An Integrated Approach to the Design of a Reinsurer's Data Architecture

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Abstract

A reinsurer's internal database can be a valuable source of data that has the potential of providing a competitive advantage. This data can be used to refine pricing, business steering, contract design, new product development, planning, reserving, capital utilization and much more. To maximize the value of this internal database, it is important that the data be aligned, complete, and as granular as possible. This paper presents some of the significant uses of internal data, describes some of the most common challenges and discusses elements of an ideal database. The paper ends with a detailed discussion on line of business structure and describes an ideal way of allocating data elements to a more granular unit with particular application to IBNR allocation to contract.

Keywords: Reinsurance Data, Reinsurance Information Management, IBNR allocation, Reinsurance line of business

1. INTRODUCTION

Insurers and reinsurers have long been aware of the value of data. Access to ISO and NCCI data has enabled US insurers to build sophisticated data driven models. Even more valuable than public data is proprietary data that is not available to competitors. Access to proprietary data can give an insurer a significant competitive advantage in its development of pricing parameters. The internal data can also provide an insurer with a deeper understanding of the accuracy of their pricing as well as a more detailed understanding of their own book of business. For example, a reinsurer can gain insight into the following questions:

> What were the profitability relativities of the various sub-segments of the book of business? Were large accounts or small accounts more profitable? Supported umbrella or unsupported? What were the relativities between new business and renewal business? The answers to these and many other similar questions can help a reinsurer steer its business to greater profits.
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> How accurate were the reinsurer's estimate of the pricing components such as frequency, severity, rate level, development patterns, and so on? Even if the loss ratio estimates were accurate, a better understanding of the components can help a reinsurer fine tune its pricing and develop a more profitable book. It can also improve the reinsurer's ability to help their clients.

These and many more examples are discussed in detail in Section 2.

The proprietary data is generated during the many processes that make up the life cycle of an insurance or reinsurance contract. One normal path for the data flow of a reinsurer is that it begins with pricing where the goal is to analyze the risk and develop pricing estimates. It then continues with the underwriting and contract process where the goal is to negotiate, determine, and bind the terms of coverage. This part of the process is sometimes referred to as the administration process.

Once the contract incepts, the data flow continues with the accounting and claims functions where cedant data is entered. The data entered during this process is sometimes referred to as the booking data. Generally the data life cycle ends with finance where additional estimates are entered and the company's financials are produced.

While the main focus at each step is to satisfy the narrow requirements of the function entering the data, the value of the proprietary database is maximized when contract data can be tracked through the whole data life cycle. The technical IT capabilities exist, but the challenge is to develop a robust data architecture and implement the database protocols to support it. The impetus to accomplish this will come from those with the vision that this data can catapult internal profitability analyses to a new dimension. There is no professional in an insurance company better suited than the actuary to combine the business vision with the technical capabilities required to execute, especially in North America.

This paper explores

1) Specific ways in which a reinsurer can use their internal data to improve their competitive position
2) Some common issues that inhibit the use of a reinsurer's internal database
3) Some basic concepts underlying the ideal design of a reinsurer's database that will allow the reinsurer to maximize its ability of using it as a competitive tool.

The paper concludes with an in-depth discussion of the line of business attribute as well as an allocation approach applied to IBNR.

2. DATA USAGE

2.1 Internal Data Used to Improve Pricing and Business Steering

2.1.1 Actual versus Expected (AvE) Analysis. This is critical in the effort to validate or fine-tune pricing assumptions. The most elementary application is a comparison of actual loss ratio and pricing expected loss ratio. AvE can be expanded to validate assumptions on: frequency, severity, paid and incurred patterns, cause of loss, probability of multi claimant occurrences, primary ELR, primary rate levels, loss trends, et cetera. A sophisticated AvE analysis will separate the catastrophe from the non-catastrophe exposures and allow analysis of the contract at coverage level.

2.1.2 Development of Pricing Parameters. Assumptions on pricing parameters such as expected loss ratios, loss development patterns, frequency and severity assumptions, trend factors, size of loss distributions are essential to any sophisticated pricing analysis. Generally, most of these assumptions are developed from industry data. This data is broadly available and, therefore, may not provide any competitive advantage. Any ability to supplement the industry data with internal data creates the opportunity to gain a competitive advantage. Internal data can be even more valuable in cases where little or no industry data exists. For specially designed reinsurance covers such as clash covers, do we

know their historic experience? Can we distinguish between the loss experience of separate components of clash covers such as runaway allocated loss adjustment expense (ALAE), multi-line accumulation, multi-insured accumulation, extra contractual obligations (ECO) and excess of policy limits (XPL)?

2.1.3 Business Steering. What are the profitability relativities of large clients versus small clients, new reinsurance contracts versus renewals, mature primary books of business versus new ventures, broad multi-line reinsurance contracts versus very specifically defined covers? Similarly what are the profitability relativities of single state versus multi-state WC reinsurance covers, reinsurance covers on admitted carriers versus excess and surplus lines carriers, claims made versus occurrence medical reinsurance covers, and small law firms versus large law firms liability policies? How do supported versus unsupported umbrella reinsurance covers compare? How about primary versus excess umbrella? What are the separate loss rates for the auto versus general liability exposure of umbrella covers? Can we separate the catastrophe versus non-catastrophe components when calculating profitability? These are just examples of the many questions that one can ask when deciding on a strategy of choosing what business to reinsure.

2.1.4 Contract Features. Many contract features have an economic impact on the contract profitability that is at best estimated and frequently totally ignored. One such example is the cost of covering ECO and XPL. Another example is a treaty clause that gives a cedant choosing to non-renew a treaty, the option to cancel on a run-off basis or a cut-off basis. There is little or no industry data that can be used to quantify the impact of many standard (and non-standard) contract terms. Properly coded internal data can provide the required data.

2.1.5 Renewal Analysis. At the annual renewal of a treaty, we perform the standard experience and exposure rating to arrive at a quote. If this treaty has been written for several years, we can examine how well these pricing methods have predicted ultimate treaty results in prior years. Consistent biases may indicate something is not adequately considered in the pricing. An analysis of the complete profitability of the relationship with the client is also important. This is especially true when making a difficult decision on a particular renewal.

2.1.6 New Product Development and Client Services. Detailed data on the cause and consequence of loss, industry segment, subline, et cetera can help a reinsurer develop and price profitable new products. Alternatively, these insights can be shared with clients to help them become more profitable. The ability of a reinsurer to use their own data to help clients better understand the profit drivers of their business can significantly strengthen the value added by the reinsurance relationship.

2.2 Internal Data Used to Improve Internal Processes

2.2.1 Pricing Reserving Linkage. The expected loss ratio, premium earnings pattern and expected incurred and paid loss lag patterns of the contract are important feeds from Pricing to Reserving. In

addition, Pricing's most recent view of past years' results can be important input into the IBNR calculation.

2.2.2 Recalculation of the Reinsurance Layer Expected Loss Ratio (ELR) At the time of pricing, the reinsurer makes assumptions on the primary ELR, primary rate changes, underlying claim frequency, loss trend, et cetera. Many of these assumptions are known with much greater certainty a year or two after contract inception. Yet for non-proportional covers, losses are still mostly unreported. A properly designed pricing database would allow easy, automatic recalculation of an updated ELR for the reinsurance layer using the more recently known values of these pricing parameters.

2.2.3 Accumulation control. A key part of risk management is tracking a company's loss exposure to a single event. The most obvious example is tracking loss exposure to a natural catastrophe (nat cat) such as a hurricane or an earthquake. Accumulation of loss by nat cat scenario (San Francisco earthquake or Gulf Coast hurricane) from pricing models is a standard feature of most catastrophe modeling tools. Casualty lines of business are also exposed to accumulation of loss from a single event. Examples include asbestos, various pharmaceutical events, and environmental catastrophes. In the absence of detailed data by contract, liability accumulations by insured, product, industry segment, et cetera are a challenge, especially for a large multinational reinsurer.

2.2.4 Asset Liability Matching & Capital management. A key requirement of both enterprise risk management and sophisticated investment management is an understanding of the probability distribution of future cash flows. Most specifically both the mean and variance of the duration of liabilities need to be estimated. Automated data feeds from the pricing database to the reserving database and from there to the enterprise risk model support this process.

2.2.5 Planning. Each year, reinsurers develop a plan detailing the expected premium, loss ratio and profit by line of business expected in the following year. A sophisticated planning process generally starts with individual planning of all large contracts. An automated feed of premium, expected loss ratio, expected cash flows and expected profitability for in-force contracts by line of business enables efficient planning down to contract level.

2.2.6 Legal Entity Data. Legal entity data is required, at a minimum for regulatory purposes. This data may also be required for tax purposes and for rating agencies. For a large global group with many legal entities (in some cases hundreds of legal entities) it is not a trivial task to ensure accurate legal entity data. A properly constructed and maintained database can simplify this process.

3. DATA ISSUES

Some of the main difficulties encountered in the goal of building an ideal internal database are discussed below.

3.1 Data Completeness

It is important to ensure that the many valuable data elements that are calculated during the pricing process or during the claims management process are stored in a database. These include

3.1.1 Expected Loss Ratio. The individual contract pricing expected loss ratio needs to be captured and transferred to reserving to serve as an a priori loss ratio.

3.1.2 Pricing Loss Lag Patterns. Portfolio patterns are generally available from reserving. However, these are historic patterns reflecting historic business mix, attachment points, et cetera. Pricing patterns reflect changes in business mix, attachment points, et cetera At a minimum these can be aggregated to serve as a check on the reserving patterns. Ideally, the individual account patterns can be used to more accurately allocate IBNR to individual accounts and to measure profitability by account.

3.1.3 Subject Premium. The reinsurer will always record the reinsurance premium. For conducting rate level and trend analyses, the reinsurance premium alone may be insufficient. The reinsurer should strive to record the underlying exposure. For example, for personal motor it would be vehicle count. For commercial motor it might be miles driven or number of power units. For hospital liability it might be number of beds. This would enable the reinsurer to track excess loss costs and excess frequency relative to an absolute exposure base that is not affected by the insurance cycle. If that is not available, then the subject premium (or equivalently the reinsurance rate) should be recorded. This, at least removes the effect of the reinsurance cycle on the exposure base.

3.1.4 Detailed Pricing Data for Advanced Applications. This includes frequency and severity expectations as well as exposure and experience rating details. For example, tracking the expected loss estimates developed from the exposure rating and experience rating of each account and comparing each of these estimates to the actual developed ultimate loss can provide feedback on how well each of these pricing approaches is performing. Capturing the expected primary loss ratio enables a straightforward update to the pricing a priori loss ratio as primary loss ratios become known.

3.1.5 Ground up Loss. When a reinsurance agreement covers an excess contract, the ground up loss needs to be recorded. For example, a reinsurance agreement covers 80% of a $4 million xs $1 million layer on a primary policy. This primary policy is excess of a $10 million lower layer covered by a different primary insurer. There is a ground up $15 million loss. The first $10 million is covered by the first primary policy. The second primary policy records a $5 million gross loss. It keeps the first $1 million and cedes 80% of the next $4 million to the reinsurer. The ground up loss reported by the second primary insurer to the reinsurer may be defined as $5 million. However, to develop accurate size of loss distributions we would need the full $15 million loss.

3.1.6 Other Claim Data. Without belaboring the point, cause of loss, consequence of loss, ECO/XPL claims, et cetera need to be recorded in order to enable sophisticated analyses. Events

with multiple claimants need to be identified and the claim data split by claimant. Claims that exceed the reinsurer's layer need to be identified and where possible, the full market loss should be recorded.

3.2 Data Alignment

3.2.1 Contract ID. It is essential to have the ability to track the contract (or contract segment) from pricing database to underwriting and contract database to accounting and claims database to Finance database. If different contract IDs are used in pricing and in the underwriting systems it can make it difficult, if not impossible, to compare actual experience versus expected.

3.2.2 Line of Business. Many reinsurance contracts provide coverage for more than one line of business. For example, a casualty excess treaty may provide coverage for general liability, umbrella, motor and workers compensation. We need to ensure that for each contract the premium and loss allocations to line of business are consistent in each of the applications. The following are some examples where an issue may arise. A homeowners quota share may be booked by accounting as 100% property or while in pricing it was split between property and liability. The property portion itself may be booked by accounting as 100% fire while in pricing it was split between fire and hurricane. Database protocols need to be established to ensure that all contracts are recorded consistently.

3.2.3 Data Corrections

When data is passed from one application to another, a misalignment may occur when data is corrected in the original application. Frequently the interface between the two applications occurs only once and the corrected data is not sent to the receiving application. Database protocols need to be established to handle such cases.

3.2.4 Other examples of data alignment challenges

Cedant must be entered identically in all applications. While this may appear trivial, it is not. Even small differences in the spelling of a cedant may make it difficult to combine data by cedant. As we discuss later, selecting the cedant from a drop down menu is an ideal way of solving this issue.

A quota share reinsurance cover on a primary excess contract can be called proportional, following the reinsurance structure, or excess based on its absolute structure. Clear database protocols need to be in place to ensure that a quota share reinsurance cover on a primary excess contract is adequately and consistently encoded in all systems.

A no-claims bonus can be considered commission (an expense) or negative premium. Again a clear set of guidelines is necessary.

A reinsurance contract may be written to provide coverage on a losses occurring basis. In this case, there is a premium portfolio transfer to the reinsurer representing the reinsurer's portion of the primary insurer's unearned premium reserve at the inception of the reinsurance contract. In addition there will be quarterly installments paid to the reinsurer representing the reinsurer's portion of the

primary insurer's premium incepting during the term of the reinsurance contract. If the reinsurance contract includes a commission paid by the reinsurer to the primary insurer, practices can differ whether to book the portfolio premium net of commission or gross of commission. Clear database protocols need to be in place to guarantee clarity and consistency.

As part of pricing, a contract specific loss payment pattern may be derived from the cedant's submission. In such cases, it is then necessary that this contract specific pattern be used for the contract profitability calculation in the profitability evaluation systems.

3.3 Data Granularity

3.3.1 Granularity. It is important that data be entered in the most granular form possible. For example, premium and loss on a treaty covering medical malpractice should be entered as medical malpractice and not to the more general professional liability. This level of granularity is necessary to enable a reinsurer to monitor the profitability of its medical malpractice business.

3.3.2 Multiline Contracts. It is important that data be separately entered for each line of a multiline contract. For example, property treaty data should be entered separately for fire and for nat cat and not entered as 100% fire. An auto quota share treaty that covers both auto liability as well as auto physical damage should be split to show premium and loss separately for liability and physical damage and not entered as 100% auto liability.

These line of business issues will be discussed in greater detail in Section 6.

3.4 Allocations

Probably the most important allocation to individual contract is IBNR. Since in most cases, IBNR is calculated at the portfolio level, it is necessary to allocate IBNR to contract in order to evaluate contract profitability. A simplistic allocation methodology may cause serious data quality issues with account profitability data.

Internal expenses, capital charges and taxes all need to be allocated if full profitability data at the contract level is desired. Again, care is necessary in developing the allocation methodology.

In section 7, this paper presents an allocation methodology that will generally produce reasonable results.

3.5 Data Inconsistency

Two examples of situations where different systems may calculate the same thing in different ways are the currency conversion routine and the discounting methodology. It is important that a uniform methodology should be used in all applications.

4. BASIC PRINCIPLES

4.1 Consistent and Aligned Contract Identification and Structure

4.1.1 A Single Internal and Universally Used Contract ID. An internal contract ID should be created for each contract and used throughout the life cycle of the contract, from submission through pricing, underwriting, accounting, claims, and finance. This ID should be contained on each record of every contract. It may be necessary to have multiple contract IDs, especially when using external vendor applications. For example, a reinsurer may use externally provided software for its premium and loss accounting or for its contact administration. These may have protocols regarding contract ID that are not consistent with the internal ID. This is acceptable. These external contract IDs, however, need to be linked to the internal contract ID and at least in the internal databases, the internal contract ID should appear on every record as well.

4.1.2 A Single Contract Structure. A single consistent contract structure should be used throughout the life cycle of the contract. This includes a consistent line of business structure, type of business (proportional versus non-proportional) structure, et cetera.

4.2 Full Income Statement at Granular Level.

Assume for example that the lowest granular level of data is line of business/underwriting year/contract. Call this the contract unit. All elements of the income statement should be calculated or allocated down to the contract unit. This includes all premium, commission and loss (including IBNR). It also includes internal expenses, capital charges and taxes. This would be done on both a nominal and discounted basis.

If all income statement components are pushed down to contract unit level, it will be possible to develop full profitability analyses on any dimension. In particular the data will be available to answer the questions raised in section 2.1.3.

4.3 Data Consistency

4.3.1 Consistent (unique) Definition and Rules for Each Variable. Each variable should be clearly defined with a unique meaning and set of rules. Examples of data elements that require special attention were discussed in Section 3.

4.3.2 Consistent Protocols for Each Calculation.

The protocols for currency conversion and investment income calculation can be very complex. Should a single point conversion be used or should a dynamic conversion routine be used? When using a dynamic conversion routine what dates should be used for estimates? In either case, should the rates be daily, monthly, or quarterly? Should they be end of period or mid-point?

4.4 Industry Standards

An industry data standard would help to align the consistency of submission, contract and financial data and to enhance the data quality end to end. Many of the issues discussed throughout this paper, could be more easily resolved if there was an accepted industry data standard. An industry data standard is currently not available.

5. IMPLEMENTATION

5.1 Corporate Culture Supporting Quality Internal Data

A high quality integrated internal database requires a corporate commitment to invest the necessary funding and resources. This is especially true for a large multi-national reinsurer. Local practices that differ by region may need to be consolidated. Practices that favor a narrow departmental view may need to be replaced by practices that support the broader corporate benefit. Specific resources dedicated to data quality management and review may need to be created.

5.1.1 Communicating and Marketing the Value of Data. Employees across the company need to understand that the data they enter is crucial to the continuing success of the corporation. Senior executives should stress that the internal data is a key component of competitive advantage. Executives should periodically publish actual examples of how data was used to generate profitable business. Occasional awards to employees responsible for significant improvements in data value should be given. These types of recognition will motivate employees towards high standards of data quality. Management support of data quality initiatives is critical to validate the necessary costs.

5.1.2 Responsibility for Data Quality. If data is really viewed as a source of value then responsibility for data entry needs to be assigned with the goal of assuring a high level of data quality. If responsibility for data entry stops at a junior level, it is not likely that the highest standards of data quality will be achieved. When a reinsurance agreement is consummated and the contract is entered into the reinsurer's database, a senior member of the deal team should sign off on the coding.

5.2 Centralized Data Functions

An integrated database requires some degree of central oversight. One way of accomplishing this is a small specialized central data unit under the guidance of a data management board that represents the various corporate functions and business units. This board will make the tough decisions on tradeoff between cost and granularity.

5.2.1 Single Uniform Definition of all Data Elements. A data dictionary needs to be established that is used throughout the company. It needs to be mandatory that all systems utilize the data dictionary. This includes the definition of each data field and all allowable values. For example, the field "Type of Business" will mean the same thing and have the same allowable values in each system. If there is a need for multiple versions of a data element, separate names must be used and

each version must be clearly defined. For example, the original pricing expected loss ratio for a contract may be modified to reflect information received after contract inception. This modified expected loss ratio is used by reserving as the contract a-priori loss ratio. These two expected loss ratios need to separate names and definitions. Education and training, including online easily available reference material, needs to be available.

5.2.2 Single Set of Booking Rules. Similarly, a single set of rules needs to be promulgated to define how contract data is to be recorded. Specifically, rules need to clearly define how to deal with multi-year contracts, nat cat exposure on homeowners contracts, proportional shares of excess contracts, and no claims bonuses, et cetera.

5.2.3 Data Quality Reviews. Peter Drucker famously said, "What gets measured gets improved." A common finding in the data quality area is that any field that is not used or reviewed can be expected to have very low data quality. A detailed discussion of data reviews is beyond the scope of this paper. The following describe major components of a data quality review.

Data Validity – Data fields are tested to ensure that they contain only valid data. For example, a numeric field whose values should be between 0 and 1 can be checked to verify that all entered data is between 0 and 1. A field containing a code can be checked to verify that the entered code is valid. Ideally, data should be automatically verified at time of entry. A data quality review would check fields that are not automatically verified.

Data Reasonability – Data fields are tested to ensure they contain reasonable values. For example, an expected paid loss lag pattern for a reinsurance contract is designed to display the cumulative percentage of ultimate loss that is expected to be paid at each yearend following the contract inception. Values that do not appear reasonable can be identified either by comparing them against a predetermined reasonable range or by testing for outliers. Values that fail the reasonability check are not necessarily invalid. There may be a reason why the data for a particular contract behaves differently than expected. These values are candidates for further investigation.

Data Alignment – Data accessed from different sources that are expected to be similar can be compared. For example, the expected premium by line of business within contract can be compared to the actual accounted premium by line of business within contract. Large differences are candidates for further investigation. This example will be covered in great detail in section 6.

Data Accuracy – Data is manually compared to source documents. This is standard data auditing.

5.3 Technical Standards

5.3.1 Header records. At the first entry of a contract into company systems (usually this will occur when the submission is received), a header record should be created. This record will contain basic

information about the contract, most importantly an internal contract ID. This header record will be contained within all systems containing contract data. It will be part of any record where data is transmitted from one system to another.

5.3.2 Single internal contract ID. This single internal contract ID from the header record is critical to ensure that all contract information can be tracked and combined. Especially when some of the systems are external, a unique contract ID cannot be ensured. Some systems may require a purely numeric contact ID while others will have alphanumeric components. The header internal contract ID will always be the same and this allows each system to define, if necessary, a second contract ID according to its unique internal system requirements without compromising the ability to match contract data in different systems.

5.3.3 Drop down menus. Wherever possible, data entry should be from a drop down menu rather than entered directly. For example, a cedant company name could be directly entered. However, this will likely lead to multiple versions of the name. An ideal way to ensure that the cedant company name will always appear identically the same, is to force that data element to be selected from a drop down menu.

5.3.4 Single Data Warehouse. Ideally all contract information should be stored in a single data warehouse. This should include data from submission, pricing, underwriting and contract, accounting and claims, IBNR, and finance.

5.3.5 Golden copy. Original data is often fed into downstream systems and from there it may be fed further downstream. Each data transfer carries with it the risk of data modification. There may be criteria that restrict full data transfer. For example, non-traditional transactions or intra group retrocessions may be excluded. In other cases, data may be modified by currency conversions, line of business mappings, et cetera. Within the data warehouse, each data element should have a "golden copy." This is the original and most accurate source for that data element. For example, the pricing expected loss ratio "golden copy" is the one that comes directly from pricing.

A more ideal solution may that each data element is only stored in one place. All reporting is handled by dynamically linked tables and queries. This may be more easily accomplished in universe-based data environment.

5.3.6 Mapping matrix. In some instances, it may not be possible for the coding in two systems to be identical. This is not a desirable situation and it violates the ideals described in this paper. It may, however, not be economically viable to correct the situation. In such cases, it is important to create a mapping matrix that shows how to map from one structure to the other.

5.3.7 Data Extraction and Report Generation. Data necessary for an analysis may need to be drawn from several data sources, each with a different reporting tool. This can be a daunting task for many potential users who are not expert on each data source and reporting tool. Databases and reporting tools should be designed to make data accessible to all users. Wherever possible, screens

should be standardized across reporting tools. An online facility should be available to help users find the data they need.

6. DETAILED DISCUSSION OF LINE OF BUSINESS (LOB) ISSUES

6.1 LoB Structure - Line of business is a complicated combination of different characteristics. The lines of business in the US NAIC Annual Statement include: peril (fire, earthquake), industry segment (farmowners, homeowners), coverage (occurrence versus claims made), object insured (airplane in aircraft coverage, ship in ocean marine coverage, automobile in auto physical damage coverage), et cetera. The lines of business used by many reinsurers are even more complex. For example, umbrella and clash are really coverage combinations of underlying lines.

The LoB attribute may have special importance to a reinsurer since this may be the most granular level for the accounting of a reinsurance contract. For example, a single reinsurance treaty may cover many primary segments of business. In addition to the segments mentioned above, these may include personal and commercial segments, different classes of business such as lawyers liability and accountants liability, and so on. On a reinsurer's books, the premium and loss for the treaty may only be split into lines of business.

Ideally, the LoB attribute would be split into at least these four attributes: industry segment, object insured, coverage and peril. Such a split allows for a much richer data structure. This may be difficult to implement because of cost considerations and because of culture shock. If this split Lob structure cannot be implemented, the following issues need to be considered.

6.1.1 Nat Cat Exposure on Other Lines of Business. Property nat cat is generally a subline of property. However, many other lines, including workers compensation, motor, marine, and aviation are also exposed to nat cat events. Let us take motor as an example. Unless we duplicate the nat cat structure into motor, we are faced with the choice of either coding the exposure to nat cat (in which case it will be considered property business and not motor) or to motor (in which case we will not be able to identify it as nat cat). Either way, how does a reinsurer track its nat cat experience on motor business?

One possible solution is to utilize the pricing nat cat component of the pricing expected loss ratio. This can be applied to the earned premium to obtain an estimate of the portion of the earned premium covering the nat cat exposure. The nat cat losses can be identified by the cause of loss code. This approach provides a breakdown of the premium and loss into cat and noncat. This approach requires a high quality alignment between the pricing ELR data and the premium and loss database, good data quality for the cause of loss data, and the ability to insert this data into the standard corporate profitability reports.

6.1.2 Personal versus Commercial. This is very similar to the above situation. Unless we duplicate lines of business we may not be able to distinguish between personal and commercial experience.

Examples are: nat cat on commercial property vs homeowners and auto assigned risk on commercial vs personal auto.

6.1.3 Coverage. Most frequent example is claims made vs occurrence. If a treaty covers both, how do we separately code the premium and loss?

6.2 LoB Alignment. For a multiline treaty, a line of business structure needs to be defined and the premium and loss need to be allocated to the lines of business. In some cases, the submission data used for pricing and the accounting data are provided on a consistent basis and the coding is straightforward. In other cases the data is not provided on a consistent basis and the coding can be challenging. For the reasons discussed in section 2, it is important that the structure and allocation be identical (or at the very minimum aligned) throughout the life cycle of the contract.

The following outlines a process to achieve this goal.

6.2.1 The LoB Structure Available for Coding is Identical in All Systems. This includes pricing, underwriting, accounting and finance. While this may sound obvious, this is not always the case.

6.2.2 The LoB Structure is Set During the Pricing Analysis. This structure will be based on the submission data and the expected accounting data. The pricing premium for each LoB of a multi-line treaty with a single indivisible premium rate will be calculated in a way that expected profitability is equal among the LoBs.

6.2.3 The Pricing LoB Structure and Premium Allocation is Fed into the Underwriting Systems. The underwriter has the ability to adjust the pricing structure and allocation but they must be aligned.

6.2.4 Aligning the Pricing and Reporting LoB Structure. The case of a non-proportional treaty with a single non-divisible rate against subject premium is discussed first. Losses are individually reported with full detail.

6.2.4.1 Submission Information is More Granular than the Accounting Information. A reinsurance professional liability treaty covering lawyers liability and accountants liability, will be used to illustrate the issues. Assume the submission provided detailed experience. Separate loss models were developed for the lawyers liability business and the accountants liability business. These loss models were combined and a single rate was quoted to the cedant for their professional liability subject premium. In the pricing database, based on the individual loss models, the reinsurance premium was allocated to the two sublines in a manner that made them equally profitable. The accounting data is reported with losses separately coded to lawyers liability and accountants liability but with a single premium for professional liability.

One alternative to alignment is to separately code each of the pricing and accounting data to the maximum granularity available. In the above example, the pricing data is separately coded to accountants liability and lawyers liability while the accounting data is coded separately for the loss data but the premium data is combined. Theoretically, the pricing data can then be used to separate

the aggregate professional liability premium into the sublines. This will allow profitability analyses, AvE analyses, recalculation of APLR for reserving, et cetera by subline. In practice, this approach has the following two disadvantages.

This additional step will need to be performed at the contract level for each separate analysis of lawyers liability versus accountants liability, thus creating an inefficiency.

Many standard reports will not include this extra step and will thus provide incomplete data.

The preferred approach is that at the time the individual accounting records are entered, the premium is separately coded to the two sublines according to the percentages coming from the pricing analysis. Since the individually accounted losses will have detailed coding from the cedant, the losses will be accurately recorded by subline. This data will now flow into all the standard corporate reports and allow for automated reporting of detailed profitability data by professional liability subline.

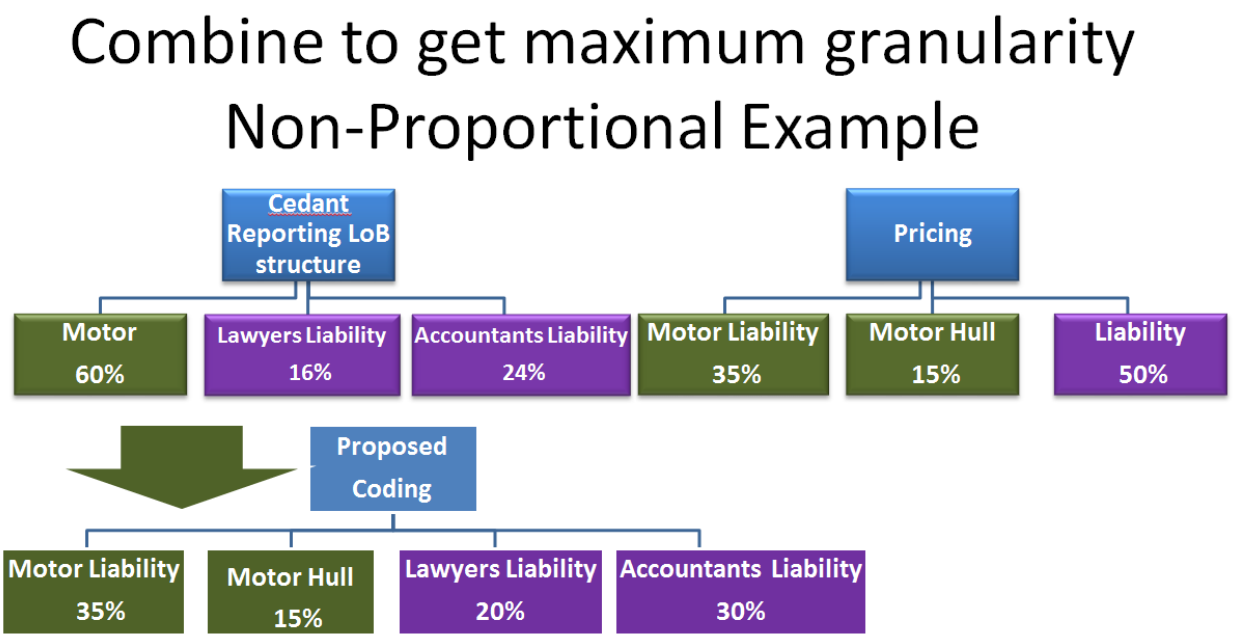
Please note that in this case even if the cedant reported a premium split between lawyers and accountants based on primary exposure that was different than the pricing percentages it is likely that the pricing percentages should be used. The reason is that the pricing allocations estimate exposure at the excess layer covered by the treaty. Primary premium distribution may not be the best indicator of how to distribute the excess premium.

6.2.4.2 More Complex Example. The following chart illustrates a more complex example. Here, the treaty covers multiple line of business. In some cases, the pricing information is more granular and in some cases the cedant reports are more granular. The proposal below, is an effort to maximize data granularity.

In this example we accept from pricing that the treaty is 50% liability and 50% motor and that the motor premium is split 70% liability and 30% hull. We accept from cedant reporting that the liability premium is split 40% lawyers and 60% accountants.

Combining all this we get the following distribution:

Reporting LoBs	**LoB %**	Calculation
motor liability	**35%**	.70 X .50
motor hull	**15%**	.30 X .50
lawyers liability	**20%**	.40 X .50
accountants liability	**30%**	.60 X .50



The mapping matrix referred to in section 5.2.7 for this example is shown below.

		Pricing LoBs		
		Motor Liability 35%	**Motor Hull 15%**	**Liability 50%**
Reporting LoBs	**LoB %**			
motor liability	**35%**	**100%**		
motor hull	**15%**		**100%**	
lawyers liability	**20%**			**40%**
accountants liability	**30%**			**60%**

6.2.4.3 Proportional Example. The proportional treaty case is generally treated the same way with two important differences:

If the cedant data differs in the allocation percentages from the original pricing expectation, then we will accept the cedant percentages. The reason for this difference is that in the proportional case the different allocation percentages are assumed to be caused by a shift in the underlying exposure. Please note that in the non-proportional case, we can also take into account shifts in underlying exposure. But, in order to do so we need to store deeper pricing information. In addition to the expected pricing premium by line, we need to store expected underlying cedant exposure and excess intensities by line. This would represent a nice additional sophistication.

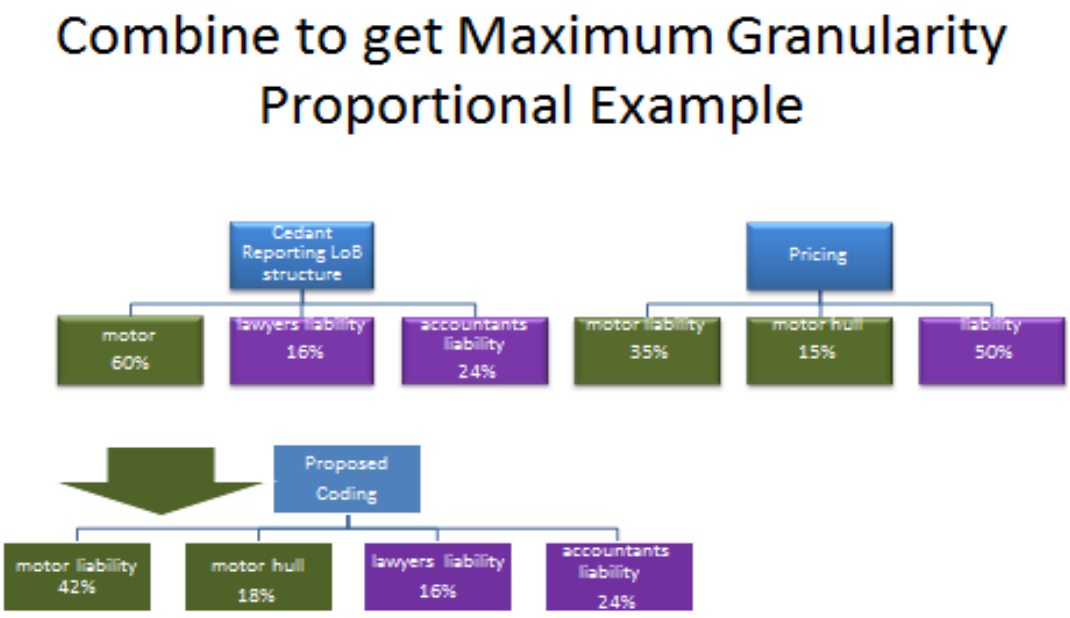
A second difference, is that since losses are generally not reported individually, then it is necessary to allocate the losses to line of business as well. The pricing percentages for loss by line of business would be used the same way they are used for premium. Please note, that the pricing percentages for loss can be different than for premium. The reason for this is that the pricing may have different expected loss ratios by line.

In this example we accept from cedant reporting that the treaty is 40% liability and 60% motor and that the liability premium is split 40% lawyers and 60% accountants. We accept from pricing that the motor premium is split 70% motor liability and 30% motor hull.

Combining all this we get the following distribution:

Reporting LoBs	LoB %	Calculation
motor liability	**42%**	.70 X .60
motor hull	**18%**	.30 X .60
lawyers liability	**16%**	.40 X .40
accountants liability	**24%**	.60 X .40

The chart for the proportional case would be as follows.



7. IBNR ALLOCATION AND OTHER ALLOCATIONS

7.1 IBNR Allocation

Many data items need to be allocated from an aggregated level to a more granular level. Examples may include: IBNR, internal expenses, capital or capital charges, taxes, et cetera. Generally speaking, the preferred approach is to calculate each of these bottom up using the individual contract features and then "truing – up" the bottom up results to match the corporate figures. In this section, this approach is applied to the allocation of IBNR from the portfolio level to the individual contract level.

IBNR is normally calculated at portfolio levels using aggregated data. But since reinsurers need to understand the profitability of historic results by client and even contract, IBNR calculated at the portfolio level is allocated to individual contract. Since the profitability of business at the client and contract level is a critical component of business decisions, care needs to be taken to allocate using the best possible estimate.

One way to improve the reasonableness of any allocation methodology is to calculate the values at the granular level using all available information and then make only relatively small adjustments to ensure that the aggregation of the bottom up numbers match the calculated numbers at the portfolio level. Ideally, the granular level calculation would take into account type and age of claim, would incorporate a methodology based on claim counts as well as claim amounts, would distinguish between paid loss and loss reserves, would separately calculate incurred but not enough reported (IBNER) and pure IBNR, et cetera. This sophisticated approach may be too complex and difficult to implement. The following simpler and more practical approach is suggested.

The following data is necessary by line of business within contract:

Earned premium (EP) (from financial systems)

Expected loss ratio (ELR) (from pricng)

Expected loss reporting pattern (LAG_t) (from pricing). This will be displayed as a cumulative percentage of expected reported loss at time t.

The initial bottom-up contract Bornhuetter-Fergusson IBNR is given by the following formula

$$\text{Initial IBNR}_t = \text{EP X ELR X } (1 - \text{LAG}_t)$$

This IBNR is aggregated over all contracts and compared to the calculated IBNR at the portfolio level. The initial contract IBNR is multiplied by an adjustment factor AF_t to ensure that the sum of the contract IBNR is equal to the portfolio IBNR. So the final contract IBNR at time t is given by

$$\text{IBNR}_t = \text{EP X ELR X } (1 - \text{LAG}_t) \text{ X } AF_t$$

The advantages of this approach are:

The contract IBNR is transparent and easily explainable. The EP is not disputed. the ELR and the lag pattern were agreed to by the deal team at the time the contract was written. The AF adjustment should hopefully be relatively small.

Assuming the AF is close to unity, the majority of the IBNR is determined by the individual contract metrics. So, it has an excellent chance of being a best estimate.

This approach automatically provides an alternate view of the portfolio IBNR. If the AF is small then the bottom up methodology supports the top down result. If the AF is large, it provides a flag to indicate which portfolios might require a more detailed analysis. This alternate approach can be particularly valuable when the portfolio is undergoing change (retentions, limits, underlying business, et cetera).

This approach clearly requires the availability of the contract/LoB ELR and Lag. This in turn requires that the pricing database captures and stores contract/LoB ELRs and Lags. In addition it requires that the pricing database and the accounting database are aligned in terms of contract ID and LoB structure. If this data is available, the approach outlines above is easy to implement and will significantly improve the credibility of the allocated IBNR as compared to an allocation based only on earned premium and incurred loss.

7.2 Expected Emerged Loss

As a byproduct of the above IBNR allocation methodology, the contract/LoB expected emerged $loss_t$ is calculated as

$$\text{expected emerged } loss_t = EP \times ELR \times LAG_t$$

A comparison of expected emerged loss and actual emerged loss can serve as an excellent metric of how a contract is performing. It is especially valuable because it is independent of any portfolio effect or impact of reserving conservatism or lack thereof. It can form the basis of both internal and external discussion without the often emotional arguments surrounding the IBNR. It can also serve as an important feedback to pricing since it uses pricing's own estimates to compare to actual.

7.3 Capital Allocation and Expense Allocation

The concept of allocating capital and expense to granular levels has been extensively discussed in the actuarial literature and a detailed discussion of these allocations is beyond the scope of this paper. However, it deserves noting that the above allocation methodology can also be effectively used for other allocations including expense allocation and capital allocation. The concept is to develop the best possible formula to calculate these items on a contract level given basic contract characteristics such as line of business, type of business, country, premium size, expected loss, number of expected claims, risk metrics such as variability and shortfall, new vs renewal, et cetera. These items are then calculated at the contract level, aggregated to the portfolio level and compared to a portfolio value that was determined previously. The individual contract values are then scaled to assure that the sum of the contract values is equal to the portfolio value.

8. CONCLUSION

Hopefully, this paper will motivate reinsurance actuaries to spearhead an increased realization of the value of a company's internal data and create the desire to develop a data architecture that will enable significantly more sophisticated data analyses. The potential benefit to those leading this effort can be very large. There is nobody better suited to be passionate about this cause than the actuarial community.