

Report on the Task Force on Application of Cash Flow Techniques to Pension Plans

Michael Cohen
Task Force Chair
William M. Mercer Ltd.
275 Slater Street
Ottawa, Ontario
K1P 5H9
Telephone: (613) 230-9348
Fax: (613) 230-9357

Other task force members are:

John Brophy
John Corp
Simon Curtis
Paule Desaulniers
Jacques Faille
Donald E. Grimes
Lucien Pouliot
Salim Shariff

Summary

The recent years have seen an increase in the volatility of economic factors that affect the operation of all financial institutions, including pension plans. Furthermore, there has been increasing concern with the solvency of all types of financial institutions.

In order to meet these concerns, actuaries working in life insurance companies have developed cash flow techniques to assist the management of insurance companies, regulators and others, to explore the impact of changing economic parameters on the operations of these companies. Actuaries advising pension plans have also been developing techniques to answer some of these questions.

The Council of the Canadian Institute of Actuaries therefore commissioned a task force to report on the applicability of cash flow techniques used by life insurance companies to pension plans.

The purpose of the report is to examine in some detail cash flow techniques used for life insurance companies and pension plans, and to recommend what future action should be taken in regard to education and standards of practice for pension plan actuaries in regard to the application of such techniques to pension plans.

It appears that little "interdisciplinary" research has been undertaken. One aim of the report is to encourage actuaries working in one domain, for example, pension plan, to become more familiar with techniques used by actuaries in another domain, for example, life insurance. This encouragement should be extended to actuaries working in yet other domains, for example, property and casualty insurance companies or investment areas (e.g. deposit institutions).

**Rapport du Groupe de travail sur
l'application des techniques de flux financiers
aux régimes de retraites**

Michael Cohen
Président du Groupe de travail
William M. Mercer Ltd.
275 Slater Street
Ottawa, Ontario
K1P 5H9
Téléphone : (613) 230-9348
Télécopie : (613) 230-9357

Les autres membres du
groupe de travail sont :
John Brophy
John Corp
Simon Curtis
Paule Desaulniers
Jacques Faille
Donald E. Grimes
Lucien Pouliot
Salim Shariff

Résumé

Nous avons assisté au cours de ces dernières années à une augmentation de la volatilité des facteurs économiques qui affectent le fonctionnement de toutes les institutions financières, y inclus les régimes de retraite. Par ailleurs, la solvabilité des institutions financières de tous types a également fait l'objet de préoccupations croissantes.

Pour tenir compte de ces réalités, les actuaires employés dans les compagnies d'assurance vie ont élaboré des techniques de flux financiers, pour aider la direction des compagnies d'assurance, les régulateurs et d'autres à explorer l'impact de l'évolution des paramètres économiques sur les activités de ces compagnies. Les actuaires conseillers de régimes de retraite élaborent également des techniques afin de répondre à certaines de ces questions.

Le Conseil de l'Institut Canadien des Actuaires a donc confié à un groupe de travail la responsabilité d'évaluer l'applicabilité des techniques de flux financiers utilisés par les compagnies d'assurance vie aux régimes de retraite et de présenter un rapport sur la question.

Le but du rapport est d'examiner de manière détaillée les techniques de flux financiers utilisées pour les compagnies d'assurance vie et les régimes de retraite, et de recommander les actions qu'il conviendra de prendre à l'avenir en matière de formation et de normes de pratique pour les actuaires chargés des régimes de retraite en ce qui concerne l'application de ces techniques.

On a pu constater que les exemples de recherche "pluridisciplinaire" sont rares. L'un des objectifs du rapport est d'encourager les actuaires travaillant dans un domaine, par exemple celui des régimes de retraite, à se familiariser avec les techniques utilisées par les actuaires dans d'autres domaines, tels que l'assurance vie. Cet encouragement devrait également être donné aux actuaires exerçant leurs activités dans d'autres domaines encore, tels que les compagnies d'assurance de biens et risques divers ou les investissements (institutions de dépôts).

APPLICATION OF CASH FLOW TECHNIQUES TO PENSION PLANS

1. INTRODUCTION

- 1.01 The Council of the Canadian Institute of Actuaries has charged this task force with exploring the applicability of cash flow techniques used by life insurance companies to pension plans. The terms of reference are found in Section 2 of this report. This report deals with issues related to defined benefit pension plans.
- 1.02 The recent years have seen an increase in the volatility of economic factors that affect the operations of all financial institutions, including pension plans. Furthermore, there has been increasing concern with the solvency of all types of financial institutions.
- 1.03 In order to meet these concerns, actuaries working in life insurance companies have developed cash flow techniques to assist the management of insurance companies, regulators and others, to explore the impact of changing economic parameters on the operations of these companies. Actuaries advising pension plans have also been developing techniques to answer some of these questions.
- 1.04 The purpose of this report is to examine in some detail: cash flow techniques used for life insurance companies; comparable techniques used for pension plans; and differences between life insurance companies and pension plans.

The report will then discuss whether some of the cash flow techniques being used by life insurance company actuaries can be profitably applied to pension plans. If so, what action should the Institute take: educational material; continuing education; guidelines or standards?

- 1.05 It appears that little "interdisciplinary" research has been undertaken. One aim of this report is to encourage actuaries working in one domain, for example, pension plans, to become more familiar with techniques used by actuaries in another domain, for example, life insurance. This encouragement should be extended to actuaries working in yet other domains, for example, property and casualty insurance companies or investment areas (e.g., deposit institutions). The authors of this report hope that the report will promote such interdisciplinary exploration.

2. TERMS OF REFERENCE

The task force is charged with examining the following questions:

- What is the purpose and scope of cash flow techniques used by life insurance companies?
- To what extent are existing cash flow techniques used by life insurance companies applicable to pension plans?
- What are the similarities and differences between life insurance companies and pension plans that have a bearing on the different techniques used?
- To what extent are existing techniques of analysis applicable to pension plans analogous to cash flow techniques used by life insurance companies?
- If the results of the previous questions indicate that additional techniques could be applied to pension plans, should such techniques, suitably modified, be:
 - incorporated into financial reporting standards for pension plans? or
 - form the subject of one or more valuation technique papers (VTPs)? or
 - form the subject of additional educational material, including continuing education?

3. CASH FLOW TECHNIQUES

- 3.01 Cash flow techniques are not new to the actuary. After all, actuaries have been projecting cash flows for insurance companies and pension plans since the earliest days of actuarial science.
- 3.02 However, in traditional actuarial work, the interest rate is determined independently of the liability cash flows. The assets and liabilities are treated separately.
- 3.03 Cash flow techniques can be distinguished by the fact that they integrate the cash flows in respect to both the assets and liabilities, in many cases treating them interactively.
- 3.04 The greater degree of volatility in financial markets, as well as increased competitive pressures among life insurance companies, have led to greater sophistication in actuarial models. Of course, greater computing power has allowed actuaries to improve on these techniques.
- 3.05 There is a perception that life insurance actuaries are more advanced in their development of these techniques as compared to pension plan actuaries. The task force has examined whether there is reality in this perception, and if so, whether and how pension plan actuaries can bridge the gap.

4. CASH FLOW TECHNIQUES USED BY LIFE INSURANCE COMPANIES

- 4.01 Cash flow techniques have been defined as processes by which the expected cash flows on financial instruments (assets, liabilities, or both) are explicitly modelled on a period-by-period basis either individually or collectively. These cash flows are commonly carried forward with appropriate reinvestment assumptions or, alternatively, their present values are taken to determine the next expected surplus position of an asset/liability block.
- 4.02 When applied to asset/liability management, cash flow techniques often recognize the interaction between the asset and liability performance, and often use more sophisticated mathematical or statistical methods to reflect the fact that investment performance contains a random and unpredictable element.
- 4.03 The same underlying principle of explicitly projecting the cash flows period by period, using realistic assumptions for all factors, applies to all cash flow models. Where models differ is in:
 - a) their sophistication as measured by the degree to which interactions between different assumptions used in the projections are reflected in the model (e.g., asset cash flows should reflect asset calls appropriate to the investment scenario used)
 - b) the degree of sophistication used to determine the expected cash flows from different elements (e.g., a stock projection, assuming that there is volatility in returns modelled, rather than returns that are flat at an expected level), and
 - c) the degree of sophistication brought to the determination of the economic scenario itself.
- 4.04 Cash flow techniques are powerful tools for several reasons. First, they are flexible and can be applied to a wide variety of financial management issues. Secondly, concepts behind them assist in demystifying actuarial work by presenting approaches that can be understood by the average layman.
- 4.05 The growth in the use of cash flow techniques and the increasing sophistication of the techniques used has directly paralleled the development of computer software/hardware technology. Cash flow techniques are used for the following applications:
 - **Pricing**
 - a) Pricing of products
 - b) Reviewing expense charges/dividends

- **Investment Management**
 - a) Setting investment product credited rates
 - b) Analysing the risk position of investment product business
 - c) Setting investment strategies
 - d) Determining liquidity requirements
- **Statutory Statement Uses**
 - a) Setting statutory reserves
 - b) Projecting surplus position under different scenarios
- **Determining net worth positions**

4.06 Each application is examined separately below.

4.06.01 Pricing

For virtually all pricing today, models are built that project the year-by-year expected cash flows taking into account any constraints imposed by statutory requirements for the business being priced. These models will explicitly project forward for each future period the premiums received, investment income earned, assumed expenses incurred, assumed benefits paid and the increase in reserve for in-force products. Profitability is usually constrained by return on initial investment, or some type of present value of future statutory profit-based measure. Models are usually developed by setting a range of individual cells (i.e., specific age/sex/product characteristics) on which cash flows are projected, and then taking an assumed business distribution over all the cells to develop a model office.

Pricing models have traditionally concentrated on the liability side of the balance sheet – in other words, the expected investment return is a direct input into the modelling. Pricing has generally concentrated on developing an adequate charge structure for the expenses and noninvestment contingencies in the product. Setting investment strategies has been handled separately. As companies, consultants, and software developers build increasingly sophisticated and user-friendly models, there will be a trend to have the pricing model office expand to include specific asset/investment strategy modelling.

Another offshoot of the increasing sophistication is the use of techniques based on “option pricing” technology in place of the traditional deterministic approach. “Option pricing” basically uses probability models to generate multiple scenarios for projecting the cash flows, and it is the weighted outcome of these scenarios which determines the price. Traditional deterministic pricing uses defined “average assumption” projections to determine a price.

These same models are often used to review expense charges and the supportability of dividend scales.

4.06.02 Investment Management

Different forms of cash flow techniques are widely used in the asset/liability management of the investment return/credited rate relationship. Specific techniques are used both for new money liabilities (i.e., those with a longer than current period investment-return guarantee), and non-new money liabilities (i.e., the investment return credited is based on the earned rate of the assets in the period), since the nature of the management is very different for these two types of business.

For new money products, cash flow techniques are used to both set the interest rate to be credited, and for providing management information systems to manage exposure to changes in the investment environment that can endanger a company's ability to earn the rate guaranteed on the liabilities.

Pricing is usually done by some form of duration, convexity, or cash flow matching between the asset cash flows for a basket of real or notional assets and those of the liabilities to be written. All three measures require the projection of the expected cash flows for both the assets and liabilities. In addition, sophisticated rate-setting could include scenario testing. This would be accomplished by carrying forward under a variety of different investment scenarios (either deterministically or randomly generated) the net cash flows generated by the assets and liabilities with reinvestment/disinvestment as necessary until the liabilities are fully discharged.

In projecting the cash flows, it is important that all relevant call options on the asset side (as well as expected defaults) be recognized. On the liability side, any embedded policyholder options such as book value withdrawals must also be recognized. The rates of election of these options must reflect the interest rates in effect at that point in time in the cash flow projection.

Usually the actual investment strategy to be followed will have the same basic guidelines as the strategy used to set the credited rates and, therefore, will require the asset and liability cash flow projections for the whole in-force block of business. Analysis of the exposure to changes in the investment environment usually involves accumulating forward with reinvestment or present valuing the different cash flow patterns that will emerge under various scenarios for future interest rates. This will indicate the surplus position exposure to interest rate changes.

The issues in managing non-new money blocks are entirely different. First, what is being tested is the ability of investment returns based on the planned investment strategy to produce a credited rate and profits sufficient to make the product viable in a competitive market. Secondly, the rate credited will generally be explicitly linked to the rate earned. Finally, the eligible asset classes will generally be broader.

The trend for developing these strategies is to use asset/liability software that models not only the investment return, but also the full financial results into the future. New models tend to be more sophisticated because, not only are the asset and liability sides of the balance sheet projected, but also, the interaction between the two is modelled.

This interaction is modelled by passing asset returns to the liability model. This affects credited rates, which in turn influence new business, surrenders and reserves for the next period. This results in revised cash flows to the asset model, which generates new asset returns to recommence the loop, and so on.

Modelling of the interaction of asset returns/liability behaviour is relatively new: many applications still run asset/liability models independently without this interaction.

The models generally need the following parameters specified in addition to building model offices of in-force assets and liabilities:

- a) description of eligible assets for future purchase
- b) expected future new business assumptions
- c) investment strategy to be followed
- d) crediting strategy based on investment return
- e) interaction parameters (i.e., impact of credited rate versus market rate on new business levels, surrenders, etc.)
- f) economic scenarios (future interest rates, and investment performance for other asset categories)

Some of the models allow different economic scenarios to be developed explicitly. Alternatively, the economic scenario could be randomly generated.

One of the limitations of many of the existing models is that while the fixed interest security modelling (i.e., bonds, mortgages) is relatively sophisticated, the modelling for other asset classes, such as stocks and real estate, is less advanced. For any analysis that involves a considerable amount of stock or real estate, a model needs to be developed that allows true variability of these returns around some norm that is considered reasonable for the scenario that is being tested.

Finally, the models developed for the asset/liability management above can be modified to be used to monitor and manage a company's liquidity requirements.

4.06.03 Statutory Statement Uses

In Canada, cash flow techniques are having a significant impact on statutory valuation in two areas.

The introduction of the policy premium method for statutory valuation means that cash flow projections are now an integral part of the statutory reserve setting process. While technique papers are still being developed, the method basically means that future cash flows are explicitly projected for premiums, benefits, and expenses, and then discounted back to the present time, all using current best-estimate assumptions plus an explicit provision for adverse deviations. In the United States, while statutory valuation still relies heavily on traditional implicit methods, GAAP valuation does apply cash flow techniques. In the U.K., a method based on cash flow techniques is the prescribed method for setting reserves for the guaranteed elements of segregated fund contracts. However, implicit techniques are still the norm for nonsegregated fund business although the actuary must demonstrate the overall suitability of the assets given the characteristics of its liabilities.

For new money products, there is a technique, VTP 9, which takes this one step further, by directly bringing into the valuation process the assets supporting a block of liabilities and the investment strategy for investing net cash flows. In addition to projecting explicitly the liability cash flows, the cash flows on assets will also be explicitly projected, with the difference re-invested/surrendered in accordance with an investment strategy for the block of business.

The assets are deemed adequate when the net cash flows, accumulated as described above, remain positive at the maturity of the last liability under a range of alternative economic scenarios.

Cash flow techniques also form the basis of the new dynamic solvency testing (DST) that has been introduced for Canadian insurance companies. DST requires the actuary to conduct an annual investigation of the company's future solvency. The prime purpose of the actuary's solvency investigation is to enable the actuary to provide advice about trends in surplus and threats to the company's solvency and to identify courses of action which may mitigate the threats. The actuary's annual investigation of the company's solvency should consider the present and potential future financial positions of the company and the sensitivity of surplus to changes in various experience factors and management policies. Investigations and cash flow projections should include both the business in force and anticipated new business.

Similar cash flow adequacy testing requirements are being put in place in the United States. In the U.S., insurance is regulated at the state level. The National Association of Insurance Commissioners has approved model regulations requiring cash flow testing of reserve adequacy. These regulations or variations on them, are being adopted by a significant number of states. In addition, the American Academy of Actuaries requires in its standards that cash flow analysis be done in connection with most life insurance company financial work (pricing, reserve setting, solvency, analysis, etc.).

In Europe, there is no dynamic solvency testing requirement.

4.06.04 Determining Net Worth Positions

A net worth valuation is a “realistic” present value placed on a block of liabilities as opposed to the usually reported statutory value. Net worth valuations form an important part of the analysis done when blocks of liabilities are transferred between companies or companies themselves are sold.

The starting point for any evaluation of net worth is usually explicit cash flow valuation of the liabilities. This is an explicit projection of the cash flows expected on the business in each future period based on best-estimate assumptions, with the net cash flows discounted back to the current period at an interest rate consistent with the rate used to project the period-by-period cash flows. The most sophisticated version of this would see the credited liability rates/discount rates tied directly to projected earned rates on the asset portfolio as described in the previous section.

5. CASH FLOW TECHNIQUES USED BY PENSION PLANS

5.01 Cash flow techniques are currently being used in a number of applications to pension plans. There is a wide range of such techniques from relatively straightforward applications, such as immunization of pensions in payment, to more complex applications that have much in common with some of the techniques described for life insurance companies. This range will be briefly described below.

5.02 Cash flow projections are used for both pension liabilities and assets for immunization of plan liabilities using duration and convexity theories.

Under this type of projection, there is little scenario testing done and little review of nonparallel yield curve shifts. When only a portion of a pension fund is immunized, projections are often used to analyse the volatility of the nonimmunized portion of the fund.

5.03 Projections of expected payout of pension benefits and commuted values are made in order to estimate liquidity requirements for the pension fund investment manager. These projections often provide valuable insight on future trends on the cash flow requirements of the fund, depending on various economic outlooks.

5.04 The solvency status of pension plans is projected on various deterministic scenarios.

This is important for some of the large flat-dollar negotiated plans with significant plant closure or plan termination benefits.

These projections may be completed by estimating the potential impact of changes in long-term interest rates compared to the expected changes in the underlying bond portfolio and determining the returns required on the equity portfolio in order to ensure that the solvency status does not deteriorate.

5.05 In asset/liability modelling, both liabilities and assets are projected in order to determine the asset mix influence on contribution levels, pension expense and/or surplus movement. In such projections, the emphasis is not so much on the absolute value of contribution or pension expense levels for a particular year, but rather on the trend over the projection period.

These are generally completed on a stochastic basis for the assets, but deterministically for the liabilities. There are many varieties of models being utilized – some relatively simple and others more sophisticated.

Models generally recognize the interrelationship between interest rates, inflation rates and real salary increases. However, models that change liabilities based on economic scenarios that are reflected in the asset behaviour do not seem to be in use at the present time. For example, such a model might assume that certain economic scenarios lead to downsizings with special early retirement benefits payable and potential partial plan wind-ups leading to an increase in liabilities.

5.06 Projections of cash flows for multiemployer plans and social security programs are being used.

These projections use both open and closed groups in order to ensure that the promised benefits are supportable by the defined contribution rate over both the short term and the longer term. These types of projections are also used for government programs (i.e., to set the contribution rate under the Canada/Quebec Pension Plan).

6. DIFFERENCES BETWEEN LIFE INSURANCE COMPANIES AND PENSION PLANS AND THE RESULTANT KEY FINANCIAL CONCERNS

6.01 Life Insurance Perspective

There are several key constraints that guide how life insurance companies manage their business. These include the following:

- 6.01.01 For many of the products, there is very limited ability to change the future premium and benefit structure after the issue date of a contract. Benefits/premium levels are usually absolutely guaranteed for all future periods, guaranteed at least for some limited future period, or contain an underlying minimum benefit/maximum premium guarantee. Conversely, benefit enhancements outside the parameters set in the initial contract are strictly under company control.
- 6.01.02 The products are sold in a very competitive market. Profit margins are small, and competitive pressure forces companies to price with the minimum acceptable provisions for adverse deviations (PADs).
- 6.01.03 Companies have a very limited ability to raise external financing to cover emerging deficiencies of premiums versus guaranteed benefits. Mutual companies by their nature cannot raise such capital, and for stock companies, raising capital through stock issues is a major undertaking often with significant implications for the company undertaking such action.
- 6.01.04 Regulations require that companies be solvent at all time. In addition, the legislative places limits on investments permitted by insurance companies.
- 6.01.05 Companies tend to offer a diverse range of products. They run the range from GIC-type annuities to term insurance to par insurance to health benefits. In addition, these products are offered to a diverse range of clientele, ranging from plans for large employers right down to individuals.
- 6.01.06 Companies often operate in several countries. They are, therefore, subject to currency fluctuation, and they are required to manage their business so as to avoid exchange risk exposures as much as possible.
- 6.01.07 Clients can terminate their contracts, and withdraw their investments, often with little or no notice, and often with significant book-value withdrawal features.
- 6.01.08 Companies need to maintain strong statutory surplus levels and good statutory income levels to retain the confidence of the consumer, rating agencies and the regulator.
- 6.02 The above constraints have several key implications for the way insurance companies manage their business. The locked-in or guaranteed nature of the contracts, the small level of provision for adverse deviations, the scarce and limited capital, the need to maintain adequate earnings for public confidence, and the ability of policyholders to withdraw funds on a book-value basis combine to require prudent insurers to be generally conservative and low-risk managers. From an investment perspective, aside from segregated account business and, to a lesser extent, participating business, this requires an investment policy where current capital preservation is key. Asset performance must be analysed in relation to its impact on the change in liability values in both the short and long term.

- 6.03 Small profit margins and margins for adverse deviations prompted by competitive pressures require companies to employ a greater degree of exactitude in pricing. These techniques enable them to set a premium level that is adequate to support the benefit structure.
- 6.04 The diverse nature of the business undertaken by a company, the requirement for ongoing solvency in an environment of competitive pricing, thin margins and limited capital, the potential for policyholder disintermediation, and the limited flexibility to alter long-term obligations all combine to require sophisticated management tools to analyse and ensure the ongoing solvency of a company.

Cash flow techniques are used as a management tool by insurance companies to address all of the above concerns.

6.05 The Pension Plan Perspective

The following are some of the characteristics of pension plans, and their implications:

- 6.05.01 Plan sponsors' ability to increase contributions when necessary varies from almost complete freedom, in some cases, to very little or no freedom in the case of a negotiated plan where the benefits may be defined and the contributions are fixed. In the former case, the effect of fluctuation in pension plan costs may be relatively minor and a plan sponsor may be willing and able to take a longer term perspective in regard to investment risks. In the latter case, or in the case of a plan sponsor where corporate solvency may be in doubt, promised benefits may be lost if the pension plan becomes insolvent, and, therefore, a more conservative approach should be taken.
- 6.05.02 Generally, pension plans are under less competitive pressure than life companies, allowing greater latitude in setting provisions for adverse deviations. However, increasingly plan sponsors are themselves under competitive pressure and may be exploring ways to control costs. In negotiated plans, there is pressure for realistic valuations.
- 6.05.03 Some pension plans should be solvent at all times. Others, those in which the plan sponsor has financial flexibility, need only meet the minimum requirements of the pension legislation. Pension legislation requires the plan to be solvent at the valuation dates. However, the present value of some past service contribution commitment can be included in the actuarial assets for this purpose. This means that in some cases, plan liabilities can exceed the value of invested assets without the plan being considered "insolvent." In the case of life insurance companies, solvency means a sufficient excess of invested assets over liabilities.
- 6.05.04 Pension obligations vary widely in nature. There are short-term obligations for terminating and deceased employees and when the sponsor is committed to purchasing annuities upon retirement. There may be large short-term obligations in the event of plant closure, sale of business, etc. There are very long-term obligations for young employees in final pay defined benefit plans and even longer in cases in which the sponsor does not purchase annuities at retirement.

Corporate sponsored pension plans range from multi-billion dollar plans covering thousands of plan members to small one or two life plans for executives or small employers.

- 6.05.05 Pension obligations are for the most part linked to future wage and price inflation. It is much more difficult to find assets that closely match these liabilities, as compared to the monthly fixed dollar liabilities of life insurance companies.
- 6.05.06 Pension plans are not subject to financial disintermediation as a result of member withdrawals. However, there can be some book-value guarantees on plan termination, as employees may be guaranteed a fixed rate of interest on their entitlement.

- 6.05.07 Pension funds invest heavily in stocks and other inflation-driven assets in order to meet long-term dynamic obligations and, considering the increased expected return on such investments, to reduce costs in the long run. Pension plan assets are generally valued at market or on a smoothed market basis. This may cause assets and liabilities to swing abruptly in opposite directions over short time periods.
- 6.05.08 Liabilities are generally denominated in Canadian dollars. Non-Canadian denominated liabilities are uncommon in pension plans (i.e., there is no “foreign” business). Nonetheless, pension plans invest heavily in non-Canadian securities.

7. COMPARISON OF USE OF CASH FLOW TECHNIQUES IN LIFE INSURANCE COMPANIES AND PENSION PLANS

- 7.01 The previous sections have indicated the similarities and differences between pension plans and life insurance companies, and the resultant differences in the use of cash flow techniques. These differences can be summarized briefly as follows:
 - 7.01.01 Life insurance companies operate in a competitive market where premium rates are difficult if not impossible to alter once a policy has been issued. Most pension plans, on the other hand, are not subject to the same competitive constraints, although there are some plans (e.g., negotiated plans) where such constraints exist.
 - 7.01.02 Given this need for a greater degree of assurance, life insurance companies have developed more sophisticated tools to help them manage the asset/liability risks. Pension plans also use techniques that are analogous to cash flow techniques used by life insurance companies, generally referred to as asset/liability modelling, for management purposes.
 - 7.01.03 Both life insurance companies and pension plans use these techniques for similar purposes – that is, to test the sensitivity to changes in economic conditions, to assist in the investment process and to identify and control risk from both sides of the balance sheet.
 - 7.01.04 For the most part, pension plans have a much higher equity position in their portfolios than is the case with the typical portfolio for most lines of business in a life insurance company. Stocks and real estate are much more difficult to model, because of the variability of return, than fixed interest investments, which form the bulk of life insurance general fund investments.
 - 7.01.05 The most sophisticated applications in life insurance companies are interactive models where parameters are passed from the asset model to the liability model and vice-versa – few pension plan models have reached this level of sophistication.

8. CONCLUSIONS

- 8.01 While pension plan actuaries are using asset/liability modelling that is comparable to many of the cash flow models currently employed by life insurance actuaries, some lessons can be learned:
 - 8.01.01 These techniques in pension plans are being used mainly to assist the investment function, although there is also some testing of sensitivity to future economic scenarios for solvency purposes, especially among negotiated pension plans. However, techniques such as immunization of fixed pensions for retired lives are used to manage the liabilities of pension plans. Insights are also being gained regarding the possible variability of plan sponsor contributions and expense figures, even for plans where the plan sponsor has greater latitude in adjusting contribution rates in the future. More concern among plan sponsors about the effects of short-term variability in cash flows may lead to more “dynamic solvency testing,” which has become an important tool for life insurance actuaries.

- 8.01.02 Interactive models, where variables are passed between the asset and liability sides, are being used in life insurance companies. There is no doubt scope for the development of such models for pension plans. While undoubtedly more complex than models which simulate the assets and liabilities separately, they will probably give interesting insights not otherwise possible.
- 8.01.03 There may be a need to look at financial and econometric models which produce future values and returns for equity investments. In addition, the foreign currency exposure of many pension plans may necessitate models that explicitly model the interrelationship of interest rates, currency exchange rates and levels of economic activity. These models could include stochastic generation of scenarios, as well as sets of deterministic scenarios.
- 8.02 Asset/liability modelling is well established among pension actuaries and is welcomed by plan sponsors as a communication tool. Cash flow techniques used by insurance company actuaries by and large appear to be somewhat more sophisticated than those used by pension actuaries. This is largely justified by the different constraints that life insurance companies operate under. It may not be appropriate or necessary for pension actuaries to duplicate all of the cash flow methods employed by life insurance companies. On the other hand, pension actuaries can adapt some of these techniques to further their own insights into the impact that different scenarios might have on pension plans. This may require work in areas where life insurance companies have not concentrated (e.g., equity securities and foreign exchange sensitivities, given the relative lack of importance of these factors in life insurance companies).
- 8.03 No doubt individual actuaries are already pursuing these ideas. Some work in this area has already been published in the literature of national and international actuarial organizations. We encourage actuaries in Canada who are engaged in such work to publish their findings, in order to share their experiences with others.
- 8.04 In some cases, cash flow techniques will assist actuaries in such areas as identifying risks, provisions for adverse deviations to cover such risks and then appropriateness of the investment policy, in a better manner than more traditional actuarial techniques. However, there are some difficulties in applying existing cash flow techniques developed for life insurance companies to pension plans. Such difficulties would include the appropriate treatment of equity and real estate investments and the determination of future contribution cash flows. Nonetheless, there is a need to consider incorporating some of the ideas and techniques that are currently in use for life insurance companies into the standards of practice for pension plan valuations.
- 8.05 There is a need for further research. We suggest that the Institute ensure that the appropriate practice committee search the literature of national and international organizations to make Canadian actuaries aware of developments elsewhere in the world. We also suggest that continued interdisciplinary study be kept up, and that, for example, the applicability of techniques used by life insurance and pension actuaries to property and casualty insurance companies be looked at, and vice-versa. The Institute may consider commissioning one or more studies to complement the current literature.
- 8.06 Accordingly, we recommend that the Institute commission a study to examine in detail the issues raised above. Subsequently, the appropriate practice committee should be charged with deciding on how to incorporate the conclusions of such a study into educational material and eventually into standards of practice. This practice committee should also develop a time-table to ensure that any action required is taken as quickly as possible.