform the basic limit profiles that often accompany property risk submissions is not uncommon. But while such information can provide much additional insight into the nature of the individual risks subject to a per-risk treaty, one must remember that the information contained in those input files is specifically meant to be used for catastrophe modeling. As such, the analyst must be careful to avoid pitfalls that could lead to a very distorted view of the business.

13.2 Why Use Cat Model Input Data?

When properly and completely coded, the input files for catastrophe models contain a wealth of information not normally found in a basic limits profile. Each location in the file is coded with a value, an occupancy type and a construction type. One of the most basic pieces of information commonly left out of a property risk limits profile pertains to deductibles or attachment points. In a profile with banded exposure ranges, the addition of an average deductible or attachment point for each band could potentially make a significant difference in any calculations the analyst might make. Each location in a catastrophe model is cross-referenced with a policy limit, an attachment point or deductible amount, and a participation share. The files also contain fields for premium on a policy basis. These may or may not be populated because this information is not required for the catastrophe models to function properly. If this part is populated, the policy premium can be allocated to individual location.

In the past, when computational power was at a premium, and most desktop computers were fairly limited in their abilities, limits profiles were provided in bands of exposure so that calculations could be made quickly and without excessive complexity. In this current age of inexpensive memory space and powerful desktop processors, exposure rating calculations on an individual location basis are often possible, and preferable to perform. If premium is allocated to location, and a non-cat limit is coded, the information necessary for such an exercise could possibly be extracted from the catastrophe model data.

13.3 Does the Cat File Represent ALL or only PART of the Business?

Putting together the input data for a catastrophe model can be a very meticulous, time intensive, and manual process. For this reason, an insurer may include in the file only as much information as is absolutely necessary. This may mean, for example, that the only locations included in the file are those locations deemed to have exposure to the catastrophes meant to be modeled. If the file is to be used as input for modeling the hurricane peril, only locations along the east coast may have been coded, and the rest of the business may not be represented at all. Or perhaps, if an insurer is primarily exposed to the earthquake peril, maybe only west coast exposures are represented in the file.

13.4 Is the File Coded with the Proper Limits and Deductibles?

Even if an insurer has included all locations in the input file, often the policy tables are coded with either earthquake or wind-specific deductibles or sub-limits specific to the peril to be modeled. To the extent that these limits are different from the non-cat, or fire limit, they are not suitable for exposure rating, which typically is meant to estimate non-cat expected loss. Also, deductibles for natural perils (as coded in cat modeling data submissions) are usually different than fire deductibles.

14. Various Country Issues

Issues related to specific countries, as well as the quality of information available, varies greatly by geographic region. The above sections provide some general practical resource information. The below sections describe some specific country issues and information, as well as some general regional observations.

14.1 US Specific issues - Valued Policy Statutes and Probable Maximum Loss

In the US, valued policy statutes alter the application of indemnification, total insurable value, and the concept of or limit assignable to a specific property's Probable Maximum Loss (PML). Twenty US states currently maintain valued policy statutes.

States implemented valued policy laws to "protect" insureds from an insurance carrier's argument of "over-insurance" following a total property loss. Essentially, carriers in valued policy states must pay the entire face amount of the property policy if the structure suffers a total loss – regardless of the property's insurable value. Insured's receive the full face value of the policy even if the actual replacement cost is less than the amount carried.

Reinsurance underwriters must know three key facts: 1) which states maintain and apply either a valued policy law or modified valued policy law; 2) the type of property affected by the law (sometime limited to residential properties); and 3) the causes of loss can trigger the valued policy statute of a particular state. Following is a chart providing each of these key facts:

Figure 24 - Valued Policy Statues - by State

State	Statute	Property Protected	Causes of Loss
Arkansas	23-88-101	All Real Property	Fire and natural disasters (excluding flood and quake)
California	2052, 53, 54, 55, 56, 58 and 75	Buildings	All perils covered by the property policy
Florida	627.702	Any building (including mobile and manufactured homes)	All perils covered by the property policy
Georgia	33-32-5	1 or 2 family residential bldgs.	Fire
Kansas	40-905	All improvements on real property	Fire, tornado, wind, lightning
Louisiana	22:1318	Inanimate / immovable property	Fire
Minnesota	65A.08	All property	All perils covered by the policy
Mississippi	83-13-5	Buildings	Fire
Missouri	379.140; 145	All property	Fire
Montana	33-24-102 and 103	Improvements to Real Property	All perils covered by the property policy
Nebraska	44-501.02	Real property	Fire, tornado, wind, lightning, explosion
New Hampshire	407:11	Buildings	Fire and lightning
North Dakota	26.1-39-05	Real property	All perils covered by the property policy
Ohio	3929.25	Any building	Fire and lightning

State	Statute	Property Protected	Causes of Loss
South Carolina	38-75-20	All real property	Fire
South Dakota	58-10-10	Real property	Fire, lightning, and tornado
Tennessee	56-7-801 to 803	Any building	Fire
Texas	862.053	All real property	Fire
West Virginia	33-17-9	Real property	All perils covered by the property policy
Wisconsin	632.05(2)	Owner-occupied dwellings	All perils covered by the property policy

14.2 Emerging Markets Issues

Risk profiles

- Sometimes not available
- Only gross, no net retained
- Number of risks / policy not available
- Definition of risk / policy is unclear
- Poor formatting e.g. lower bound & upper bound in the same column
- Information not passing consistency tests such as (*see section 7.2 for more details*):
  - average AOI doesn't fall within bands even after adjusting for inuring facultative reinsurance
  - average premium per policy progression by band is unusual
  - average premium per 100AOI progression by band is unusual
  - comparison to others in country and other countries is inconsistent
- The sum of premiums in risk profiles deviates from GNPI significantly
- Rate change not available

Large Loss

- Does not split among ground-up, gross and retained
- Better if they can tell us their share of the loss in the market
- Event losses are shown individually but combined
- Information is not consistent (e.g. number of years of data provided)
- Large loss threshold amounts not provided

As-if Statistics

- What are the as-if assumptions (Change in retention? Change in underwriting guideline?)
- Does not provide the statistics in without as-if basis for comparison

Triangles

- Sometimes only the diagonal is available
- Does not split between paid and outstanding
- Does not provide the amount of direct commission
- Does not provide enough number of years (Good to have 10 years)

Top 10 risks

- Sometimes not provided

Cat exposures

- Sometimes they provide PML only Information about coinsurance / inward fac
- Not provided

Expiring Leader

- Sometimes not provided

The submission in Japan reinsurance market is very unique because the PML estimation is very common in Japan. Some Japanese insurers even have their own risk management company to estimate PML ratio.

For example, the sum insured of a risk may be JPY 1 billion, but the PML ratio may be 30 percent, which means that the PML for the risk is only JPY 0.3 billion. Therefore, JPY 0.3 billion rather than JPY 1 billion should be used in exposure rating.

What's more, there may also be an indemnity limit for a risk. For instance, the sum insured of a risk is JPY 1 billion, but the indemnity limit for the risk is only JPY 0.6 billion, which also affects the exposure rating.

China Insurance Law does refer to Valued Policies. In practice here, for some special property items such as antiques and artworks, valued policies are issued to them because of the difficulty in establishing their monetary value.

As to claims, insurers do not need to evaluate the value of loss but the ratio of damage. For example, if the amount of insurance of the valued policy is CNY 2 million and the ratio of damage is 40 percent, then the amount of claims payment is CNY 2 million * 40 percent =CNY 0.8 million.

When considering pricing, the amount of insurance is used, which has the same meaning as the common concept of sum insured.

14.3 The Impact of Inuring Reinsurance Treaties and "As-If" Data in Emerging Markets

In general, some other proportional reinsruance treaties usually inure to the benefit of the per-risk excess-of-loss reinsurers. If the structure of the proportional reinsurance treaties remain stable year by year, then the impact of the inuring reinsurance can be analysed relatively simply.

In emerging markets, however, many insurers usually grow very quickly and the structure of their reinsurance arrangement is often changed every few years. For instance, an insurer has a quota share reinsurance treaty covering its property line since 2006. However, the retention of the quota share reinsurance treaty was 70% from 2006 to 2010 and was changed to 60% from 2011 to 2015. In 2016, the retention of the quota share treaty will change to 50%.

Now, there is a per risk property excess-of-loss reinsurance treaty covering the property line in 2016. The insurer gives the information of risk profiles to reinsurers as below.

Tables of risk profile (Illustrative)

Net Retained Risk Profile of 2015			
Sum Insured Band	Total Sum Insured	Number of Risks	Total Premium
0-50M	15000	500	15
50-100M	24000	300	24
100-150M	25000	200	25
150-200M	17000	100	17
200-250M	13200	60	13.2
250-300M	10800	40	10.8
300-400M	6600	20	6.6
400-500M	6300	15	6.3
above 500M	5600	10	5.6
Total	123500	1245	123.5

In the meantime, the information of historic large losses is also provided by the insurer as below.

Historic Large Loss Information

Insured	Date of Loss	Cause of Loss	Net Retained Paid Loss	Net Retained O/S Loss
ABC	9 Sep 2013	Fire	60,000,000	0
DEF	10 May 2008	Fire	30,000,000	0
HIJ	22 August 2015	Explosion	10,000,000	10,000,000
…	…	…	…	…

If the reinsurers price the per-risk excess-of-loss treaty using the information directly without any adjustments, the results will be greatly biased.

Referring to the net retained risk profile, it should be adjusted to the new numbers with a 50% quota share treaty in 2016 from a 60% quota share treaty in 2015, even if the portfolio is unchanged during the two years.

Referring to the net retained historic large loss information, we should check the data of loss as well as the policy period and find out how much was ceded into the quota share treaty at that time. All the loss data should be adjusted with a 50% quota share inuring treaty in 2016.

The adjusted data in accordance with the new reinsurance structure in the coming year is usually called "as-if data" in the emerging markets.

Therefore, it can be witnessed that it is very imperative for ceding insurers to provide reinsurers with the "as-if" data information in the emerging markets.

When the ceding company does not provide the "as-if" data, the reinsurers can make some adjustments by themselves if the inuring reinsurance is a quota share treaty, but the reinsurers should know the changes of the cedant's quota share treaty during the past few years.

However, if the inuring reinsurance is a surplus reinsurance treaty with a grading retention, then it is hardly possible for the reinsurers to find the "as-if" data by themselves.

15. Conclusions

The main conclusions of this research paper are:

- Show the importance of each of the data elements that are requested in used the various items.
- Provide a reference document to those who may want to explore a deeper understanding of how each of these items fits together in gathering a deeper understanding of the pricing of property per risk exposures
- Provide a framework for potential extension of this work for other property and casualty lines of business

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Prior GIRO Working Party and CARe Links

http://www.actuaries.org.uk/research-and-resources/documents/d2-pricing-london-market-20-years

This presentation reviewed the changes during the past two decades and referred to several valuable papers.

http://www.actuaries.org.uk/research-and-resources/documents/report-2004-reinsurance-pricing-giro-working-party-rating-long-tail

This is the report of the 2004 reinsurance pricing WP which referred to the work of the 1998 and 1999 reinsurance pricing WPs.

http://www.actuaries.org.uk/research-and-resources/documents/reinsurance-pricing-working-party-report

This is the one of 1999 WP.

http://www.actuaries.org.uk/research-and-resources/documents/1998-gisc-reinsurance-pricing-working-party

This is the one of 1998 WP.

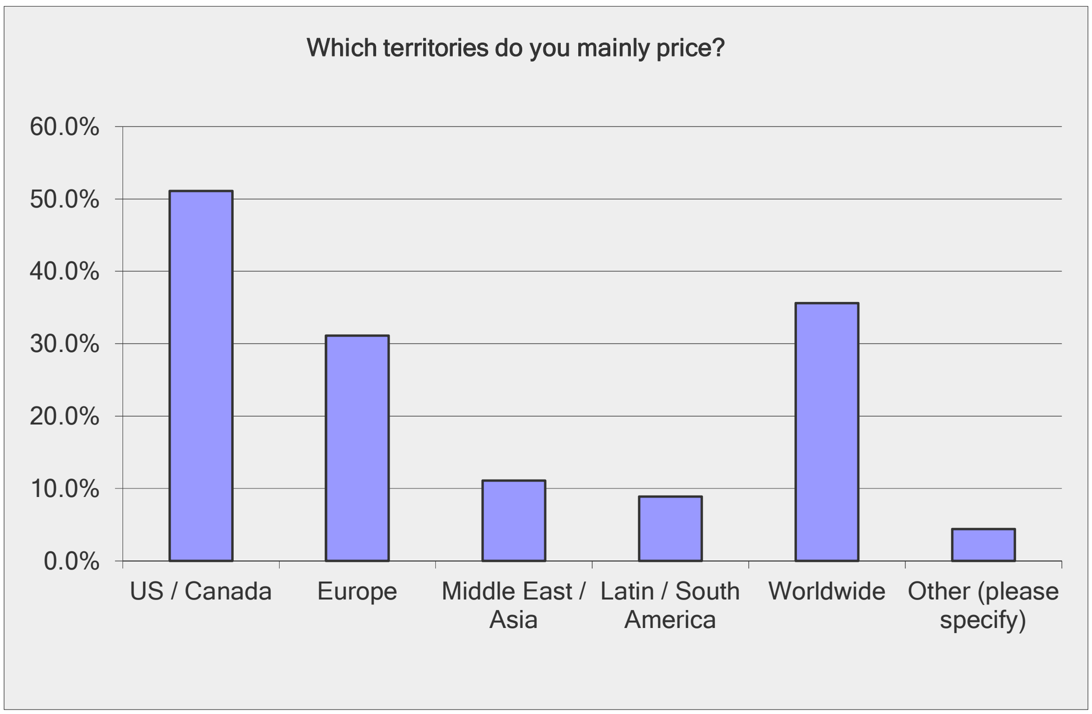
Appendices

Appendix A Survey Results

The initial survey for the CARe conference in Philadelphia in June 2015, had 44 responders, 86% of whom were actuaries. The remaining 14% came from other areas including actuary turned underwriter, underwriter turned actuary, and CRO.

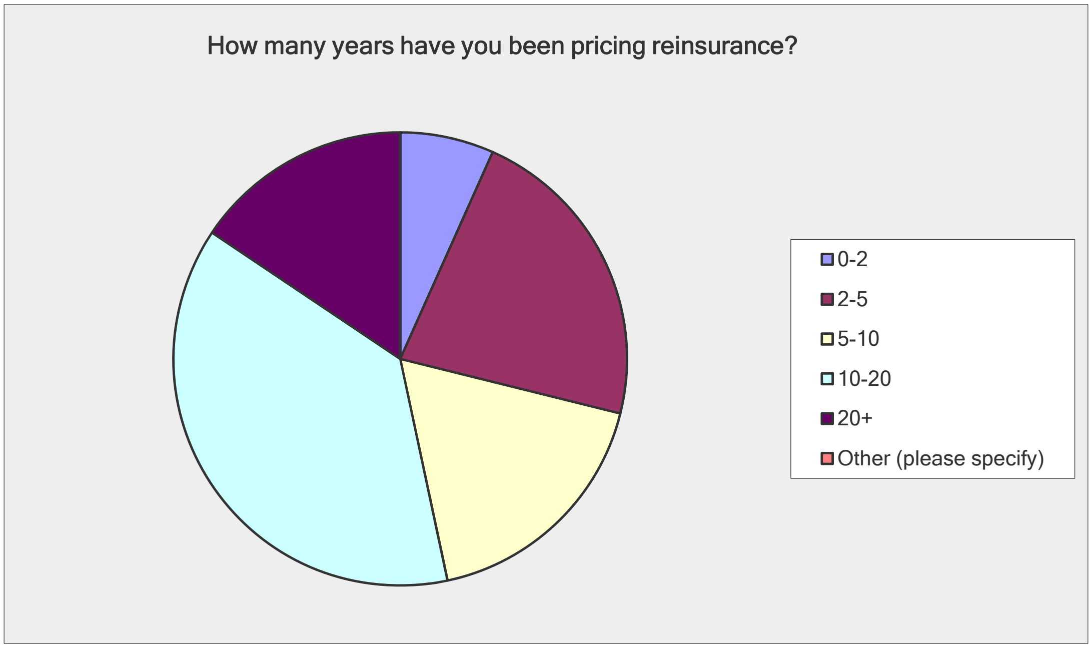
- Broken down by affiliation, 25 responders were members of the CAS, 16 were members of IFOA, and 13 were members of organizations from other regions/countries, including France, China and Australia/NZ (some were members of multiple organizations).
- The exhibit below shows a wide variety of priced territories:

Figure 25 - Survey: Which territories do you mainly price?



- The survey sample was composed of relatively experienced respondents, with 53% having worked in reinsurance pricing for more than 10 years and 71% for more than 5 years:

Figure 26 - Survey: How many years have you been pricing reinsurance?

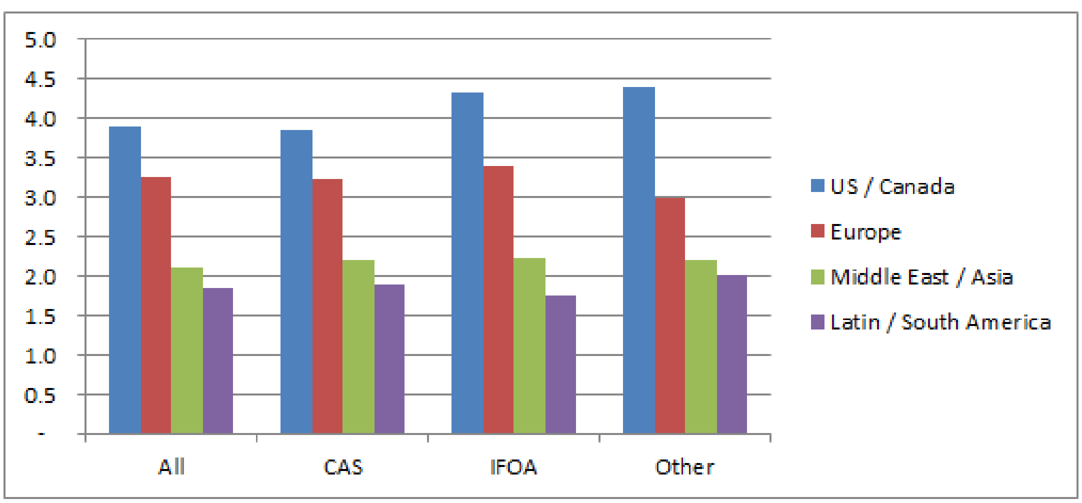


Current status of submission quality

The survey showed that submission quality is generally considered to be at least "Average" (3 out of 5) in Europe and towards "Good" (4 out of 5) in the US / Canada. Submission quality is considered "Below Average (2 out of 5) in other territories. There is some differentiation in responses of the different Actuarial organizations with the non-CAS respondents ranking US submissions higher than the CAS members but generally responses were similar across Actuarial communities.

The graph below shows the submission quality rank (1 = poor, 5 = Excellent) by Territory and Actuarial organization. Note that respondents were asked to only rank submissions for territories with which they are familiar:

Figure 27 - Survey: Submission quality rank

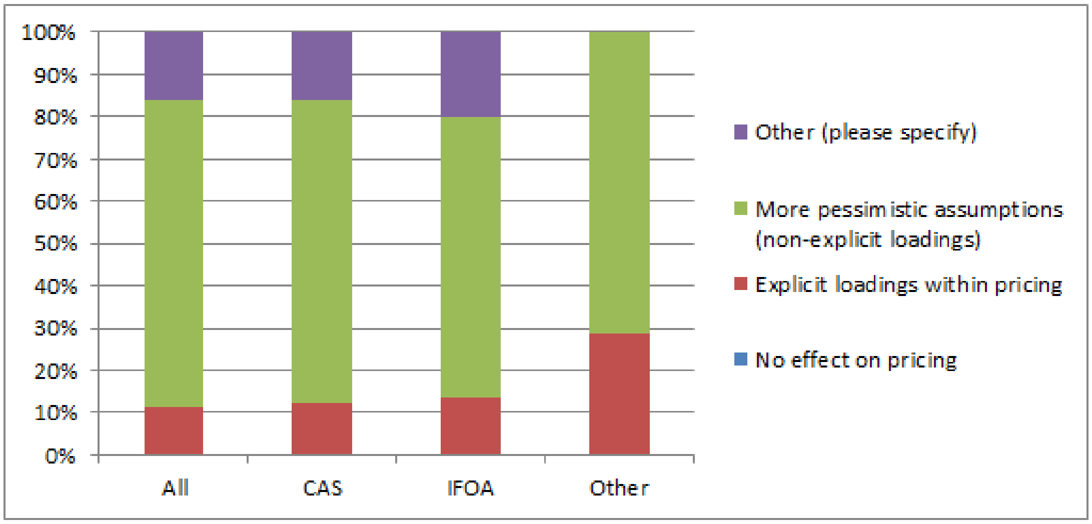


It was noted in the responses that it might be useful to distinguish between UK and "Rest of Europe" as well as to indicate Australia separately. Additionally, comments were made that Asia tends to produce higher quality submissions than those coming out of the Middle East and North Africa. One respondent noted the importance of size and sophistication of the broker and ceding company on the submission quality.

Impact of submission quality on pricing

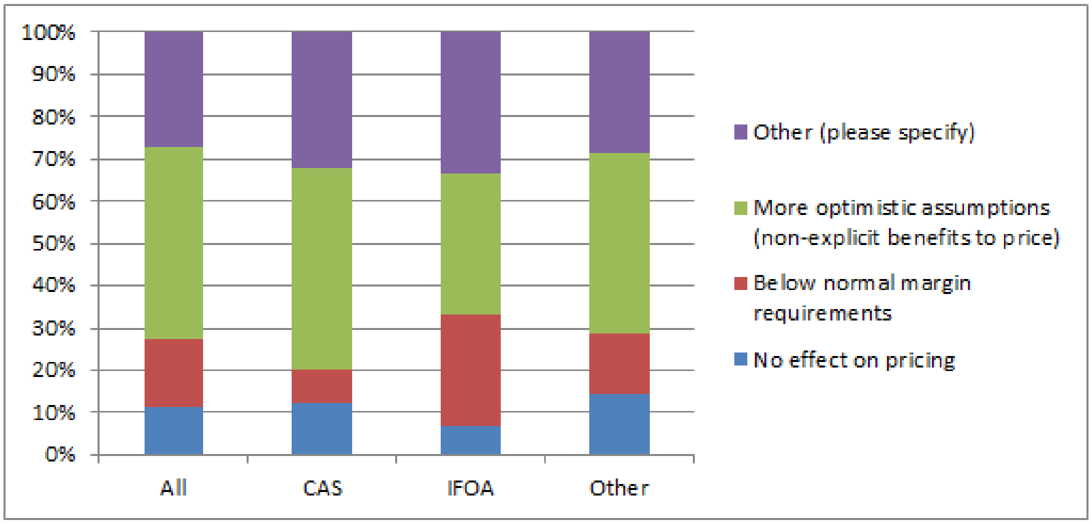
The survey then went on to discuss the impact of submission quality on pricing. Respondents were asked firstly how a poor quality submission impacts price, and secondly, how an excellent quality submission impacts price. They were then asked to rate, subjectively, how much submission quality impacts price.

Figure 28 - Survey: How does a poor quality submission impact price?



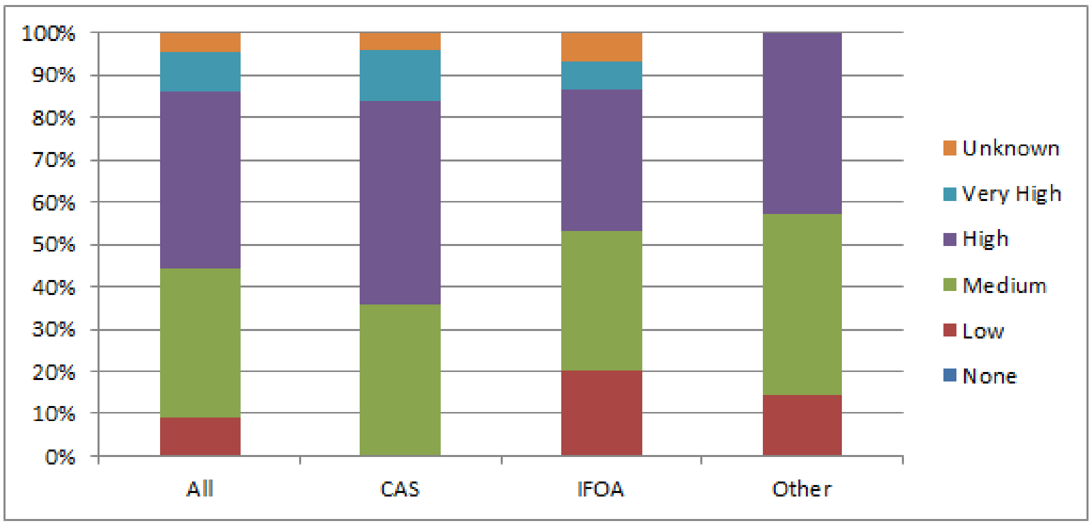
As shown above, no responders indicated that poor submission quality would have no impact on price. A clear majority indicated that the result of poor submission quality would be that more pessimistic assumptions would be made, rather than the application of explicit loadings. The “other” responses included comments that poor quality would result in a combination of assumptions and loadings, and often leads to declination of the risk, more uncertainty in pricing and makes them less likely to perform a full pricing analysis.

Figure 29 - Survey: How does an excellent quality submission impact price?



As shown above, approximately 10% said that a submission of excellent quality would have no effect on pricing, while approximately 60% indicated there would be a price benefit to the cedant in some form. There were a large number of "other" responses to this question. Many comments seemed to agree with the sentiment that, with excellent quality submissions, more credit is given to cedant data and less benchmark pricing is involved. It was noted that this does not necessarily mean a lower price, but instead suggests a price that is tailored to the cedant's data. Comments were also made that high quality submissions give credibility to what the cedant is saying about their underwriting, are easy to validate, provide insight into underling portfolios and give confidence that cedants are competent, which in turn helps with underwriting appetite.

Figure 30 - Survey: How much does quality of submission impact your price?



Clearly this is a subjective question, but as demonstrated above, no respondents said that submission quality had no impact on price, and approximately 50% said the impact was "high" or "very high".

<u>Data elements that make up a quality submission</u>

Respondents were asked whether they normally receive 8 common exposure rating items and 8 common experience rating items in a submission. They were then asked to rank each of the items in terms of what they would like to receive. The tables below show the responses received:

Figure 31 - Survey: Exposure Rating Ranked Importance

	All		CAS		IFOA		Other	
	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank
a. In-force risk profile (banded)	93%	1	92%	1	87%	1	86%	1
b. Historic risk profiles (banded)	23%	5	8%	6	60%	4	29%	3
c. Individual risk listing (all cat/non-cat exposures)	30%	3	24%	2	33%	2	43%	6
d. Individual risk listing (above certain threshold)	48%	7	48%	7	53%	5	29%	8
e. Historic from ground up loss ratios (cat and non-cat)	57%	2	68%	3	40%	3	71%	2
f. Written explanation of risk profile	25%	4	20%	5	27%	5	29%	4
g. Risk profile detail	34%	6	32%	4	40%	7	29%	5
h. Link of claims to risk profiles	7%	8	4%	8	7%	8	29%	7

Figure 32 - Survey: Experience Rating Ranked Importance

	All		CAS		IFOA		Other	
	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank	% Receiving	Rank
a. Large loss listing (no triangle)	100%	1	100%	1	100%	1	100%	1
b. Historic large loss listing (triangle)	30%	3	24%	3	33%	2	29%	4
. Large loss claim description including cat/non-cat indicator	82%	4	96%	4	73%	4	71%	3
d. Historic premium	93%	2	96%	2	87%	3	100%	2
e. Historic exposures (# of risks, # of exposures / risk)	30%	6	20%	6	40%	5	57%	5
f. Projected rate change	43%	7	56%	6	27%	7	29%	7
g. Historic rate change	59%	5	84%	5	33%	6	57%	6
h. Rate monitor (renewal policies)	18%	8	24%	8	20%	8	0%	8

The White Paper considers further survey results (also shown in attached Excel file) around the type of data required and how important that data is in pricing. We also try to highlight the benefits to ceding companies in collecting and providing high quality submission data. These benefits are not limited to reinsurance purchasing / pricing but also directly to the primary insurers original business.

Appendix B Raw Survey Data

http://www.actuaries.org.uk/practice-areas/pages/international-pricing-research-working-party

Appendix C Additional COPE Details

Figure 33 - COPE: Construction Class Cheat Sheet

Construction Class Cheat Sheet

(Separated by Roof/Floor Material)

Wall Material	Floor/Roof Material	Construction Class	Code
Wood / Combustible	Wood / Combustible[1]	Frame	1
Non-Combustible / Metal	Wood / Combustible[1]	Frame	1
Masonry[2]	Wood / Combustible[1]	Joisted Masonry	2
Modified Fire Resistive	Wood / Combustible[1]	Joisted Masonry	2
Fire Resistive	Wood / Combustible[1]	Joisted Masonry	2

[1] Includes a "Combustible Assembly"

[2] One layer of non-load-bearing bricks covering metal studs is **not** considered a masonry wall; it is a non-combustible wall with a brick facade.

Wall Material	Floor/Roof Material	Construction Class	Code
Wood / Combustible	Non-Combustible / Slow Burning[3]	Frame	1
Non-Combustible / Metal	Non-Combustible / Slow Burning	Non-Combustible	3
Masonry	Non-Combustible / Slow Burning	Masonry Non-Combustible	4
Modified Fire Resistive	Non-Combustible / Slow Burning	Masonry Non-Combustible	4
Fire Resistive	Non-Combustible / Slow Burning	Masonry Non-Combustible	4

[3] This includes Built-Up Tar and Gravel Roof

Wall Material	Floor/Roof Material	Construction Class	Code
Wood / Combustible	Concrete, Modified Fire Resistive or Fire Resistive	Frame	1
Non-Combustible / Metal	Concrete, Modified Fire Resistive or Fire Resistive	Non-Combustible	3
Masonry[4]	Concrete, Modified Fire Resistive or Fire Resistive	Modified Fire Resistive	5
Masonry[5]	Concrete or Fire Resistive	Fire Resistive	6
Modified Fire Resistive	Concrete, Modified Fire Resistive or Fire Resistive	Modified Fire Resistive	5
Fire Resistive[6]	Modified Fire Resistive	Modified Fire Resistive	5
Fire Resistive[6]	Concrete or Fire Resistive	Fire Resistive	6

[4] If the masonry does not meet the requirements of footnote "4" but is at least 4 inches thick, then the structure is classed as modified fire resistive.

[5] To qualify, the wall must be either: 1) **solid** masonry at least 4" thick; 2) hollow masonry at least 12" thick; or 3) hollow masonry between 8" and 12" think with a listed fire resistance rating of at least 2 hours.

[6] "Fire Resistive" is defined as a non-combustible material or assemblies with a fire resistance rating of at least 2 hours. Can be accomplished based on the material or by the application of a sprayed on cementitious mixture covering all exposed metal. If between 1 and 2 hours fire resistance rating, the member is considered "modified fire resistive."

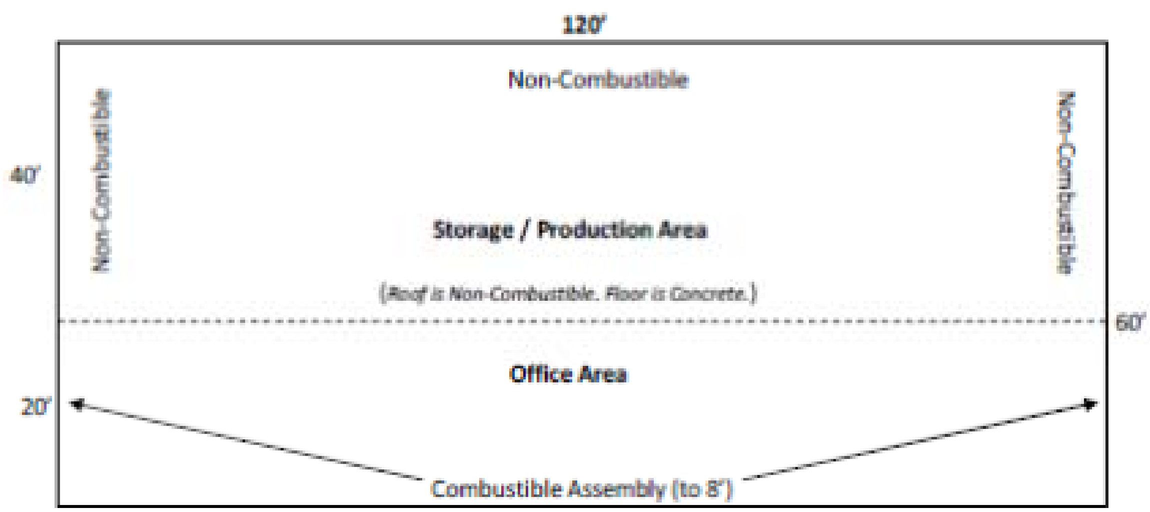
Figure 34 - COPE: Mixed Construction Examples – Example 1

Mixed Construction Examples

Example 1: Different Wall Materials

This building is located in an industrial park. This is a one story building measuring 120 feet by 60 feet with a wall height of 10 feet. The front of the building has been converted into office space and the rear is for storage and minor production. When originally built, the walls and roof were all metal siding on metal studs with approved "slow-burning" insulation on the interior of the walls qualifying the building as a construction class "3" structure. Upon moving in, the tenant and landlord installed a dividing wall between the intended office area and the warehouse/production area. Wood paneling was attached to the metal studs in the office area to a height of 8 feet and a drop-panel ceiling installed. The office area is 20 x 110. Does the creation of a frame assembly change the construction class of this building?

Total Exterior Wall Area (360' perimeter x 10 feet tall)	3,600 square feet
Combustible Assembly Wall Area (160' exterior perimeter x 8 feet high)	1,280 square feet (35.6%)
Non-Combustible Wall Area (160 ' exterior perimeter x 2 feet high) + (200 exterior perimeter x 10 feet high)	2,320 square feet (64.4%)



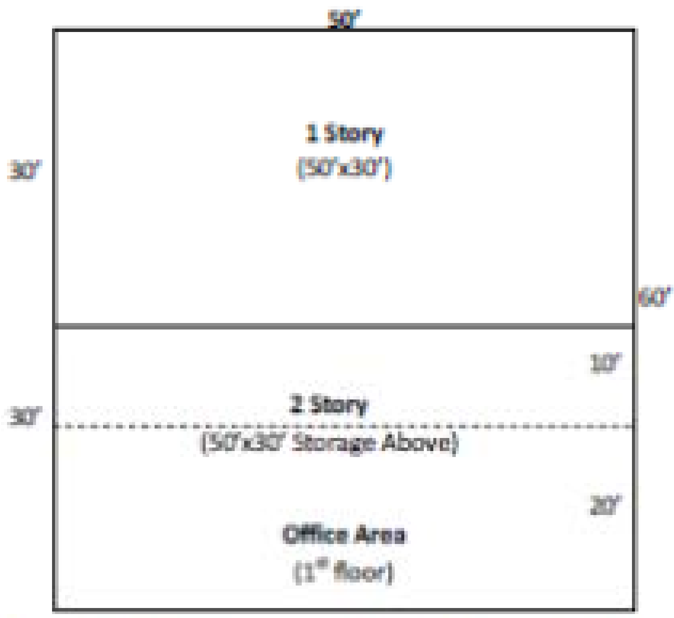
Because the combustible assembly makes up more than 33 1/3% of the total wall area, this building must be rated as a **construction class "1"** rather than the "3" it would have earned otherwise. Had the tenant used drywall rather than wood, the building could have maintained its class "3" construction rating.

Figure 35 - COPE: Mixed Construction Examples – Example 2

Example 2: Differing Floor and Roof Materials

This structure was originally constructed as a one story, 3000 square foot (50' x 60') structure with 12 inch masonry walls and a non-combustible, built-up tar and gravel roof and a wall height of 20 feet. The building/business owner, due to the need for more storage area, added a 50' x 30' mezzanine storage area over the front office area and extending into part of the work area. The storage area is ¾ inch plywood on top of metal joists – a combustible assembly. Prior to this addition, the building was rated as masonry non-combustible (construction class "4"). How does this addition affect the building's construction class? The answer is based on the combination of the floor and roof area since the exterior walls are all of the same masonry material.

Total Floor and Roof Area (50' x 60')+(50' x 30')	4,500 square feet
Combustible Floor Area (50' x 30')	1,500 square feet (33.33%)
Non-Combustible Roof Area (50' x 60')	3,000 square feet (66.67%)



In this building, the construction class does not change. The reason: the superior non-combustible construction accounts for 66.67% of the combined roof and floor area. Thus the structure <u>**retains its construction class "4" rating**</u>. Had the second floor, combustible-assembly storage area been a greater percentage of the combined roof and floor area, the structure's construction classification would have to be changed to "2." Insureds must be careful when making any additions.