FUNDING FOR RETAINED WORKERS' COMPENSATION EXPOSURES

Brian Z. Brown
Michael D. Price

Funding for Retained Workers Compensation Exposures

ABSTRACT

by Brian Z. Brown and Michael D. Price

The self-insured workers' compensation market has grown dramatically over the past five years. An employer faces costs and benefits when evaluating the decision to retain or self-insure part of its workers' compensation.

This paper outlines several methods that can be used to establish funding levels for an entity which retains its workers' compensation exposure. We have included a discussion of methods appropriate to establish the funding level when the potential self-insured maintains an adequate database. In addition, for an employer with more limited data, we present three alternative methods for estimating the required funding level.

We also discuss:

- Benefit and cost considerations involved in self-insuring;
- Regulatory requirements associated with self-insuring; and
- Funding level considerations.

We believe that the concepts outlined in this paper can assist an entity in:

- Structuring a self-insurance program (or deciding whether to self-insure); and
- Funding for a self-insurance program.

Finally, the paper may be helpful to the actuarial or risk management analyst confronted with these issues for the first time.

The authors would like to thank Gary R. Josephson and Robert K. Bender for reading the initial draft of the paper. Their helpful comments and suggestions improved the final version. Additionally, members of the review committee (Steven Visner, Mike Lamb and Lee Smith) provided important guidance. We would also like to thank Rosemary Poeller for her diligence in typing numerous drafts.

FUNDING FOR RETAINED WORKERS' COMPENSATION EXPOSURES

INTRODUCTION

The self-insured workers' compensation market has grown dramatically over the past five years. The following table displays the percentage of the total market that is self-insured by calendar year (based on premiums and premium equivalents).[1)]

Workers' Compensation Percentage of Market Self-Insured[1)]	
Calendar Year	Self-Insured Percentage
1986	20.1%
1987	21.2
1988	22.3
1989	25.5
1990	25.9
1991	29.0

As the self-insured market has grown, the need for appropriate "funding levels" has increased. It is important for self-insured firms to set aside an appropriate accrual for their retained exposure as most states do not have guarantee funds for self-insured entities.[2)]

---

1) Self-Insurance Trends & Perspectives 1992, Johnson & Higgins. The term self-insurance denotes any program employing risk retention as the primary method for funding expected losses. This definition includes self-insured programs deemed "qualified" under state laws, but does not include self-insured retentions or deductibles in conventional insurance programs.

2) However, it should be noted that most states have established collateral requirements for self-insured entities. We will discuss collateral requirements in Section II.

Establishing funding levels for entities that self-insure their workers' compensation exposure is a complex process. This paper defines the term funding level and describes methods that can be used to establish funding requirements.

The paper is divided into six sections. The first section discusses some of the benefit and cost considerations involved in deciding whether to commercially insure or retain some of the exposure in-house. The second section describes some of the significant requirements that states impose on firms that self-insure their workers' compensation exposure. In the third section, the funding level is defined.

The fourth section provides two detailed funding level calculations. The first calculation presented is for an employer that has been self-insured for a number of years and has substantial historical loss and exposure information. The second calculation is for an employer which has only been self-insured for a short time period and has limited loss and exposure information.

The fifth section of the paper discusses several additional items which an entity may want to consider in structuring and funding a workers' compensation self-insurance program:

- Confidence Levels;
- Discounting; and
- Excess Insurance.

The final section of the paper is the conclusion.

I. BENEFITS AND COSTS OF SELF-INSURANCE

An employer faces costs and benefits when evaluating the decision to retain or self-insure part of its workers' compensation exposure. Each organization will perceive the overall value of self-insuring differently.

A) Benefits of Self-Insuring Workers' Compensation Exposures

The potential benefits of self-insuring Workers' Compensation exposures result from:

- Cost Savings to Employers
- Enhanced Awareness and Control of Loss Costs
- Other Considerations

Cost Savings to Employers

Lower cost is often considered to be the most important benefit of self-insurance. However, cost should not be considered in isolation. The cost of self-insuring must be considered in relation to the cost of purchasing insurance from the commercial marketplace and the increased risk assumed by the self-insured employer.

Premiums charged by commercial insurers contain several distinct components including expected loss costs, operating expenses, risk load, and profit. The self-insured entity can potentially achieve cost savings in three of these four premium components.

The expected loss costs underlying commercial premiums generally reflect the insurance company's estimate of the average loss cost for a group of similar insureds. To the extent that the entity considering self-insurance has lower expected loss costs than the "average" entity in the group, this difference is realized as cost savings by the self-insurer. That is, the self-insurer reaps the full benefit of better than expected loss experience. Furthermore, the self-insurer benefits directly and immediately from any reduction in expected loss costs which results from the successful implementation of loss control or loss prevention strategies. This incentive to self-insure has not escaped the attention of the commercial marketplace. There are numerous mechanisms available to the commercial insurer wishing to compete for the business of the better than average risk, including experience rating, retrospective rating, prospective rating (e.g., schedule rating) and dividend plans. However, all of these options either dilute or delay (or both) the full benefit of good loss experience.

Additionally, for an entity which encounters difficulty obtaining insurance from the voluntary market, self-insurance is a means to avoid the stigma and increased costs associated with purchasing coverage in the residual market.

The operating expense component of commercial premiums may include a provision for such costs and services as claims handling, underwriting, taxes, dividends, assigned risk assessment, administrative costs, marketing, acquisition costs, and overhead. Self-insurance may potentially eliminate or reduce the need for several components of operating expense, thus resulting in cost savings to the self-insured entity. Self-insured

entities will not incur expenses for underwriting, marketing, dividends, or acquisition of business (commissions). Also, subject to various state regulations, self-insured entities may be exempt from assigned risk assessments. Self-insurers can further achieve cost savings by retaining the provision for profit in the rates.

We believe that the self-insurer cannot avoid the uncertainty of outcomes associated with retaining its exposures to loss. This "cost" will be borne by the self-insurer either through the opportunity cost of funds, in excess of the expected value, set aside for possible adverse claim results or the need to "borrow" from other parts of the organization (or an outside source) during those years with poor loss experience. Commercial insurers often include a provision in their rates, known as a risk load, to compensate for this uncertainty. More discussion on this component will follow in a later section.

Enhanced Awareness and Control of Loss Costs

As a consequence of the decision to self-insure workers' compensation exposures, the employer becomes responsible for many aspects of the risk management and financing processes that may otherwise be addressed by the commercial insurer. Claims handling, database management, loss prevention and loss control functions are often moved in-house or contracted with a third party provider.

Oftentimes this may provide the self-insurer with a firsthand opportunity to witness the magnitude of the financial and human costs associated with workplace accidents. Self-

insuring may provide a more direct link between employer actions such as loss control and loss prevention and the company's bottom line. Thus, greater awareness may often lead to measures enacted with the intention of reducing costs and providing a safer workplace.

Other Considerations

The employer is able to guarantee the availability of coverage (subject to regulatory approval). While for Workers' Compensation insurance, all employers are required to obtain coverage, if not from the voluntary market then from the residual market, many employers wish to avoid the stigma of being considered a substandard risk if they are forced to obtain coverage from an assigned risk mechanism. Furthermore, while coverage availability is guaranteed, there is no guarantee that an insured can place its business with the company of its choice.

By means of potential cost savings and enhancement of employee morale, the employer is given a direct incentive to aggressively rehabilitate injured workers. This not only may result in cost savings for the employer, but there is a societal benefit associated with restoring an individual to a state of health and productivity. Furthermore, overall employee loyalty may be enhanced. The self-insurer retains more control over the claims handling process, and thus has more authority over decisions to deny claims or investigate fraud.

Finally, the self-insurer retains authority over its investment portfolio, that is, it controls the assets which back the liabilities incurred by self-funding. This freedom allows the company to potentially seek higher rates of return than what may be reflected in commercial premiums.

B) Costs of Self-Insuring for Workers' Compensation Exposures

The costs of self-insuring for Workers' Compensation exposures result from:

- Increased Variability of Insurance Related Costs
- Additional Staffing Costs
- Other Considerations

Increased Variability of Insurance Related Costs

While the expected value of costs under a self-funding arrangement may be equal to or lower than the cost of purchasing commercial insurance, the variability of these costs is potentially much greater to the self-insured entity. This result follows from consideration of the "Law of Large Numbers". That is, the relative variance associated with the collective outcomes of multiple contingent events, is lower than the relative variance associated with the outcome of a single contingent event.

Premiums charged by commercial insurers and funding levels established by self-insurers may contain a provision for contingencies referred to as a risk load. The relative magnitude of the risk load is usually dependent on the variance of possible

losses relative to the expected amount of losses associated with insuring exposures. Additionally, it may be more difficult for the self-insurer to accurately determine the ultimate value of its anticipated loss costs, than it is for an insurance company to develop rates that are adequate on an overall basis. This characteristic, referred to as parameter risk, can also be attributed to the "Law of Large Numbers". That is, estimates of claim frequency and severity which are derived from a large credible database, such as those available to most large commercial insurers are more statistically reliable than estimates developed from smaller less credible databases such as those maintained by self-insurers.

An insurance company can provide coverage for a large number of employers, who are diverse both economically and geographically, while a self-insurer is limited to providing coverage for its own exposures. Thus, the insurance company requires a proportionately smaller loading for the risk that losses will, in the aggregate, exceed their expected value by some percentage, than does the self-insurer. This differential represents a cost of self-insurance.

A related cost results from the fact that, in contrast to the purchase of commercial insurance, the amount of funding required to pay insurance claims is unknown. Although estimates are made and funding levels may include a risk load, the actual cost of self-insuring may not be known for many years. This uncertainty can complicate the financial planning process of the employer. This complication can be viewed as a cost of self-insurance.

Additional Staffing Costs

The employer that decides to self-insure must provide or contract for many services otherwise provided by the commercial insurer, including claims handling, database management, and loss control/prevention services.

These services are essential to the successful management and financing of workers' compensation exposures. Other services required by a self-insurer include audit, actuarial, and investment management services.

Therefore, the self-insurer must either purchase these services from an outside party, or move the functions in-house. Often, especially at first, the self-insurer cannot undertake these operations as cost effectively as they were provided by the commercial insurer.

Generally, additions to staff will be required to perform or monitor these functions, as well as handle other administrative tasks associated with managing a self-insurance program. Skilled risk management personnel will be required to supervise these functions as well as address the technical needs of the program (e.g., what excess limits of coverage to purchase). Often, a company must purchase computer hardware and software to establish a risk management database required for monitoring and analyzing exposures to loss. Actuarial, audit, and investment management services can be purchased from professional firms specializing in these areas.

It should also be noted that the commercial insurer, due to economies of scale, may provide better service and/or provide the service at a lower overall cost than the self-insured entity.

Other Considerations

One additional cost associated with the decision to self-insure, is the potential adverse impact of self-insuring on the employer's relationship with its employees. If the employer chooses to move the claims adjusting process in-house, the employer and the employee can be thrust into an adversarial relationship under certain circumstances. Consider the decision to deny claims. If the employer denies an employee's claim, the employer may be viewed as unsympathetic by the injured person's friends and co-workers. This can have a damaging effect on the firm's relationships and reputation. Similar difficulties arise if the employer takes a hard line on investigating and eliminating fraudulent claims. For these reasons many firms which self-insure their exposures to loss choose to contract for claims management services with a third party administrator (TPA). The TPA is often viewed as an objective decision maker, balancing the goals of the employer against the needs and rights of injured workers.

Another potential cost is the availability and affordability of excess insurance. Many self-insured entities will want (or be required) to purchase excess insurance and this subjects these companies to:

- The uncertainty regarding market conditions, and the effect upon the availability and affordability of the coverage; and

- The credit risk associated with future excess insurance recoveries.

It should be noted that we regard Federal Income Tax considerations to be outside the scope of this paper.

II. SELF-INSURANCE REGULATORY REQUIREMENTS

Most states have established requirements to provide funds for injured workers in the case of a self-insured entity's bankruptcy. In addition, states have attempted to limit the "availability" of self-insurance to financially strong firms. This section discusses several common self-insurance requirements imposed by the various states. The requirements are divided into initial filing requirements and additional requirements.

Self-insurance initial filing requirements often include:[3)]

1) A parental guarantee (if applicable);
2) The most recent audited financial statement of the entity considering self-insurance; and
3) Loss experience and payroll information.

[3)] "The Self-Insurance Manual" by C. C. Lilly and H. G. Boggs, NILS Publishing Company summarizes each state's statute related to workers' compensation self-insurer requirements.

The parental guarantee is a promise by the parent corporation to "guarantee" the workers' compensation payments of a subsidiary. This requirement will decrease the credit risk associated with the self-insured entity's exposure by committing not only the subsidiary's assets but also the parents' assets to guarantee the self-insurers' workers' compensation payments.

The second requirement, a recent audited financial statement, allows the state to financially evaluate the potential (or current) self-insured employer in order to determine if the employer is financially strong enough to self-insure. This procedure should minimize the number of financially weak self-insured employers.

The last requirement, of requesting loss and payroll information, allows the Insurance Department to determine the reasonableness of the collateral (which is discussed later).

As a note, some states have established additional and more specific requirements. For example, the Vermont regulations require that the applicant must meet target ratios in six categories.[4)]

If a self-insured employer meets the initial filing requirements and the state is satisfied with the entity's financial condition then two additional requirements may be imposed:

---

4) There are target ratios for minimum: cash flow, liquidity, working capital, net worth, profitability, and turnover.

- Excess insurance; and
- Security or bonding.

One reason to require excess insurance is to increase the predictability of the self-insured employer's retained loss experience. The purchase of excess insurance may make the loss experience more predictable from year to year and may reduce the probability of an insolvency (of the self-insured entity) due to poor loss experience in one particular year. States will usually require excess insurance if the self-insured employer has some financial shortcomings. The importance of excess insurance and its relationship to the funding level will be discussed in Section V.

The security or collateral requirement is the mechanism the states have established to compensate claimants in the event of a self-insured employer's bankruptcy. Most states do not have guarantee funds covering the obligations of self-insured employers. Therefore many states require self-insured employers to provide the state with a letter of credit (LOC) or surety bond. These funds would then be available in the case of a self-insured employer's bankruptcy. States use various methods to establish the security requirement. In reviewing the various state regulations, it appears that many states use one (or more) of the following three methods to determine the amount of security:

- A minimum flat dollar amount;
- A factor times case reserves; or
- A formula approach based on the recent loss experience of the insured.

A few states require an actuarial analysis to assist in determining the amount of collateral. It should be noted that states do not require security for municipalities and political subdivisions that self-insure. This may be due to the fact that these entities typically have tax authority and therefore are unlikely to be unable to meet claim obligations.

This section has discussed some of the more common self-insurance requirements. However, specific requirements vary significantly from state to state.

III. FUNDING LEVEL

The discussion of the funding level in this section assumes that the self-insured entity is utilizing a risk financing technique, for its retained exposure, which involves earmarking assets. A partial list of the most commonly used risk financing techniques for retained exposures include:[5]

- Current expensing of losses;
- An unfunded reserve;
- A funded reserve (i.e. earmarking assets);
- Use of borrowed funds; and
- Retention through an affiliated ("captive") insurer.

---

[5] Head, George L. and Horn, Stephen II, Essentials of the Risk Management Process, Volume II (Insurance Institute of America, Inc.)

There are advantages and disadvantages associated with each of the above mentioned techniques. A partial list of the reasons for using a funded reserve as a risk financing technique include:

1) It may be more likely that liquid assets will be available to pay for retained losses. If an entity earmarks assets for retained exposures, oftentimes a cash flow (or duration) analysis will be performed on the retained exposure.

2) Accounting considerations may require the entity to establish a balance sheet reserve for its retained exposure. The applicable standard board statements are Financial Accounting Standards Board (FASB-5) for private companies and Governmental Accounting Standards Board (GASB-10) for public entities.[6]

3) Regulators may prefer that firms formally establish a funded reserve. In fact, some states have allowed, in essence, a formally structured funded reserve (escrow account) to meet the collateral requirements established by the state.[7]

Two potential disadvantages of a funded reserve as a risk financing technique are [8]:

---

[6] It should be noted that these accounting obligations could be met through an unfunded reserve.

[7] An escrow account is a written agreement entered into among three parties. Funds are deposited for safekeeping with the third party as custodian. The custodian or depository is obliged to follow strictly the terms of the agreement agreed upon by the other parties.

[8] IBID [5]

1) The entity may have better use of its funds than merely to invest in financial instruments in anticipation of future losses. The firm may be able to earn more by deviating funds to regular productive activities; and

2) The funded reserve may appear as idle funds and be used for other corporate purposes.

The required "Fund" is defined as the amount of assets needed to satisfy all past years' retained insurance obligations plus insurance obligations for the upcoming self-insurance year. This is analogous to (but not identical to) an insurance company's:

- Liabilities as of year-end; plus
- Next year's premium.

The required Fund for a self-insured employer consists of the following elements:

- Liabilities as of year-end
  - Claim liabilities (including a provision for allocated loss adjustment expenses (ALAE);
  - Other loss adjustment expense liabilities;
  - Any potential loss sensitive premium related obligations prior to self-insuring (e.g., additional retrospective rating plan premium);

- Expected additional excess insurance premium payments for prior years' exposure (due to a positive payroll audit);
- Second injury fund assessments, taxes payable, etc.;
- Other (general) expense liabilities; and
- A provision for uncollectible excess insurance.

- Funding obligations for the upcoming self-insurance year
  - Claim costs including ALAE;
  - Unallocated loss adjustment expense (ULAE) costs;
  - Marketing/sales costs (for a group self-insurer);
  - Excess insurance cost;
  - Second injury fund assessment, taxes etc.; and
  - Other expense (expected to be incurred in the upcoming self-insurance year).

As a note, the above mentioned claim costs refer to the retained (after the application of excess insurance) exposure. We are assuming that a self-insurance year will provide coverage for all claims occurring during the year.

The "Funding Level" for the upcoming year, is then equal to:

- The prior years' liabilities; plus
- The funding obligations for the upcoming self-insurance year; minus

- The amount of assets earmarked to pay for obligations.

If investment income is intended to remain in the Fund, then the assets should include the accrued investment income.

We have not defined claim costs with regard to whether the amount is discounted or undiscounted or whether the amount is an expected value or established at some confidence level amount. The fifth section of the paper will discuss these concepts.

There are probably other ways to define funding levels; however, it appears that many self-insured entities use the definitions discussed in this section.

V. FUNDING LEVEL EXAMPLES

In this part of the paper, we will outline approaches that can be used to estimate the funding needs of a self-insured employer, the claim related liabilities as of year-end, and the expected claim costs for the upcoming year. We will assume that the self-insured employer is able to estimate the amount of non-claim related items (e.g. excess insurance costs). In addition, we will provide funding level calculations for two scenarios.

- Scenario number one - the self-insured employer has adequate data to utilize several commonly accepted actuarial projection methods; and

- Scenario number two - the self-insured employer does not have sufficient data to utilize commonly used actuarial protection techniques and therefore some creative but necessary techniques are required.

A) Adequate Data Example

For scenario one, the employer has been self-insured for ten years. The employer purchases specific excess coverage above $500,000 per claim. The employees are in two classes (based on NCCI class codes).

We will first discuss a procedure to project gross losses. As a note, it may not be necessary to project gross losses to estimate net losses. However, we will discuss the projection of gross losses for the following two reasons:

- A projection of net losses could involve subtracting projected excess losses from gross losses; and

- If any excess carriers are insolvent or financially troubled, this may necessitate a projection of gross losses to estimate an uncollectible excess insurance provision.

The following data is available by self-insured year and development year:

- Exhibit 1-displays the employer's paid loss experience (including ALAE);
- Exhibit 2-displays the employer's incurred loss experience (including ALAE);
- Exhibit 3-displays the corresponding claim count data (for lost time claims); and
- Exhibit 4-displays the employer's average incurred severity.

Additionally, Exhibit 5 displays the self-insured employers workers' compensation payroll by self-insured year and class.

Projection of Gross Losses

Based on the above mentioned data items, we can use several methods to estimate ultimate losses by self-insured year. As a technical note, we will use the term loss to include both loss and ALAE. The unpaid claim liability can then be computed as the ultimate losses less the losses paid-to-date. The following generally accepted projection methods are used to project ultimate losses by self-insured year:

- Paid loss development (Exhibit 6);
- Incurred loss development (Exhibit 7)
- A counts times averages method (Exhibit 8);
- An expected loss method (Exhibit 9);
- A trended pure premium approach (Exhibit 10); and
- A Bornhuetter-Ferguson method (Exhibit 11).

We will not provide the details on these methods in the text as they are relatively well documented in the actuarial literature. However the exhibits should be relatively self explanatory.

We should note that if more refined data is available, several enhancements could be made to the projection methods outlined on Exhibits 6 through 11. For example, the projection methods outlined on Exhibits 6 through 11 could be performed separately:

1) By class;
2) By type of loss (medical, indemnity, and expenses); or
3) A combination of 1 and 2 from above (i.e., by class for medical costs versus by class for indemnity costs).

The further breakouts of the data may reveal trends not apparent by viewing the data more globally. However, the further breakouts will involve less data and hence involve credibility considerations.

It should also be noted that while we have not explicitly introduced credibility into the loss projection methods, we have used various projection methods. Presumably the analyst will be in a position to assign credibility to the various projection methods in selecting ultimate losses.

The above mentioned data items and hence the above estimates are gross (i.e. before the application of the entity's excess insurance program). In the above mentioned gross loss projections we have assumed that there were no unusually large losses that would distort the projections. If there had been unusually large losses, we would recommend that they be treated separately.

Projection of Net Losses

Several methods can be used to estimate the retained losses for the entity and we will discuss two sets of methods. The first set derives the retained losses by repeating the projection techniques performed for gross losses. However, retained losses are used in lieu of gross losses in constructing the triangles. Therefore, individual losses will be limited at the per claim retentions. With regard to aggregate recoveries, it may be more reasonable to contstruct "triangles" gross of aggregate retentions and limit the projected losses at the aggregate retention. As a note, both the B-F method and the expected loss method will require an independent estimate of the ultimate retained losses. These retained losses can be calculated based on:

- An estimate of unlimited losses; and
- Excess ratios published by the National Council on Compensation Insurance (NCCI).

The second technique is a Bornhuetter-Ferguson method for the excess layer and involves subtracting estimated excess losses from gross losses. The a-priori estimate of ultimate excess losses is based on the selected gross losses and an estimate of the

percentage of losses which will exceed a specific amount. For discussion purposes, we relied on excess ratios published by Mr. William R. Gillam in "Retrospective Rating: Excess Loss Factors" PCAS LXXVIII, Page 1.

These excess ratios will vary by state hazard group. However a discussion of the procedures necessary to calculate excess ratios is beyond the scope of this paper.

Several sources can be used to estimate the excess reporting patterns. A partial list includes:

- Data published by the Reinsurance Association of America (RAA);
- Data from A. M. Best's for reinsurance companies; and
- Data from the individual entity (if the entity is large enough).

It should be noted that both the RAA data and A. M. Best data have several limitations including:

- A mixture of attachment points and retention levels are reflected in the data;
- A mixture of different types of risks;
- Varying company reporting requirements and reserving philosophies. and
- A mixture of different reinsurance arrangements (e.g., excess of losses, quota share).

Exhibit 12 displays the calculation of the a-priori excess losses. Exhibit 13 displays the Bornhuetter-Ferguson calculation for excess losses.

The retained losses are then calculated by subtracting the estimated excess losses from the estimated gross losses. Exhibit 14 displays our selected:

- Gross losses;
- Excess losses;
- Retained losses; and
- Retained Unpaid Claim Liability.

The expected value of losses for the upcoming year (1994) then can be determined based on:

- An expected loss method; and
- A trended pure premium approach.

Exhibit 15 summarizes these estimates.

The required Fund (on an expected value basis) is then equal to the sum of:

- The net unpaid claim liabilities; plus
- The expected retained claim costs for the upcoming year.

Exhibit 15 displays the calculation.

B) LIMITED DATA EXAMPLE

The XYZ Manufacturing Company has self-insured its workers' compensation exposures for the past six (6) years. While the firm has paid over $9,000,000 in claims during that time period, they have only recently begun to establish case reserves for individual claims. Aggregate loss payments are available by calendar year, but individual claim detail is not available. In addition, the paid loss data is available for medical versus indemnity payments.

The Company has recently established a database capturing information on all open and newly reported claims as of January 1, 1993. The accident date and the current reserve amount are captured; however, prior payments and prior reserve levels on open claims are not known. Reserves are available separately for medical versus indemnity losses. In addition, the Company has not captured exposure information by NCCI class code.

The absence of a complete set of cumulative data triangles for paid and incurred losses poses a unique problem for estimating the unpaid claim liabilities of the Company, as traditional actuarial methodologies cannot be employed without modification. The first step is to estimate the required reserve levels for the Company from inception of the self-insured period as of year-end 1993 (self-insured years 1988-1993).

Three nonstandard actuarial techniques will be employed to estimate the ultimate losses of the XYZ Manufacturing Company:

- Case Reserve Development Method;
- Calendar Year Incremental Payment Method; and
- A de-trended Bornhuetter-Ferguson projection method.

For reference, Exhibit 16 displays the available loss experience of the Company.

Case Reserve Development Method

The case reserve development method is similar to the paid and incurred loss development methods. A set of multiplicative factors, which vary according to the maturity of a given accident year, are applied to the known case reserves for each accident year as of a common evaluation date. The factors are referred to as case development factors. For a given year, the product of the case development factor and the case reserve amount yields an estimate of the total unpaid losses (including IBNR) for that accident year.

Case development factors can be derived from cumulative paid and incurred loss development factors. Consider,

P_t = Paid loss development factor from t months to ultimate

I_t = Incurred loss development factor from t months to ultimate

P = Paid losses at t months of development

I = Incurred losses at t months of development

U = Ultimate losses

Then, on an expected value basis

$(P) \times (P_t) = U$ implies $P = (U)/(P_t)$

$(I) \times (I_t) = U$ implies $I = (U)/(I_t)$

We desire a factor, k, such that (on an expected value basis):

(I-P) x (k) = (U-P); that is case reserves at t months, (I-P), multiplied by the factor k yields total unpaid losses, (U-P).

Therefore, on an expected value basis:

$(U/I_t - U/P_t) \times (k) = U - U/P_t$

$(U) \times (1/I_t - 1/P_t) \times (k) = (U) \times (1 - 1/P_t)$

$(1/I_t - 1/P_t) \times (k) = (1 - 1/P_t)$

Thus, $k = (1 - 1/P_t)/(1/I_t - 1/P_t)$.

In the case of XYZ no credible development history exists from which to select paid and incurred development factors. Therefore, external data sources will be used to derive development patterns. Exhibit 17 displays paid and incurred development factors based on our interpretation of data published by NCCI in a specific state, for medical and

indemnity losses, as well as the calculation of case development factors according to the formula derived above.

Exhibits 18 and 19 depict the application of the case development factors to the case reserves of the Company and the resulting estimates of unpaid losses.

Calendar Year Incremental Payment Method

The calendar year incremental payment method is based on an assumed loss payout pattern, a loss trend, and an exposure (payroll) trend to derive a factor which can be applied to calendar year paid losses to produce an estimate of unpaid losses for all accident years.

The payout pattern employed is derived from the development pattern we used in the case development method. Exhibit 20 displays the selected payment patterns. For the purposes of this example, we will assume that medical losses (pure premiums) will increase at a rate of 10% annually, while indemnity losses will increase by 3% annually. [9] As a note, these trends are in excess of payroll growth. We will assume that XYZ's exposures have increased by approximately 4% per year (including payroll growth).

---

[9] A good starting place for trend factors would be a bureau filing. For example NCCI provides separate medical and indemnity loss ratio trends in most states.

Let

AY_0 denote an accident year at time t [10]

Then,

AY_1 is an accident year at time (t-1)

AY_2 is an accident year at time (t-2)

AY_k is an accident year at time (t-k)

Let P_t represent the incremental percentage of ultimate losses paid in year t

Then, given the amount paid in calendar year t on AY_0 losses, unpaid losses at time t on AY_0 exposures can be estimated by multiplying calendar year payments by the following factor:

$$\frac{(1 - \sum_{i=1}^{t} P_i)}{P_t}$$

That is, the ratio of the percentage of ultimate losses yet to be paid at time t, to the percentage paid in year t.

---

[10] That is AY_0 is the first accident year and its maturity is t years from inception.

Allowing for the effect of trends in accident year loss costs and exposures, the factor to estimate unpaid losses on AY_k exposures is given by:

$$\frac{(1 - \sum_{i=1}^{(t-k)} P_i)(1+r)^k}{P_{t-k}\,(1+r)^k}$$

As a note, the trend factor is the product of the loss and exposure trend. Notice that the trend factor, $(1+r)$ could be factored out of this expression, yielding the result that trend is irrelevant to the calculation of the reserve for a single accident year. However, as will be seen below, trend is important when multiple accident years are combined.

Now suppose that the calendar year losses resulting from k accident years are known, but their breakdown by accident year is unknown. An expression can be developed which when applied to the calendar year payments at time t yields an estimate of unpaid losses, for all accident years, at time t.

Conceptually, this expression should reflect the sum of all future payments for each of the k accident years, divided by the sum of the calendar year t payments for each of the k accident years (based on an assumed payment pattern). The expression is:

$$\frac{\sum_{n=0}^{k}\{ (1 - \sum_{i=1}^{(t-n)} P_i)\,(1+r)^n \}}{\sum_{n=0}^{k} P_{t-n}\,(1+r)^n}$$

This expression can be seen to be the ratio of the sum of the numerators for each of the k accident year factors to the sum of the denominators for each of the k accident year factors. Notice that the trend factor cannot be factored out of this expression. The trend factor impacts the relative weights given to each accident year factor.

Exhibits 21 and 22 display the mechanics of the methodology as well as the resulting estimate of unpaid indemnity and medical losses for the XYZ Manufacturing Company.

As a note, this model can also be used to vary the future trend from historical averages. For example if XYZ entered into a long-term contract with a particular hospital that would reduce expected future medical costs by 1% per year (and almost all of the injured workers were treated at this hospital), then this 1% reduction could be factored into the model.

The future projected medical payments would be reduced by 1% annually or multiplied by a factor of $(.99)^x$ (where x is the number of years from the date the long-term contract began to the date the projected payment is made).

De-Trended Bornhuetter-Ferguson Method

The last method discussed is a de-trended Bornhuetter-Ferguson projection method. This method can be used to estimate the unpaid claim liability as well as provide an estimate of the upcoming year's expected losses. For this method the following elements are required:

- An estimate of ultimate losses for the most recent year;
- An assumed reporting pattern for incurred losses;
- An assumed loss trend; and
- An assumed exposure method.

For the XYZ Company, the ultimate losses for 1993 can be estimated based on incurred and/or paid loss projection methods. The ultimate losses for prior accident years can then be estimated based on the combined loss and exposure trend. For example, the ultimate losses for self-insured year 1990 can be estimated by dividing the 1993 ultimate losses by $(1+r)^3$. A Bornhuetter-Ferguson method can then be used to estimate the IBNR reserves by year (the case reserves can then be added to estimate the unpaid claim liability). Exhibit 23 displays the calculation. The upcoming year's expected losses can then be estimated by multiplying the results of the incurred projection method by the selected trend factor of $(1+r)$. Exhibit 24 displays this calculation. Exhibit 25 displays the selected unpaid claim liability at 12/31/93 along with expected 1994 claim costs.

The funding for 1994 is then equal to required Fund less the amount of assets set aside to pay claim liabilities.

VI. ADDITIONAL CONSIDERATIONS

This section will discuss additional factors besides cost estimates, that an entity may want to consider in structuring a self-insured program (and determining a funding level):

- The variability associated with cost estimates;
- The time value of money; and
- Issues related to excess insurance.

Loss Probability Levels

The estimates described in Section V are expected values. Therefore, a significant percentage of the time (50% for a symmetric loss distribution) the actual losses will exceed the estimates derived in Section V. The attached Exhibit 26 displays a distribution of actual losses for the upcoming self-insurance year for a risk with $500,000 of expected losses.[11]

As this graph displays, for a risk with expected losses of $500,000, there is a 9.6% probability that actual losses will exceed $1,000,000 in the upcoming self-insurance year. The self-insured entity will want to consider this information in determining funding levels. Exhibit 27 displays some of the key figures underlying the graph.

In determining the probability level at which to fund, the risk may also want to consider:

- How easy it would be to obtain additional funds if loss experience is worse than expected?;
- Would bonds have to be liquidated at a loss to fund for adverse insurance results?;

---

[11] This distribution is based on our interpretation of data published by the NCCI. Specifically the distribution is based on the second derivative of the insurance charge curve. The state and hazard group adjustment is based on an Illinois hazard group IV risk.

- What are the insurance costs relative to the net worth, sales, and net income of the entity?; and

- What is the corporation's philosophy with regard to assuming risk?

These factors along with the variability of losses should be used by the entity to determine the funding level.

As we discussed previously, the claim cost funding for the next year is equal to:

- Next year's projected claim costs; plus
- The claim related liabilities for the prior years as of year-end; minus
- The assets earmarked to pay claim liabilities.

In deriving probability levels, we are interested in the distribution of the funding level. The assets as of year-end are fixed (ignoring credit risk); therefore; the probability level is a function of the combined distribution of:

- Next year's claim costs; and
- The future loss payments associated with the unpaid claim liabilities for prior years as of year-end.

While a discussion of the combined aggregate loss distribution is outside the scope of this paper, we would point the interested reader to "Hospital Self-Insurance Funding: A Monte

Carlo Approach" by Dave Bickerstaff in the Spring 1989 Edition of the CAS Forum. This is one of the few papers that attempts to estimate the aggregate loss distribution of the combination of:

- The run-off of the fund's prior years' losses; plus
- The prospective year's losses.

Discounting

Another item that the self-insured entity may wish to consider is the time value of money. The attached Exhibit 28 displays how $100 of workers' compensation losses are projected to be paid out over time.

If the entity invested funds and received interest payments equal to 6% of the invested funds annually, then less than $100 could be invested at the beginning of the period to cover the expected loss payments. This is due to the fact that the interest payments will also be available to pay for future loss payments. In this example, approximately $90 invested at the beginning of the period, along with projected interest payments (at 6%) are anticipated to be sufficient to cover the expected loss payments contained on Exhibit 28.

In determining discounted unpaid claim liabilities, the Actuarial Standards Board has outlined several issues and considerations that an actuary should take into account in "Actuarial Standard of Practice No. 20 - Discounting of Property and Casualty Loss and Loss Adjustment Expense Reserves". A partial list of issues and considerations include:

- The timing of future payments and potentially a range of payment-timing estimates;
- The selected interest rate for discounting; and
- Risk margins associated with the discounted loss reserves (as the discounting process introduces additional uncertainties).

The entity may also want to consider the interaction of the loss payment stream and the probability level of the undiscounted losses. For example, if the entity suffers an unusual number of large claims (resulting in a relatively high probability level) it may be more likely that the payment pattern will be extended. Large lifetime workers' compensation claims are typically paid-out over an extended time period. This factor has resulted in some analyses assuming that the discounted probability level amounts are simply equal to the undiscounted amounts multiplied by the present value factor (based on the premise that this assumption is conservative). With this assumption, the discounted probability level amounts could be computed by multiplying the undiscounted amounts by a uniform factor of .90.

Excess Insurance Issues

It appears that the most common types of excess insurance for workers' compensation are:

- Per occurrence coverage; and
- Aggregate coverage.

The per occurrence coverage provides coverage in excess of a dollar threshold per occurrence.

Aggregate coverage limits the entity's exposure in total for a self-insured year. It provides coverage in excess of a dollar threshold for all claims occurring in a self-insured year.

Excess insurance reduces the variability associated with the retained claim liabilities. The per occurrence coverage limits individual claim amounts that are retained; therefore, for a large claim only the first $ x will be retained. The aggregate coverage limits the retained losses for any one self-insured year and therefore provides an upper limit to the retained exposure (ignoring credit risk and policy limits being exhausted).

Exhibit 29 displays the effect of the per occurrence excess insurance on the distribution of costs for the upcoming self-insurance year.[12] The exhibit displays the probability level amounts for a risk with $500,000 of expected unlimited losses (both with and without a $50,000 per occurrence loss limit). In addition, we have added a provision for the cost of excess insurance. As a note, for illustrative purposes, we have assumed that the excess insurer would include a 25% loading of the undiscounted expected value to determine premium.[13]

If the risk does not purchase per occurrence excess insurance, the actual claim payments are projected to exceed $980,000 one year in every ten or 10% of the time. However if the risk

---

[12] Based on our interpretation of data published by NCCI.

[13] While the 25% on the face of it appears low (for expenses, profit, and a risk margin) it should be noted that excess workers' compensation payments are made over an extended period of time. Therefore, if the excess insurer reflects the time value of money the discounted expected losses will be significantly less than the undiscounted amounts.

purchases excess insurance, the corresponding probability for approximately $980,000 of insurance costs is 5% or one year in every twenty. Exhibit 30 graphically displays the distribution of loss outcomes assuming the risk purchased per occurrence excess insurance. In comparing Exhibit 30 and Exhibit 26 it should be noted that:

- The distribution of insurance costs is less dispersed for the risk that purchases excess insurance; and

- The risk is forgoing the possibility of very favorable insurance costs (with the purchase of excess insurance) for reducing the possibility of adverse loss experience.

VI. CONCLUSION

This paper has outlined several methods that can be used to establish funding levels for an entity which retains its workers' compensation exposure.

In addition we have discussed:

- Benefit and cost considerations involved in self-insuring;
- Regulatory requirements associated with self-insuring; and
- Funding level considerations.

We believe that the concepts outlined in this paper can assist an entity in:

- Structuring a self-insurance program (or deciding whether to self-insure); and
- Funding for a self-insurance program.

ABC Company
Paid Losses 1)
Medical and Indemnity Combined
($000's)

Self Insured Year	Months of Development 12	24	36	48	60	72	84	96	108	120
1984	145	711	900	1,001	1,100	1,113	1,124	1,130	1,130	1,130
1985	201	845	1,011	1,101	1,151	1,170	1,170	1,170	1,170	
1986	290	1,011	1,294	1,412	1,480	1,500	1,513	1,519		
1987	359	1,210	1,421	1,513	1,570	1,590	1,600			
1988	450	1,445	1,551	1,701	1,851	1,940				
1989	680	1,599	1,819	2,001	2,100					
1990	750	2,150	2,445	2,550						
1991	980	2,050	2,500							
1992	1,325	2,700								
1993	1,522									

Development Factors

Self Insured Year	Months of Development 12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	
1984	4.903	1.266	1.112	1.099	1.012	1.010	1.005	1.000	1.000	
1985	4.204	1.196	1.089	1.045	1.017	1.000	1.000	1.000		
1986	3.486	1.280	1.091	1.048	1.014	1.009	1.004			
1987	3.370	1.174	1.065	1.038	1.013	1.006				
1988	3.211	1.073	1.097	1.088	1.048					
1989	2.351	1.138	1.100	1.049						
1990	2.867	1.137	1.043							
1991	2.092	1.220								
1992	2.038									
Average	3.169	1.186	1.085	1.061	1.021	1.006	1.003	1.000	1.000	
Column Sum	2.649	1.174	1.080	1.060	1.023	1.006	1.003	1.000	1.000	
Selected Age to Age Factor	2.200	1.174	1.080	1.060	1.023	1.011	1.005	1.002	1.001	
Selected Cumulative Factor	3.113	1.415	1.205	1.116	1.053	1.029	1.018	1.013	1.011	1.010 Tail

1) Including ALAE

Note: In selecting factors, we would suggest reviewing ABC Company data as well as development factors published by the NCCI for state X.

Note: The most recent diagonal has been brought to year end based on data through September 30.

Exhibit 2

ABC Company
Incurred Losses 1)
Medical and Indemnity Combined
($000's)

Self Insured Year	Months of Development 12	24	36	48	60	72	84	96	108	120
1984	400	800	990	1,111	1,115	1,125	1,130	1,130	1,130	1,130
1985	510	902	1,096	1,151	1,160	1,170	1,170	1,190	1,190	
1986	790	1,180	1,396	1,500	1,540	1,560	1,500	1,519		
1987	901	1,391	1,501	1,559	1,570	1,590	1,690			
1988	1,120	1,460	1,661	1,842	1,950	2,000				
1989	1,401	1,701	1,900	2,011	2,110					
1990	1,761	2,340	2,465	2,550						
1991	1,700	2,316	2,675							
1992	2,400	2,995								
1993	2,600									

Development Factors

Self Insured Year	Months of Development 12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	
1984	2.000	1.238	1.122	1.004	1.009	1.004	1.000	1.000	1.000	
1985	1.769	1.215	1.050	1.008	1.009	1.000	1.017	1.000		
1986	1.494	1.183	1.074	1.027	1.013	0.962	1.013			
1987	1.544	1.079	1.039	1.007	1.013	1.063				
1988	1.304	1.138	1.109	1.059	1.026					
1989	1.214	1.117	1.058	1.049						
1990	1.329	1.053	1.034							
1991	1.362	1.155								
1992	1.248									
Average	1.474	1.147	1.070	1.026	1.014	1.007	1.010	1.000	1.000	
Column Sum	1.373	1.132	1.065	1.030	1.015	1.008	1.010	1.000	1.000	
Selected Age to Age Factor	1.373	1.132	1.065	1.030	1.015	1.008	1.005	1.000	1.000	
Selected Cumulative Factor	1.753	1.277	1.128	1.059	1.028	1.013	1.005	1.000	1.000	1.000 Tail

1) Including ALAE

Note: In selecting factors, we would suggest reviewing ABC Company data as well as development factors published by the NCCI for state X.

Note: The most recent diagonal has been brought to year end based on data through September 30.

Exhibit 3

ABC Company
Indemnity Incurred Claim Counts [1]

Self Insured Year	Months of Development 12	24	36	48	60	72	84	96	108	120	Ultimate Claim Counts	Ultimate Frequency Per $Million of Payroll [2]
1984	382	400	409	409	409	409	409	409	409	409	409	2.525
1985	400	412	418	418	418	418	418	418	418		418	2.416
1986	444	462	480	480	480	480	480	480			480	2.619
1987	469	487	500	501	502	502	502				502	2.619
1988	523	548	566	580	584	584					584	2.925
1989	559	580	590	591	591						591	2.947
1990	600	613	620	622							623	2.937
1991	657	680	688								693	3.124
1992	700	725									745	3.200
1993	761										811	3.303

Development Factors

Self Insured Year	Months of Development 12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	
1984	1.047	1.023	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1985	1.030	1.015	1.000	1.000	1.000	1.000	1.000	1.000		
1986	1.041	1.039	1.000	1.000	1.000	1.000	1.000			
1987	1.038	1.027	1.002	1.002	1.000	1.000				
1988	1.048	1.033	1.025	1.007	1.000					
1989	1.038	1.017	1.002	1.000						
1990	1.022	1.011	1.003							
1991	1.035	1.012								
1992	1.036									
Average	1.037	1.022	1.005	1.001	1.000	1.000	1.000	1.000	1.000	
Column Sum	1.037	1.021	1.005	1.002	1.000	1.000	1.000	1.000	1.000	
Selected Age to Age Factor	1.037	1.021	1.005	1.002	1.000	1.000	1.000	1.000	1.000	
Selected Cumulative Factor	1.066	1.028	1.007	1.002	1.000	1.000	1.000	1.000	1.000	1.000 Tail

1) Claims that either have closed with an indemnity payment or have an indemnity reserve.

2) Exponential trend of 3.7% per year.

Exhibit 4

ABC Company
Incurred Loss Severity Triangle

Self Insured Year	Months of Development 12	24	36	48	60	72	84	96	108	120	Ultimate Severity [1]
1984	1,047	2,000	2,421	2,716	2,726	2,751	2,763	2,763	2,763	2,763	2,763
1985	1,275	2,189	2,622	2,754	2,775	2,799	2,799	2,847	2,847		2,847
1986	1,779	2,554	2,908	3,125	3,208	3,250	3,125	3,165			3,165
1987	1,921	2,856	3,002	3,112	3,127	3,167	3,367				3,400
1988	2,141	2,664	2,935	3,176	3,339	3,425					3,483
1989	2,506	2,933	3,220	3,403	3,570						3,681
1990	2,935	3,817	3,976	4,100							4,333
1991	2,588	3,406	3,888								4,366
1992	3,429	4,131									5,168
1993	3,417										5,784

Development Factors

Self Insured Year	Months of Development 12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	
1984	1.910	1.210	1.122	1.004	1.009	1.004	1.000	1.000	1.000	
1985	1.717	1.198	1.050	1.008	1.009	1.000	1.017	1.000		
1986	1.435	1.139	1.074	1.027	1.013	0.962	1.013			
1987	1.487	1.051	1.037	1.005	1.013	1.063				
1988	1.244	1.101	1.082	1.051	1.026					
1989	1.170	1.098	1.057	1.049						
1990	1.301	1.042	1.031							
1991	1.316	1.142								
1992	1.205									
Average	1.421	1.123	1.065	1.024	1.014	1.007	1.010	1.000	1.000	
Column Sum	1.353	1.114	1.062	1.025	1.014	1.007	1.010	1.000	1.000	
Selected Age to Age Factor	1.353	1.114	1.062	1.025	1.014	1.007	1.010	1.000	1.000	
Selected Cumultive Factor	1.693	1.251	1.123	1.057	1.031	1.017	1.010	1.000	1.000	1.000 Tail

[1] Based on an exponential trend, we selected an annual trend factor for severity of 8.3%.

ABC Company
Payroll by Class Code
($000's)

Self Insured Year	Class Code A	Class Code B	Total
1984	131,004	31,004	162,008
1985	140,001	33,001	173,002
1986	147,762	35,492	183,254
1987	154,672	37,001	191,673
1988	159,843	39,836	199,679
1989	160,510	40,001	200,511
1990	169,452	42,671	212,123
1991	177,001	44,806	221,807
1992	185,811	47,001	232,812
1993	196,152	49,398	245,550
1994 1)	203,998	51,374	255,372

1) Based on 1993 payroll trended 4%.

ABC Company
Projection of Ultimate Losses
Paid Loss Projection
($000's)

Self Insured Year	Paid Loss	Cumulative Development Factor	Projected Ultimate Losses
1984	1,130	1.010	1,141
1985	1,170	1.011	1,183
1986	1,519	1.013	1,539
1987	1,600	1.018	1,629
1988	1,940	1.029	1,996
1989	2,100	1.053	2,211
1990	2,550	1.116	2,846
1991	2,500	1.205	3,013
1992	2,700	1.415	3,821
1993	1,522	3.113	4,738
Total	18,731		24,117

ABC Company
Projection of Ultimate Losses
Incurred Loss Projection
($000's)

Self Insured Year	Incurred Loss	Cumulative Development Factor	Projected Ultimate Losses
1984	1,130	1.000	1,130
1985	1,190	1.000	1,190
1986	1,519	1.000	1,519
1987	1,690	1.005	1,698
1988	2,000	1.013	2,026
1989	2,110	1.028	2,169
1990	2,550	1.059	2,700
1991	2,675	1.128	3,017
1992	2,995	1.277	3,825
1993	2,600	1.753	4,558
Total	20,459		23,833

Exhibit 8

ABC Company
Projection of Ultimate Losses
Average Severity Projection

Self Insured Year	Projected Ultimate Severity	Projected Ultimate Incurred Claims	Projected Ultimate Loss ($000's)
1984	2,763	409	1,130
1985	2,847	418	1,190
1986	3,165	480	1,519
1987	3,400	502	1,707
1988	3,483	584	2,034
1989	3,681	591	2,175
1990	4,333	623	2,699
1991	4,366	693	3,026
1992	5,168	745	3,850
1993	5,784	811	4,691
Total			24,021

Exhibit 9

ABC Company
Projection of Ultimate Losses
Based on NCCI Losts Costs

Self Insured Year	Class Code = A: Class Payroll ($000's)	Class Code = A: Loss Cost [1]	Class Code = A: Expected Losses ($000's)	Class Code = B: Class Payroll ($000's)	Class Code = B: Loss Cost [1]	Class Code = B: Expected Losses ($000's)	Total Expected Losses ($000's)
1990	169,452	1.23	2,081	42,671	2.08	889	2,970
1991	177,001	1.31	2,326	44,806	2.23	998	3,324
1992	185,811	1.41	2,613	47,001	2.38	1,121	3,734
1993	196,152	1.50	2,951	49,398	2.55	1,260	4,211
1994[2]	203,998	1.61	3,284	51,374	2.73	1,403	4,687

1) The expense components of the rates have been stripped out.

2) Based on 1993 payroll trended at 4%.

Note: The loss costs for the prior years have been de-trended based on the NCCI trend factor.

Exhibit 10

ABC Company
Projection of Ultimate Losses
Trended Pure Premium Approach
Self-Insured Year 1992 - 1994

Self Insured Year	Total Payroll ($000's)	Selected Ultimate Loss [1] ($000's)	Pure Premium Per $100 Payroll	Pure Premium Trended To 1992 [2]	Selected Pure Premium	Selected Ultimate Loss ($000's)
1988	199,679	2,011	1.007	1.370		
1989	200,511	2,190	1.092	1.376		
1990	212,123	2,773	1.307	1.524		
1991	221,807	3,015	1.359	1.468		
1992	232,812				1.435 [3]	3,341
1993	245,550				1.550	3,806
1994	255,372				1.673 [4]	4,272

1) Based on an average of the paid and incurred projections.

2) Selected Trend Factor of 8.00% based on analyzing industry data.

3) 1.435 = {(1.37+1.376+1.524+1.468)/4}

4) 1.673 = (1.435) * (1.08)^2

ABC Company
Selection of Ultimate Losses
Bornhuetter-Ferguson Projection Method
($000's)

Self Insured Year	Preliminary Selected Ultimate Loss*	Expected 1) Percentage Unreported	Expected IBNR	Incurred Loss	Indicated Ultimate
1992	3,734	21.69%	810	2,995	3,805
1993	4,211	42.96%	1,809	2,600	4,409

* Based on the expected loss method from Exhibit 9.

1) Selected from Exhibit 2.
The Expected percentage unreported = (1-(1/LDF))

ABC Company
Projection of Losses
Excess of 500,000 per Claim

Self Insured Year	Expected [1] Unlimited Losses (000's)	Excess [2] Ratio	Projected Excess Losses
1990	2,970	0.030	89
1991	3,324	0.032	106
1992	3,734	0.034	127
1993	4,211	0.037	156
1994	4,687	0.039	183

[1] From Exhibit 9

[2] From Exhibit 2 of Mr. Gillam's paper mentioned in the text. As a note, we have assumed that the factors are appropriate for the 1990 year and adjusted the excess ratio through the use of adjusting the loss limit for inflationary factors for the more recent years. For example, a $500,000 loss limit in 1990 may be equivalent to a $450,000 loss limit in 1992.

ABC Company
Projection of Excess Losses
Bornhuetter - Ferguson Method
($000's)

At September 30, 1993

Self Insured Year	Projected Excess Losses 1)	Expected Percentage of Excess Losses Unreported	Estimated IBNR Reserves	Reported Case Incurred	Projected Ultimate Excess Losses
1990	89	55%	49	0	49
1991	106	70%	74	300	374
1992	127	80%	102	0	102
1993	156	95%	148	0	148
1994	183	100%	183	0	183

1) From Exhibit 12

Note: For purposes of this paper, it is assumed that the entity will not have any excess claims for self-insured years 1989 and prior.

Exhibit 14

ABC Company
Selection of Ultimate Losses
($000's)

Self Insured Year	Indicated Ultimate Gross Loss Based on: Paid Loss Projection	Incurred Loss Projection	Average Severity Projection	Expected Loss Method	Trended Pure Prem Approach	Bornhuetter-Ferguson Projection	(A) Selected Ultimate Gross Loss	(B) Projected Excess Recoveries	(C) Paid Losses	(A)-(B)-(C) Total Retained Reserves
1984	1,141	1,130	1,130	xxxx	xxxx	xxxx	1,136	0	1,130	6
1985	1,183	1,190	1,190	xxxx	xxxx	xxxx	1,187	0	1,170	17
1986	1,539	1,519	1,519	xxxx	xxxx	xxxx	1,529	0	1,519	10
1987	1,629	1,698	1,707	xxxx	xxxx	xxxx	1,664	0	1,600	64
1988	1,996	2,026	2,034	xxxx	xxxx	xxxx	2,011	0	1,940	71
1989	2,211	2,169	2,175	xxxx	xxxx	xxxx	2,190	0	2,100	90
1990	2,846	2,700	2,699	2,970	xxxx	xxxx	2,804	49	2,550	205
1991	3,013	3,017	3,026	3,324	xxxx	xxxx	3,451	374	2,500	577
1992	3,821	3,825	3,850	3,734	3,341	3,805	3,807	102	2,700	1,005
1993	4,738	4,558	4,691	4,211	3,806	4,409	4,521	148	1,522	2,851
Total	24,117	23,833	24,021				24,300	673	18,731	4,896

ABC Company
Projected Ultimate Losses
Self Insured Year 1994
($000's)

Self Insured Year	Expected Loss Method	Trended Pure Premium Method [2]	Selected Gross Losses	Projected Excess Losses [3]	Projected Retained Losses
1994	4,687 [1]	4,272	4,480	183	4,297
				Unpaid Claim Liability @ 12/31/93	4,896 [4]
				Required Fund	9,376

[1] From Exhibit 9
[2] From Exhibit 10
[3] From Exhibit 12
[4] From Exhibit 14

XYZ Manufacturing Company
Retained Workers Compensation Loss Experience

Accident Year	Medical Paid	Medical Reserves as of 12/31/93	Indemnity Paid	Indemnity Reserves as of 12/31/93	Total Paid	Total Reserves as of 12/31/93
1988	N/A	$311,429	N/A	$467,143	N/A	$778,572
1989	N/A	80,355	N/A	120,533	N/A	200,888
1990	N/A	128,002	N/A	192,003	N/A	320,005
1991	N/A	180,331	N/A	270,497	N/A	450,828
1992	N/A	460,633	N/A	690,949	N/A	1,151,582
1993	593,137	470,377	400,991	875,066	994,128	1,345,443
Total	$593,137	$1,631,127	$400,991	$2,616,191	$994,128	$4,247,318

Note: Values have been projected through year-end based on data through September 30.

Calendar Year	Paid Medical Losses	Paid Indemnity Losses	Total Paid Losses
1988	$260,862	$272,544	$533,406
1989	$651,032	$467,240	1,118,272
1990	$871,846	$637,620	1,509,466
1991	$910,173	$780,913	1,691,086
1992	$1,027,186	$1,041,109	2,068,295
1993	$1,236,234	$1,430,987	2,667,220
Total	$4,957,333	$4,630,412	$9,587,744

Exhibit 17

Derivation of Case Development Factors
Based on NCCI Data for a Specific State

	Cumulative Medical Development Factors			Cumulative Indemnity Development Factors		
Age	Paid	Incurred	Case	Paid	Incurred	Case
72	1.177	1.069	1.752	1.215	1.043	1.304
60	1.203	1.070	1.633	1.288	1.058	1.325
48	1.237	1.076	1.584	1.416	1.069	1.282
36	1.299	1.074	1.427	1.659	1.092	1.269
24	1.463	1.103	1.419	2.197	1.170	1.364
12	2.611	1.346	1.714	4.297	1.517	1.799

*The above factors were selected for illustrative purposes.

Exhibit 18

XYZ Manufacturing Company
Case Development Method

Accident Year	Medical Reserves as of 12/31/93	Medical Case Development Factor	Indicated Total Unpaid Medical Loss as of 12/31/93
1988	$311,429	1.752	$545,615
1989	80,355	1.633	131,232
1990	128,002	1.584	202,746
1991	180,331	1.427	257,373
1992	460,633	1.419	653,445
1993	470,377	1.714	806,299
Total	$1,631,127		$2,596,710

Exhibit 19

XYZ Manufacturing Company
Case Development Method

Accident Year	Indemnity Reserves as of 12/31/93	Indemnity Case Development Factor	Indicated Total Unpaid Indemnity Loss as of 12/31/93
1988	$467,143	1.304	$609,038
1989	120,533	1.325	159,682
1990	192,003	1.282	246,065
1991	270,497	1.269	343,311
1992	690,949	1.364	942,227
1993	875,066	1.799	1,574,347
Total	$2,616,191		$3,874,670

Exhibit 20

Selected Payment Patterns

Based on NCCI data for a Specific State

	Paid Losses as a Percent of Ultimate Losses			
	Medical		Indemnity	
Age	Cumulative	Incremental	Cumulative	Incremental
72	0.850	0.018 P_6	0.823	0.047 P_6
60	0.831	0.023 P_5	0.776	0.070 P_5
48	0.808	0.039 P_4	0.706	0.103 P_4
36	0.770	0.086 P_3	0.603	0.148 P_3
24	0.684	0.301 P_2	0.455	0.222 P_2
12	0.383	0.383 P_1	0.233	0.233 P_1

XYZ Manufacturing Company

Calendar Year Incremental Payment Method

Medical Losses

Accident Year	Trend (in Years)	Calendar Year Incremental Payments 1991	1992	1993	1994 & Subsequent
1988 AY_0	0	0.039	0.023	0.018	0.150
1989 AY_1	1	0.099	0.044	0.026	0.193
1990 AY_2	2	0.393	0.113	0.050	0.251
1991 AY_3	3	0.573	0.450	0.129	0.345
1992 AY_4	4		0.656	0.515	0.542
1993 AY_5	5			0.750	1.209
Total		1.104	1.286	1.489	2.690

	Indication 1	Indication 2	Indication 3	Selected
Calendar Year Unpaid Loss Factor:	2.436 *	2.092	1.806	
Calendar Year Paid Losses:	910,173	1,027,186	1,236,234	
Indicated Unpaid Medical Losses @ 12/31/93:	2,217,490	2,148,695	2,232,609	2,199,598

Loss Trend: 10.0%
Exposure Trend: 4.0%
r = 14.4%

$$*2.436 = 2.690/1.104 = \frac{\sum_{i=0}^{5}\{(1-\sum_{j=1}^{(6-i)} P_j)(1+r)^i\}}{\sum_{i=0}^{1} P_{3,i}(1+r)^i}$$

That is the sum of all future payments (1994 and subsequent) for accident years 1988-1993 divided by calendar year 1991 payments on accident years 1988-1991.

XYZ Manufacturing Company
Calendar Year Incremental Payment Method
Indemnity Losses

Accident Year	Trend (in Years)	Calendar Year Incremental Payments 1991	1992	1993	1994 & Subsequent
1988 AY_0	0	0.103	0.070	0.047	0.177
1989 AY_1	1	0.158	0.103	0.070	0.240
1990 AY_2	2	0.255	0.148	0.103	0.337
1991 AY_3	3	0.286	0.222	0.148	0.488
1992 AY_4	4		0.233	0.222	0.717
1993 AY_5	5			0.233	1.082
Total		0.803	0.776	0.823	3.041
		Indication 1	Indication 2	Indication 3	Selected
Calendar Year Unpaid Loss Factor:		3.788 *	3.917	3.695	
Calendar Year Paid Losses:		780,913	1,041,109	1,430,987	
Indicated Unpaid Indemnity Losses @ 12/31/93:		2,958,275	4,078,386	5,287,960	4,108,207
Indicated Unpaid Medical Losses @ 12/31/93:		2,217,490	2,148,695	2,232,609	2,199,598
Indicated Total Unpaid Losses @ 12/31/93:		5,175,765	6,227,081	7,520,569	6,307,805

Loss Trend: 3.0%
Exposure Trend: 4.0%
r = 7.1%

$$* 3.788 = 3.041/.803 = \frac{\sum_{n=0}^{5} \{ (1 - \sum_{i=1}^{(6-n)} P_i) (1+r)^n \}}{\sum_{n=0}^{5} P_{3,n} (1+r)^n}$$

That is the sum of all future payments (1994 and subsequent) for accident years 1988-1993 divided by calendar year 1991 payments on accident years 1988-1991.

Exhibit 23

XYZ Manufacturing Company
De-Trended Bornhuetter-Ferguson Method

Accident Year	Indemnity Selected Ultimates*	Indemnity % Unreported	Indemnity Estimated IBNR	Medical Selected Ultimates**	Medical % Unreported	Medical Estimated IBNR	Estimated IBNR	Case Reserves	Unpaid Claim Liability
1993	1,800,000	34.08%	613,448	1,500,000	25.71%	385,587	999,035	1,345,443	2,344,478
1992	1,680,672	14.53%	244,200	1,311,189	9.34%	122,441	366,641	1,151,582	1,518,223
1991	1,569,255	8.42%	132,208	1,146,144	6.89%	78,971	211,179	450,828	662,007
1990	1,465,224	6.45%	94,575	1,001,874	7.06%	70,764	165,339	320,005	485,344
1989	1,368,090	5.48%	74,999	875,764	6.54%	57,293	132,292	200,888	333,180
1988	1,277,395	4.12%	52,663	765,528	6.45%	49,412	102,075	778,572	880,647
Total			1,212,094			764,468			6,223,880

* Trend Factor 7.1%

** Trend Factor 14.4%

Ultimate Loss Projection
Accident Year 1993

Indemnity	Amount	LDF	Ultimate	Medical	Amount	LDF	Ultimate
Paid	400,991	4.297	1,723,058	Paid	593,137	2.611	1,548,681
Incurred	1,276,057	1.517	1,935,778	Incurred	1,063,514	1.346	1,431,490
Selected			1,800,000	Selected			1,500,000

Exhibit 24

XYZ Manufacturing Company
Projected Ultimate Losses
For Self-Insured Year 1994

	Indemnity	Medical	Total
Selected 1993 Ultimate Loss	1,800,000	1,500,000	3,300,000
Selected Annual Trend Factor	1.03	1.10	
Anticipated Exposure Growth	1.04	1.04	
Ultimate Losses Self Insured Year 1994	1,928,160	1,716,000	3,644,160

Exhibit 25

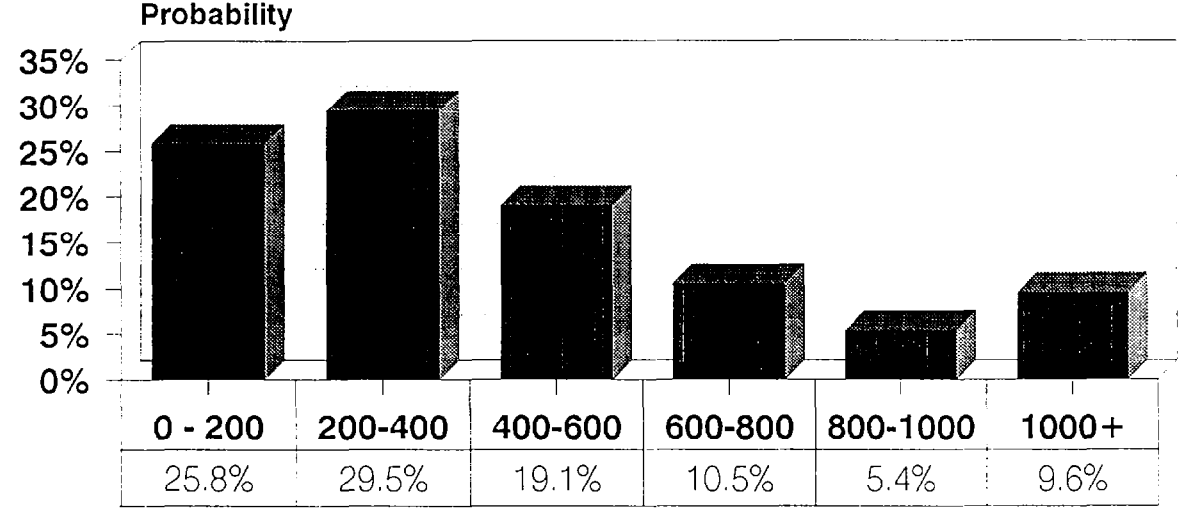
XYZ Manufacturing Company
Selected Fund at 12/31/93
($000'S)

1.) Estimated Unpaid Claim Liability - Case Development Method	6,471
2.) Estimated Unpaid Claim Liability - Incremental Payment Method	6,308
3.) Estimated Unpaid Claim Liability - De-Trended Bornhuetter-Ferguson Method	6,224
4.) Selected Unpaid Claim Liability as of December 31, 1993 {Average((1)+(2)+(3))}	6,334
5.) Selected Claim Costs for 1994	3,644
6.) Required Fund at 12/31/93 (4)+(5)	9,979

Probability Distribution of Losses

Expected Unlimited Losses = $500,000

No Per Occurrence Loss Limitation



For Illustrative Purposes Only

Probability Distribution of Losses
Expected Unlimited Losses = $500,000

No Occurrence Loss Limitation of $50,000

Probability Level	Loss Amount	Relativity to Expected Values
Exp value	$500,000	
75%	605,000	1.21
90%	980,000	1.96
95%	1,425,000	2.85

Exhibit 28

ABC Company
Workers' Compensation
Projected Payout Pattern

Number of Years From Inception of the Exposure	Cumulative Loss Payments	Incremental Loss Payments	Incremental Discounted Loss Payments
1	32	32	31
2	71	39	35
3	83	12	11
4	90	7	5
5	95	5	4
6	97	2	2
7	98	1	1
8	99	0	0
9	99	0	0
10	99	0	0
11	99	0	0
12	100	0	0
13	100	0	0
Total		100	90

Discount @ 6.0%

Discount Factor 0.90

Confidence Level Analysis

Expected Losses = 500,000
No Per Occurrence Loss Limitation

Probability Level	Loss Amount	Relativity To Expected Value
Expected Value	$500,000	
75%	605,000	1.21
90%	980,000	1.96
95%	1,425,000	2.85

Expected Ultimate Losses = 500,000
Per Occurrence Loss Limitation = 50,000

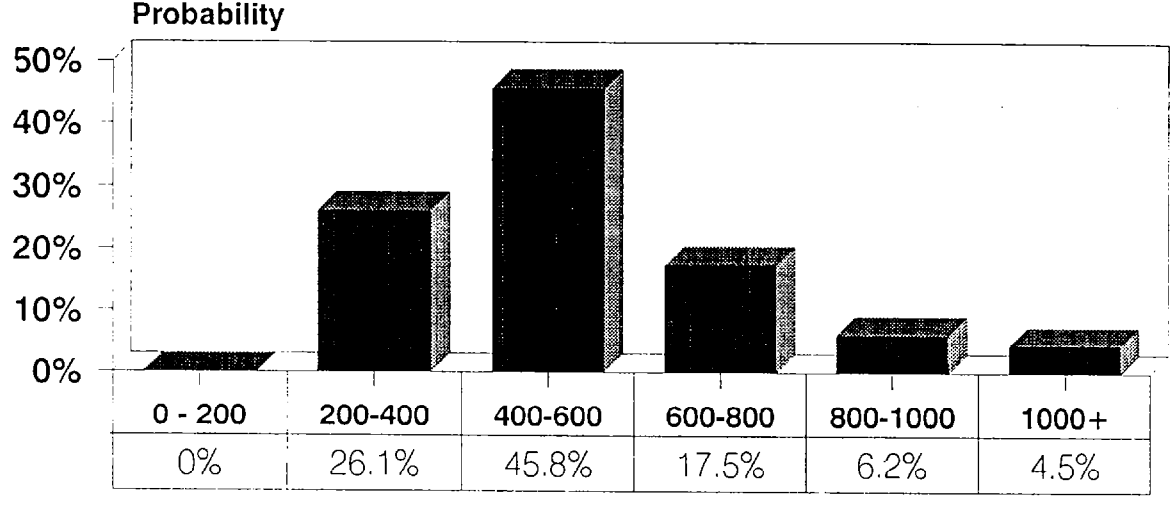
Probability Level	Loss* Amount	Expected Excess	Total Insurance Costs	Relativity To Expected Value
Expected Value	$321,000	223,750	544,750	
75%	398,040	223,750	621,790	1.14
90%	587,430	223,750	811,180	1.49
95%	747,930	223,750	971,680	1.78

*** Excludes 179,000 of Expected Excess Losses Which Based on a 25% Loading Results in an Excess Premium Amount of 223,750**

For Illustrative Purposes Only

Probability Distribution of Losses

Expected Unlimited Losses = $500,000
Per Occurrence Retention of $50,000



For Illustrative Purposes Only