Volume LXXXIV, Part 2 No. 161

PROCEEDINGS
November 9, 10, 11, 12, 1997

FUNDING FOR RETAINED WORKERS COMPENSATION EXPOSURES

BRIAN Z. BROWN AND MICHAEL D. PRICE

Abstract

The number of firms retaining part of their workers compensation exposure has grown dramatically over the last 5 to 10 years. It is important that firms fund and reserve for their retained exposure so that their balance sheet and income statements are accurate. This paper outlines several methods that can be used to establish funding levels for self-insured employers. Additionally, we outline several considerations which employers face in deciding whether or not to self-insure and some of the factors which affect the structure of a self-insured program.

1. INTRODUCTION

The self-insured workers compensation market grew dramatically between 1986 and 1991. Table 1 displays the growth in

TABLE 1

WORKERS COMPENSATION
PERCENTAGE OF MARKET SELF-INSURED

Calendar Year	Self-Insured Percentage
1986	20.1%
1987	21.2
1988	22.3
1989	25.5
1990	25.9
1991	29.0

the percentage of the total market that is self-insured (based on premiums and premium equivalents).[1]

In this paper we will outline various methods that can be used to estimate the self-insured employers' liability for their retained exposures. Although a more rigorous definition will be provided later, the "funding level" can be thought of as the contributions needed to:

- pay the expected amount of claims and related costs in the "upcoming year," and
- establish an appropriate accrual as of the end of the year.

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 estimate the funding level.

The paper is divided into seven sections. The first section is the introduction. The second section discusses some of the benefit and cost considerations involved in deciding whether to commercially insure or retain some of the exposure in-house.

[1]See Johnson & Higgins [1]. 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.

The third section describes some of the significant requirements that states impose on firms that self-insure their workers compensation exposure. In the fourth section, the funding level is defined.

The fifth 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 that has been self-insured for only a short time period and has limited loss and exposure information.

The sixth section of the paper discusses several additional items that 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.

2. 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, and
- other considerations.

A.1. 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: expected loss costs (including allocated loss adjustment expenses), operating expenses, expected profit (excluding risk load), and risk load.[2] The self-insured entity can potentially achieve cost savings in three of these four premium components. The entity cannot avoid the risk load "cost."

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, the difference between the average loss costs and the entity's loss costs is expected to be realized as cost savings by the self-insurer. That is, the self-insurer reaps the full benefit of better-than-expected loss experience. This is not to say that commercial insurer pricing is inaccurate. Rather, an entity may have recently changed its risk management and/or loss control policies and these changes have not yet been reflected in data which is measurable. Therefore, by self-insuring, the entity is "betting" that its changes are more favorable than measured by the commercial insurance market.

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[2]We are using the term "profit" to include both underwriting results and investment returns. One way to measure this profit is to compute the discounted (present value) of the net cashflows (premium less expenses and losses) at the insurer's projected yield rate. We believe it is important to consider investment returns in the profit calculation since the self-insured losses will be paid over an extended period of time whereas the commercial insurance premium is paid at policy inception. To focus solely on underwriting income (and ignore investment results) would ignore the fact that the self-insured can invest the funds it would have paid for commercial insurance.

Furthermore, the self-insurer benefits directly and immediately from any reduction in expected loss costs that 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 used by 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, in most cases, these options either dilute or delay (or both) the full benefit of reduced loss potential. For example, under a dividend plan, a $1 reduction in loss experience does not usually translate into a $1 dividend; furthermore, the dividend payment is made many months after the close of the policy period.

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 and premium taxes. Self-insurers can further achieve cost savings by retaining the provision for expected profit in the rates.

We believe that the self-insurer cannot avoid the uncertainty of outcomes associated with retaining its exposure 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.

A.2. 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 purchased from 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 or loss prevention, and the company's bottom line. This greater awareness may often lead to measures enacted with the intention of reducing costs and providing a safer workplace.

A.3. Other Considerations

Through the mechanism of self-insurance, the employer is able to provide workers compensation benefits to its employees (subject to regulatory approval). While all employers are able to obtain workers compensation coverage from the residual market, if not from the voluntary market, many employers wish to avoid the stigma of being considered a substandard risk when 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 may result not only in cost savings for the employer, but also in 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 that back the liabilities incurred by self-funding. This freedom allows the company to seek potentially higher rates of return than are 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 cost to employers,
- increased variability of insurance related costs,
- additional staffing costs, and
- other considerations.

B.1. Increased Cost to Employers

To the extent that the entity considering self-insurance has higher-than-expected loss costs, this difference is realized as an additional cost when self-insuring. Additionally, many states will require a letter of credit (LOC) or other collateral to be posted by self-insured entities. The fee for obtaining this collateral is an additional cost.

B.2. 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. This result follows from consideration of the Law of Large Numbers. That is, the variance associated with the sample mean is less than or equal to the variance associated with a single observation [2].

Premiums charged by commercial insurers and funding levels established by self-insurers may contain a provision for contin-

gencies 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 insured exposures. Additionally, there may be greater uncertainty when the self-insurer estimates its ultimate future costs than when an insurance company develops average rates. The uncertainty involved in estimating cost or rate parameters is referred to as "parameter risk." Estimates of claim frequency and severity that are derived from large credible databases, 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 self-insurer requires a proportionately larger loading than the insurance company does for the risk that losses will, in the aggregate, exceed their expected value by some percentage. This differential represents a cost of self-insurance.

Furthermore, the amount of funding required to pay insurance claims is less certain and more variable for a self-insured employer. 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 increased uncertainty can complicate the financial planning process of the employer. This complication can be viewed as a cost of self-insurance.

B.3. Additional Staffing Costs

The employer that decides to self-insure must provide or purchase many services otherwise provided by the commercial insurer, including claims handling, database management, and loss control/prevention services. Other services required by a self-insurer include audit, actuarial, and investment management services.

These services are essential to the successful management and financing of workers compensation exposures. 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 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 exposure 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.

B.4. Other Considerations

One additional cost associated with the decision to self-insure is the potential adverse impact 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 that self-insure their exposure 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 pertains to 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 payment risk due to insolvency associated with future excess insurance recoveries.

It should be noted that, although federal income tax considerations are outside the scope of this paper, they may be significant. Typically a self-insured employer can deduct losses only as they are paid, whereas commercial insurance premiums are fully deductible. Also, many states require self-insured entities to meet various administrative requirements. These requirements may involve substantial time and cost.

3. 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),

[3]"The Self-Insurance Manual" [3] summarizes each state's statute related to workers compensation self-insurer requirements.

2. the most recent audited financial statement of the entity considering self-insurance, and

3. loss experience and payroll information.

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 parent's assets to guarantee the self-insurer's workers compensation payments.[4]

The second requirement, a recent audited financial statement, allows the state to 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 reduce the number of financially weak self-insured employers.

The last requirement, 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.[5]

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 [3]:

- excess insurance, and
- security or bonding.

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[4]Credit risk is the possibility that one entity will suffer a financial loss due to the inability of a second entity to satisfy its obligations. For example, if a self-insured employer went bankrupt, other employers in the state may be required to pay claimants' bills. Credit risk is discussed in more detail in Brown [4].

[5]There are minimum target ratios for: cash flow, liquidity, working capital, net worth, profitability, and turnover [3].

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 6.

The security or collateral requirement is the mechanism that states have established to compensate claimants in the event of a self-insured employer's bankruptcy. Most states do not have prefunded 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, in general, 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 taxing 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, the reader is cautioned that specific requirements vary significantly from state to state.

4. FUNDING LEVEL

For illustrative purposes, 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 that involves earmarking assets.[6] A partial list of the most commonly used risk financing techniques for retained exposures includes:

- 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.

There are advantages and disadvantages associated with each of the above mentioned techniques. Some of the advantages of using a funded reserve as a risk financing technique include the following.

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 accrue a liability 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.[7] An appropriate (i.e., reasonable)

[6]A risk financing option involving earmarking assets has several advantages from a financial planning standpoint, as the text discusses. The gross liability to the employer is similar regardless of the risk financing option. The risk financing options affect only the distribution of assets.

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

funded reserve would probably satisfy these requirements.

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.[8]

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

1. The entity may have better use of its funds than merely to invest in financial instruments in anticipation of paying future losses. The firm may be able to generate a better return by devoting funds to regular productive activities.
2. The funded reserve may appear as idle funds and be redeployed for other corporate purposes.

We define the required "fund" 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])

[8]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.

  - 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
  - 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 costs
  - Second injury fund assessment, taxes etc.
  - Risk charge (this is discussed under loss probability levels in Section 6)
  - 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 calendar year is then equal to:

- the prior years' liabilities, plus
- the funding obligations for the future accident year, minus

- the amount of assets earmarked to pay for the obligations.

If investment income is intended to remain in the fund, then the assets should include the investment income earned on the earmarked assets.

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. Section 6 will cover 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.

5. FUNDING LEVEL EXAMPLES

In this part of the paper, we will outline approaches that can be used to estimate the funding level 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 One—The self-insured employer has adequate data to utilize several commonly accepted actuarial projection methods.
- Scenario Two—The self-insured employer does not have sufficient data to utilize commonly used actuarial projection 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 National Council on Compensation Insurance [NCCI] class codes).

We will first discuss a procedure to project gross losses, although 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, a projection of gross losses is needed to estimate an uncollectible excess insurance provision.

We will use the term "loss" to include both losses and ALAE.

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

- Exhibit 1 displays the employer's paid loss experience,
- Exhibit 2 displays the employer's incurred loss experience,
- 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 employer's workers compensation payroll by self-insured year and class.

A.1. Projection of Gross Losses

Based on the above-mentioned data items, we can use several methods to estimate ultimate losses by self-insured year. The unpaid claim liability can 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 count times average 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 well documented in the actuarial literature. The exhibits should be self-explanatory.

Note that if more refined data are 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 expense), or
3. a combination of 1 and 2 above (e.g., by class for medical costs versus by class for indemnity costs).

Further breakdown of the data may reveal trends not apparent by viewing the data more globally. However, this will involve less data and hence introduce credibility concerns.

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 gross loss projections we have assumed that there were no unusually large losses that would distort the projections. If there are unusually large losses, they should be treated separately.[9]

A.2. Projection of Net Losses

Several methods can be used to estimate the retained losses for the entity. We will discuss two. 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 construct "triangles" gross of aggregate retentions and limit the projected losses at the aggregate retention. As a note, both the Bornhuetter–Ferguson 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 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 from Gillam [5].

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

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[9]For example, the large losses can be removed from the projection methodology and evaluated independently.

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

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

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

- a mixture of attachment points and retention levels,
- a mixture of different types of risks, and
- varying company reporting requirements and reserving philosophies.

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) can be determined based on an expected loss method and a trended pure premium approach. 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 summarizes the estimates and displays the calculation.

B. Limited Data Example

The XYZ Manufacturing Company has self-insured its workers compensation exposures for the past six years. While the firm has paid over $7,000,000 in claims during that time period, it has 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. 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 claims are not known. Reserves are available separately for medical versus indemnity losses. The company has not captured exposure information by class code.

The absence of a complete set of cumulative data triangles for paid and incurred losses poses a problem for estimating the unpaid claim liabilities of the company. Traditional actuarial methodologies cannot be employed without modification. The first step is to estimate the reserve accrual for the company from inception of the self-insured period as of year-end 1993 (i.e., self-insured years 1988–1993 valued as of 12/31/93).

Three nonstandard actuarial techniques will be employed to estimate the reserve accrual 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.

B.1. Case Reserve Development Method

The case reserve development method is similar to the paid and incurred loss development methods and is predicated on the assumption that case reserves have been established in a manner consistent with industry standards. Unusually large losses may distort the development projection and therefore should be treated separately.

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 incurred but not reported losses [IBNR]) for that accident year.

This method may be well suited for application to workers compensation losses since most of the development beyond 24 months is attributable to supplemental development on known case reserves. Case development factors can be derived from cumulative paid and incurred loss development factors. Define the following notation:

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, and

U = Ultimate losses.

Then, on an expected value basis:

$$(P) \times (P_t) = U \text{ implies } P = (U)/(P_t), \quad \text{and}$$

$$(I) \times (I_t) = U \text{ implies } I = (U)/(I_t).$$

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

$$(I - P) \times (k) = (U - P);$$

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:

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

$$(U) \times (1/I_t - 1/P_t) \times (k) = (U) \times (1 - 1/P_t); \qquad \text{and}$$

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

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

In the example, 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 the 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.

B.2. Calendar Year Incremental Payment Method

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

- there is no change in the payment pattern by accident year (e.g., no speed up in claim settlements),

- the loss trend is constant and does not vary by accident year or calendar year, and
- there have been no usually large claim payments.

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 this example, we assume that medical losses (pure premiums) will increase at a rate of 10% annually and indemnity losses will increase by 3% annually.[10] As a note, these trends are in excess of payroll growth. We assume that the company's exposures have increased by approximately 4% per year (including payroll growth).

Let AY_0 denote accident year 0, and let P_0^t represent the incremental percentage of ultimate losses paid in year t for AY_0.

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:

$$\frac{\left(1 - \sum_{i=0}^{t} P_0^i\right)}{P_0^t},$$

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

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

$$\frac{(1+r)^k - \sum_{i=0}^{(t-k)} P_k^i (1+r)^k}{P_k^{t-k}(1+r)^k}.$$

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

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 factor 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 z 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 z accident years (z is the number of years self-insured), divided by the sum of the calendar year t payments for the z accident years (based on an assumed payment pattern). The expression is:

$$\frac{\sum_{k=0}^{z}\left[(1+r)^k - \sum_{i=0}^{(t-k)} P_k^i (1+r)^k\right]}{\sum_{k=0}^{z} P_k^{t-k}(1+r)^k}.$$

This expression can be seen to be the ratio of the sum of the numerators for each of the z accident year factors to the sum of the denominators for each of the z accident year factors. Notice that the trend factor cannot be factored out of this expression. The trend factor affects 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).

B.3. De-Trended Bornhuetter–Ferguson Method

The last method discussed is a De-Trended Bornhuetter–Ferguson [6] 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 losses,
- an assumed loss trend, and
- an assumed exposure trend.

For XYZ, the ultimate losses for 1993 are estimated based on incurred and paid loss projection methods. The ultimate losses for prior accident years are then estimated based on the combined loss and exposure trend. For example, the ultimate losses for self-insured year 1990 are equal to 1993 ultimate losses divided by $(1 + r)^3$. A Bornhuetter–Ferguson method can then be used to estimate the total reserves by year. Exhibit 23 displays the calculation.

The upcoming year's expected losses are 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

equal to the required fund less the amount of assets set aside to pay claim liabilities.

6. ADDITIONAL CONSIDERATIONS

This section will discuss factors other than 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 5 are expected values. Therefore, a significant percentage of the time the actual losses will exceed the estimates derived in Section 5. The attached Exhibit 26 displays a hypothetical example of a distribution of projected losses for the upcoming self-insurance year for a risk with $500,000 of expected losses.

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 employer may also want to consider:

- How easy would it 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?

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

In deriving losses associated with 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 David Bickerstaff [7]. 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. 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 earnings will be available to satisfy future loss payments. In

this example, approximately $90 invested at the beginning of the period, along with projected interest earnings (at 6%) are anticipated to be sufficient to cover the expected loss payments shown 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 [8]. A partial list of issues and considerations includes:

- the timing of future payments and potentially a range of payment timing estimates,
- the interest rate selected 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 period. This consideration has resulted in some analysts assuming that the discounted losses associated with various probability levels (the present value of the losses associated with the probability level) are simply equal to the undiscounted amounts multiplied by the best estimate of the present value factor (based on the premise that this assumption is conservative). Given this assumption, the discounted probability level amounts could be computed by multiplying the undiscounted amounts by a uniform factor of .90 (see Exhibit 28).

Excess Insurance Issues

It appears that the most common types of excess insurance for workers compensation are per occurrence coverage and ag-

gregate coverage. 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. 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. For the latter, we have added a provision for the cost of excess insurance. For illustrative purposes, we have assumed that the excess insurer would include a 25% loading of the undiscounted expected value to determine premium.[11]

If the employer 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 employer 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 employer purchased per occurrence excess insurance. In comparing Exhibit 30 and Exhibit 26 it should be noted that:

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

- the distribution of insurance costs is less dispersed for the employer that purchases excess insurance, and
- the employer is forgoing the possibility of very favorable insurance costs (with the purchase of excess insurance) for reducing the possibility of adverse loss experience.

7. CONCLUSION

This paper has outlined several methods that can be used to establish funding levels for an entity that 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.

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[3] Lilly, C. C. and H. G. Boggs, "The Self Insurance Manual," NILS Publishing Company.

[4] Brown, Brian Z., "Pricing for Credit Exposure," *PCAS* LXXIX, 1992, pp. 186–214.

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[6] Bornhuetter, R. L., and R. E. Ferguson, "The Actuary and IBNR," *PCAS* LIX, 1972, pp. 181–195.

[7] Bickerstaff, David, "Hospital Self-Insurance Funding: A Monte-Carlo Approach," *Casualty Actuarial Society Forum*, Spring 1989, pp. 89–138.

[8] Actuarial Standards Board, Actuarial Standard of Practice No. 20, "Discounting of Property and Casualty Loss and Loss Adjustment Expense Reserves," American Academy of Actuaries, April 1992.

EXHIBIT 1

ABC COMPANY PAID LOSSES*—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									

*Including ALAE.

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

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*—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									

*Including ALAE.

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

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*

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**
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

*Claims that either have closed with an indemnity payment or have an indemnity reserve.
**These frequencies imply an exponential trend of 3.7% per year.

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

EXHIBIT 4

ABC COMPANY INCURRED LOSS SEVERITY TRIANGLE

Self Insured Year	Months of Development										Ultimate Severity*
	12	24	36	48	60	72	84	96	108	120	
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

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

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 Cumulative Factor	1.693	1.251	1.123	1.057	1.031	1.017	1.010	1.000	1.000	1.000 Tail

EXHIBIT 5

ABC COMPANY PAYROLL BY CLASS CODE ($000'S)

Self Insured Year	Class Code A	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*	203,998	51,374	255,372

*Based on 1993 payroll trended 4%.

EXHIBIT 6

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

EXHIBIT 7

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

	Class Code = A			Class Code = B			Total
Self Insured Year	Class Payroll ($000's)	Loss Cost*	Expected Losses ($000's)**	Class Payroll ($000's)	Loss Cost*	Expected Losses ($000's)**	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***	203,998	1.61	3,284	51,374	2.73	1,403	4,687

*The expense components of the rates have been stripped out.
**Subject to rounding error.
***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* ($000's)	Pure Premium Per $100 Payroll	Pure Premium Trended to 1992**	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***	3,341
1993	245,550				1.550	3,806
1994	255,372				1.673****	4,272

*Based on an average of the paid and incurred projections.
**Selected Trend Factor of 8.00% based on analyzing industry data.
***1.435 = {(1.37 + 1.376 + 1.524 + 1.468)/4}.
****1.673 = (1.435)*(1.08)^2.

EXHIBIT 11

ABC COMPANY SELECTION OF ULTIMATE LOSSES BORNHUETTER–FERGUSON PROJECTION METHOD ($000'S)

Self Insured Year	Preliminary Selected Ultimate Loss*	Expected** 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.
**Selected from Exhibit 2. The expected percentage unreported = (1 – (1/LDF)).

EXHIBIT 12

ABC COMPANY PROJECTION OF ULTIMATE LOSSES EXCESS OF 500,000 PER CLAIM ($000's)

Self Insured Year	Expected* Unlimited Losses	Excess** 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

*From Exhibit 9.
**From Exhibit 2 of Gillam [5]. As a note, we have assumed that the factors are appropriate for the 1990 year and adjusted the excess ratio by adjusting the loss limit for inflationary factors for the more recent years. For example, a $500,000 loss limit in 1990 is equivalent to a $450,000 loss limit in 1992.

EXHIBIT 13

ABC COMPANY PROJECTION OF EXCESS LOSSES BORNHUETTER–FERGUSON METHOD ($000'S)

At September 30, 1993

Self Insured Year	Projected Excess Losses*	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

*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:						(A) Selected Ultimate Gross Loss	(B) Projected Excess Recoveries	(C) Retained Paid Losses	(A)–(B)–(C) Total Retained Reserves
	Paid Loss Projection	Incurred Loss Projection	Average Severity Projection	Expected Loss Method	Trended Pure Prem Approach	Bornhuetter-Ferguson Projection				
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

EXHIBIT 15

ABC COMPANY PROJECTED ULTIMATE LOSSES FOR SELF INSURED YEAR 1994 ($000'S)

(1) Self Insured Year	(2) Expected Loss Method	(3) Trended Pure Premium Method	(4) Selected Gross Losses	(5) Projected Excess Losses	(6) Projected Retained Losses
1994	4,687	4,272	4,480	183	4,297
		Unpaid Claim Liability @ 12/31/93*			4,896
			Required Fund		9,193

Col. 2: From Exhibit 9.
Col. 3: From Exhibit 10.
Col. 5: From Exhibit 12.
*From Exhibit 14.

EXHIBIT 16

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	$ 200,663	$ 209,649	$ 410,312
1989	500,794	359,415	860,209
1990	670,651	490,477	1,161,128
1991	700,133	600,702	1,300,835
1992	790,143	800,853	1,590,996
1993	950,949	1,100,759	2,051,708
Total	$3,813,333	$3,561,855	$7,375,188

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	1.218	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

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	$0.018 = P^5$	0.823	$0.047 = P^5$
60	0.831	$0.023 = P^4$	0.776	$0.070 = P^4$
48	0.808	$0.039 = P^3$	0.706	$0.103 = P^3$
36	0.770	$0.086 = P^2$	0.603	$0.148 = P^2$
24	0.684	$0.301 = P^1$	0.455	$0.222 = P^1$
12	0.383	$0.383 = P^0$	0.233	$0.233 = P^0$

EXHIBIT 21

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 AY0	0	0.039	0.023	0.018	0.150
1989 AY1	1	0.099	0.044	0.026	0.193
1990 AY2	2	0.393	0.113	0.050	0.251
1991 AY3	3	0.573	0.450	0.129	0.345
1992 AY4	4		0.656	0.515	0.542
1993 AY5	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:	700,133	790,143	950,949	
Indicated Unpaid Medical Losses @ 12/31/93:	1,705,762	1,652,842	1,717,392	1,691,999

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

*2.436 = 2.690/1.104 or 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 22

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 AY0	0	0.103	0.070	0.047	0.177
1989 AY1	1	0.158	0.111	0.075	0.240
1990 AY2	2	0.255	0.169	0.119	0.337
1991 AY3	3	0.286	0.273	0.181	0.488
1992 AY4	4		0.306	0.293	0.717
1993 AY5	5			0.328	1.082
Total		0.803	0.930	1.043	3.041

	Indication 1	Indication 2	Indication 3	Selected
Calendar Year Unpaid Loss Factor:	3.788*	3.270	2.916	
Calendar Year Paid Losses:	600,702	800,853	1,100,759	
Indicated Unpaid Indemnity Losses @ 12/31/93:	2,275,596	2,618,481	3,209,583	2,701,220
Indicated Unpaid Medical Losses @ 12/31/93:	1,705,762	1,652,842	1,717,392	
Indicated Total Unpaid Losses @ 12/31/93:	3,981,358	4,271,323	4,926,975	

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

*3.788 = 3.041/.803 or 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	857,764	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

* Indemnity Trend Factor: 7.1%

** Medical 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

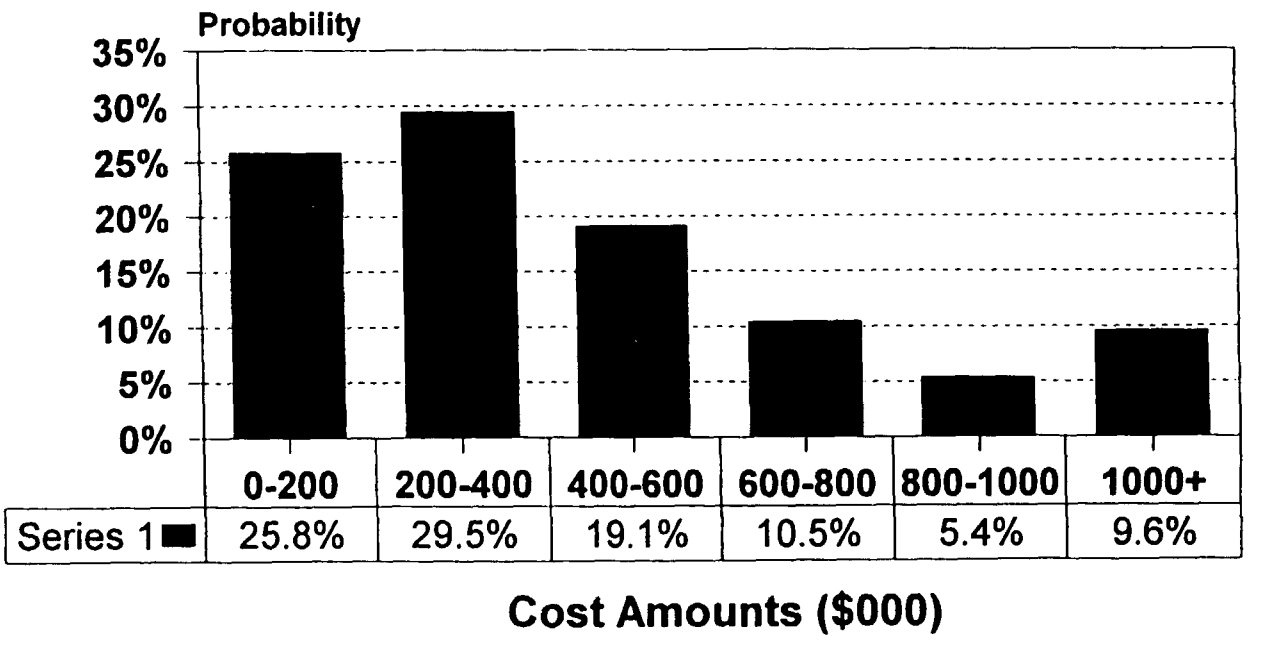
XYZ MANUFACTURING COMPANY SELECTED FUND AT 12/31/93 ($000'S)

1)	Estimated Unpaid Claim Liability—Case Development Method	6,471
2)	Estimated Unpaid Claim Liability—Incremental Payment Method	4,393
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)]}	5,696
5)	Selected Claim Costs for 1994	3,644
6)	Required Fund at 12/31/93 (4) + (5)	9,340

EXHIBIT 26

PROBABILITY DISTRIBUTION OF LOSSES
EXPECTED UNLIMITED LOSSES = $500,000

No Per Occurrence Loss Limitation



For Illustrative Purposes Only

EXHIBIT 27

PROBABILITY DISTRIBUTION OF LOSSES EXPECTED UNLIMITED LOSSES = $500,000

No Per Occurrence Loss Limitation

Probability Level	Loss Amount	Relativity to Expected Values
Exp value	$ 500,000	1.00
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	Discounted Incremental 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

EXHIBIT 29

CONFIDENCE LEVEL ANALYSIS

Expected Losses = 500,000
No Per Occurrence Loss Limitation

Probability Level	Loss Amount	Relativity to Expected Value
Expected Value	$ 500,000	1.00
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	1.00
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.

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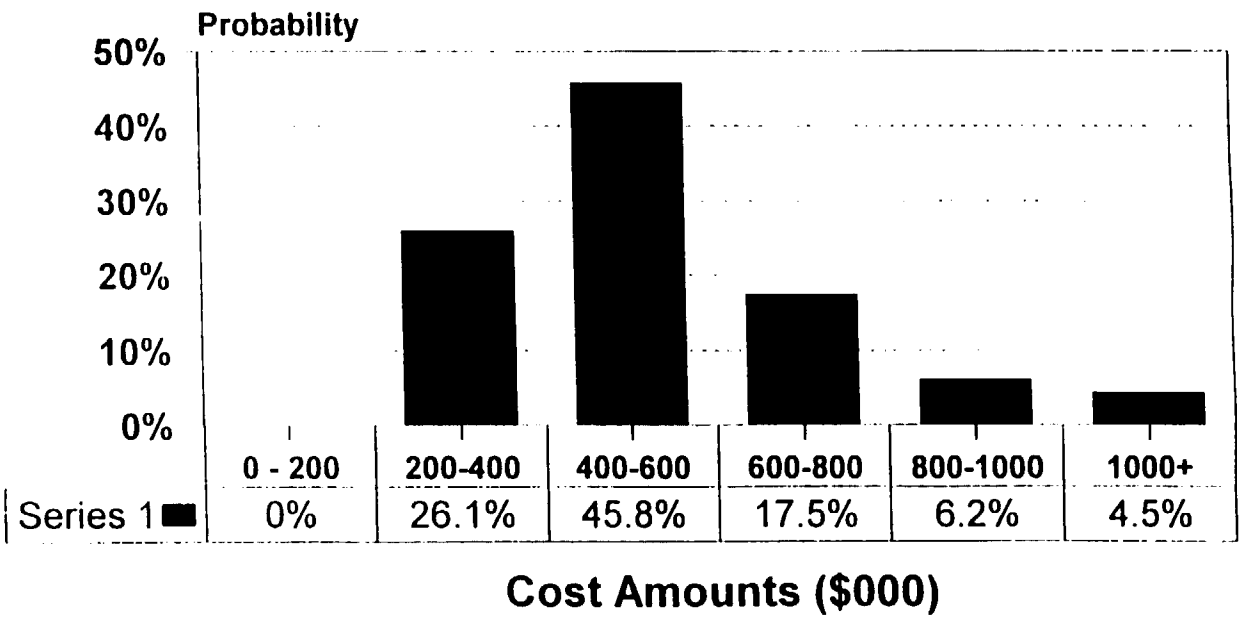
EXHIBIT 30

PROBABILITY DISTRIBUTION OF LOSSES
EXPECTED UNLIMITED LOSSES = $500,000

Per Occurrence Retention of $50,000



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