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MODELLING A UNIT-LINKED LIFE OFFICE

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1. INTRODUCTION

This paper describes the Corporate Planning system which has been developed in my office over the last 6 years or more. It first makes a high level pass through the various components and how they fit together and then looks in more detail at some of the components.

2. STRUCTURAL OVERVIEW

A structural chart of the system is shown in the Appendix.

New business is of fundamental importance to a unit-linked office, so the first stages of the system help develop production forecasts. First of all, the Agency Model is used to predict the future size, shape and initial commission earnings of our direct sales force.

In the New Business Model, the direct sales force initial commissions are combined with estimates of sales through brokers and our salaried sales force. Product mix trends, average premium sizes, typical monthly phasing patterns and so on are then used to develop a full, month-by-month new business forecast for each product, throughout the selected projection period.

The new business data are combined with information about the in-force portfolio, expected future work flow volumes for different types of transaction, and so on, to produce a package for the divisional management of each area. With help from the finance team, divisional management then project staff by numbers and by job grade. This is the stage of the planning system which requires most human interaction and intervention!

Staff information (numbers, salary scales, etc.), business volumes and much detailed accounting data are then used to prepare comprehensive expense forecasts. These include the projection of the expenses themselves and the derivation of expense loadings for products.

Once this is done, we are ready to run the Products Model, which is really the heart of the whole structure. Products Model is a large, mainframe computer system which—amongst many other things—calculates the contribution each product line makes to corporate profit.

Products Model is supported by the Table Maintenance System, which is on-line and controls the set up, amendment and internal consistency of all the parameters used within Products Model. There are many tens of thousands of

parameters involved, although a large number of these are automatically generated by Products Model itself at the data extraction stage. Parameters of this type are only modified in the light of special, alternative information or when using the system for 'what-if' corporate experiments.

Products Model builds up a picture from the viewpoint of the liabilities. Assets Model reanalyses the liabilities from an assets viewpoint. Where are the liabilities invested? What income and gains can be expected from these assets? How much income is franked? How much gain is realized—and chargeable? etc. . . .

Both shareholders' and policyholders' assets are included. Once we begin to talk of shareholders, we introduce a new set of problems.

What objectives do the directors and shareholders have for dividend per share and growth in dividend per share? How are dividends related to surplus? How will share option schemes, rights issues, and so on, affect capital levels and the *amount* of the dividend payments in the future?

Equity Model helps answer these questions. In doing so it draws upon targets and objectives that the finance team have agreed with the Board and with shareholders. For example, we have objectives for real growth in surplus per share above inflation, target cover levels for dividends, as a proportion of surplus, and a standard approach to determining the split between interim and final dividend levels.

The Tax and Surplus Model collects together much of what has gone on before to calculate, in detail, the current Corporation Tax charge and the change for the year in the deferred taxation reserve.

Once this is done, the surplus for the year can also be calculated.

The process I have described so far is performed for a series of years. The year-by-year results are then used in the Embedded Values Model to calculate embedded values at the base date and each year end thereafter.

The corporate net worth and the present value of the in-force in each embedded value are analysed into their main components. For example, in net worth we can separately see freehold property, furniture and fixtures, agents balances, free assets and the like. The present value of the in force we divide by main product class—life assurance, protection plans; life assurance, savings plans; executive pensions; individual pensions; and so on.

There are two other models to close with. The Statutory Solvency Test Model takes in force business data together with liability and asset data to calculate the required solvency margins and the actual margin position at the base date and each year end in the projection period. This includes both explicit and implicit margins. From this model we can see how our solvency margin position would be likely to develop in the environment modelled within each run.

Finally there is a Results Analysis Model which draws much of the information together to present a set of standard summary reports. These show numbers and trends on the one hand—aided by graphics—and on the other can be used to prepare comparisons of the high level assumptions and results of this run with those from an earlier forecast.

3. ENVIRONMENT

The sheer size of the Products Model requires that this be mainframe based. It is written in PL1 and maintained by a mixed-discipline team of actuaries, systems designers and programmers. The specifications are held in word-processed form, which aids amendment and extension to new products. A print-out of the specifications onto A4 fills 18 lever-arch files! However, we have found that good documentation is essential to good understanding and control as different generations of personnel use the system.

The other models are all micro-computer based, mainly written in LOTUS 123. LOTUS's file extraction and combination facilities—used via 'macro' programs within the models—enable results and data to be moved efficiently and accurately from one area to another.

4. SOME MODELS IN MORE DETAIL

Having completed our high level pass through the system, we will next consider in rather more detail four of the models: Agency; Products; Assets and, finally, the Tax and Surplus Model.

5. AGENCY MODEL

Agency Model—which analyses and projects the structure and production of the direct sales force—has three main stages:

Analysis of data
Choice of assumptions
Forecasting

In analysing the data we examine the experience of new recruits on the one hand and existing men split by performance band on the other. New recruits are divided into those absolutely new to the business and those recruited from within the industry—and hence with pre-existing experience.

Existing men have a track record within the company. Each year there are various sales 'clubs' which agents qualify for by dint of new business production. The clubs carry rewards including, for example, attendance at the company's prestigious conventions. They are also a good indicator of likely *future* success. Once qualified for a club, agents tend to requalify year after year. It is easy to develop a taste for expenses-paid trips to the best hotels in the Seychelles, Barbados and Hong Kong, even though there is a business content!

Based on these main groupings we interrogate the Agent Database looking for month of appointment, production per month and year, club achievements, date of leaving for leavers and so on. In addition, the age of each agent is also accessed. The data can then be analysed across age groups. For new recruits and those who have not yet achieved one of the senior clubs this is quite important. As you

would expect, it is less important *within* the senior clubs. There, the fact that you have shown you can make it is much more relevant than age.

The extracted information helps determine appropriate values for a range of parameters in the Agency Model. For example, the 'attrition' rate—the rate of loss of agents with time—can be established for each group.

Other statistics obtained are:

—promotions/demotions: the rates of movement to higher and lower sales clubs;
—production: the average new business production for each subgroup;
—manpower ratios: the average number of agents per branch manager (which influences success);
—regional and branch subsets: which are easily separated and can give different insights as well as more homogeneous splits. For example, how does the Greater London Region compare with the North West and why?

Data analysis provides much information. To get the most from the model we must then talk to senior management—especially the sales force management—to pick up opinions, mood about the market and its prospects, new intentions, and so on.

Combining these sets the whole scene and permits us to establish an agreed 'most likely' future scenario. Involving management here also involves them in the results—if they agree with the assumptions and scenario, the outputs carry much greater credibility and interest.

As a back-stop to scenario setting, we also try to bring into consideration the results of a macro model of the life and pensions market and our interaction with it.

I will only consider this additional, independent model briefly. It attempts to identify the key links between the company, the market and what each are doing in terms of new business performance, market share and product mix for new business. It is based on an analysis of data over a timescale of about 10 years. The variables which appear to be important and which are used include: GDP, advertising spend, the proportion self employed (the self employed are an important market for us), interest rates, legislation and tax (changes in which cause irregularities in progress) and Stock Market movements.

Thus, for example, if we intend to treble our advertising spend, GDP is rising quickly and Stock Market confidence is high, the macro model can help us judge the extent of additional real growth in new production per agent, over and above the growth we would typically expect from inflation and the effect of increasing experience amongst each sales cohort.

Having developed the range of key inputs already described, the final step is to include assumed numbers of new recruits for each month of the projection period. Again, this is based on a combination of recent experience and management intentions.

After that the model can go to work, preparing a picture of future sales force numbers and the distribution of those numbers across performance bands and

age groups, by length of service. From there the numbers of qualifiers for each sales club and the overall total production can be forecast, for each year of the projection period.

Apart from giving a 'best guess' estimate of future production and sales force structure, the model also provides a powerful 'what-if' testing facility. What if recruitment rates are stepped up?, what if the rate of leaving of senior agents increases?, and so on.

Individual regions—or even branches—can be analysed, or compared against the norm to assess performance. All of this greatly aids other work connected with costs, production, profitability, and so on.

6. PRODUCTS MODEL

The second model we will look at is Products Model, by far the largest and most complex in the overall system.

The objectives of the Products Model are:

—to forecast the financial development of the linked and non-linked life, pensions and annuity products of the company;
—to provide planning information to the company's management. For example, the expected numbers of death claims which will need to be processed in the claims department.

The results produced by the Model are communicated through ten main reports and several subsidiary reports. The production of the reports and, in some instances, the detail of a report are controlled by the user through a number of parameters.

The Model itself divides into five major sections:

Data extraction;
Data manipulation and grouping;
Generation of supporting factors;
Projection and analysis of products;
Reporting of results.

Tables and Parameters

The projection calculations require the support of a large number of tables and parameters. Examples of the information required are:

—initial and renewal commission rates;
—initial and renewal expense loadings;
—mortality rates and mortality adjustment factors, which allow basic tables of q_x to be modified into the form $aq_{x+b}+c$, for different products and purposes;
—rates of investment income;
—withdrawal rates—for both cash surrender and regular income withdrawals;
—unit allocation rates;

—unit prices;
—valuation parameters.

This list is not exhaustive and, in addition, each product has its own small selection of product specific parameters.

Some of the tables are fairly static, e.g. unit allocation rates or commission rates. Such tables will only change for special runs of the model, or as a result of infrequent market changes. Other tables are more volatile, changing every production run or annually, perhaps, as other information comes to hand. Examples here would be unit prices, mortality rates and withdrawal rates.

It is necessary for the flexible operation of the Model for the tables and parameters to be capable of easy and swift amendment.

Once a set of tables and parameters has been established, a separate program is run which checks internal consistencies, value ranges for each parameter, changes from the previous parameter set, and so on. A warnings and errors report is then produced, together with:

—a full list of all parameters;
—a list of all changed parameters since the previous run.

The purpose of these steps is, of course, to reduce the risk of running the system with faulty variable values.

Data extraction

The information about the in-force business at the base data of the projection period is extracted from the valuation data files for the valuation as at the day immediately preceding the base date. The base date of the projection period is always 1 January.

The valuation data files are used as the source files for Products Model because:

—The creation of the valuation data files involves calculations on the data extracted from the company's master files. A number of these calculations would also be required if the Products Model data were to be extracted directly from the company's master files, and so duplication of effort is avoided.
—The data in the valuation system has already been subjected to the closest scrutiny and validation, including detailed reconciliations to outputs from a range of other independent systems. We can therefore rely on the quality of the data we are using.

Data Manipulation and Grouping: The Model Group

To reduce the volume of data, policy information extracted from the valuation data files is grouped on certain common values. These data groups or data cells we refer to as model groups.

The key elements on which model groups are formed are as follows:

Business category	(life, pensions or general annuity)
Fund link	
Product code	
Benefit code	(identifies versions of a product)
Status	(in-force or paid up)
Frequency	
Sex	
Sales outlet	(broker, sales associate or salaried sales force)
Commencement month	(an index starting at 1 in May 1971)
Representative age	(grouped into 5- or 2-year bands)
Term	(longer terms are grouped into 2-, 3- or 5-year bands)

The full key does not apply to all model groups. In particular:

—frequency and sex are mutually exclusive, a model group can only be keyed on one or the other;
—pension products are keyed by term but not representative age;
—with one exception, life and general annuity products are keyed by representative age but not term;
—the product we call Adaptable Mortgage Plan is keyed by representative age and term because the profit profile is sufficiently sensitive to each that we feel we would lose too much accuracy by further grouping.

Beneath its key identifiers a model group contains a number of descriptive values, or its 'stock', appropriate to the particular product. Examples might be:

—number of contracts;
—basic premiums (sliced according to the start date of each component of the total premium for some products);
—guaranteed sums assured;
—capital units;
—accumulation units.

New Business Factors

The new business premiums used in the projection of products open to new business are available initially only at a high level for each month of the projection. They are analysed only by product code and sales outlet. There is therefore a need to distribute these premiums across the various key items by which the modelling data is classified.

For example, product version (single life, joint life first death or joint life second death, for one type of product), age group, term, frequency, and so on. This spreading and analysis of the new business premiums is done automatically by the system in what we have come to call the 'New Business Explosion'.

Armed with the detailed premium split, the next step is to generate ancillary

information such as number of new business contracts and new business sums assured. All of this is achieved using a number of new business factors, the more important of which are:

—premium (or negotiated increase) distribution factor;
—average premium, and assumed rate of increase;
—guaranteed sum assured factor;
—annuity rate per mille.

There are around twenty such factors in all, the others being specific to particular products.

The new business factors are derived by analysing the new business which came into force in the twelve months prior to the base date of the projection period, including negotiated increases on pensions products.

The assumption underlying this approach to new business factors is that the distribution of new business during the projection period will be similar to that experienced in the twelve months immediately prior to the base date. For some products this will not be true for one reason or another, and for any new products there will be no prior new business from which factors can be created. For these reasons, it is necessary that existing new business factors can be amended and that factors for new products can be created. The Table Maintenance System allows such steps to be followed through easily.

Model Funds

The company has a number of unit-linked funds to which life and pensions products may be linked. It also has three pension unit funds which are, by strict definition, non-linked unitized funds since policies linked to these funds do not provide benefits determined by reference to particular assets.

There is little advantage in taking each of the unit-linked funds into Products Model and predicting the future increases for each of them in turn. Assumptions may differ from fund to fund in the very short term, but they would soon become less specific and begin to move towards a common gross rate of increase which can be adequately modelled by using a weighted average. Moreover, the inclusion of several funds, each with its own growth rate, would cloud the results, providing more interactions which may have to be quantified to look through to the underlying trends, without necessarily improving the forecast.

There *is* a need to separate unit-linked funds according to tax treatment, that is, between life funds and pension funds, because there is a permanent and quantifiable difference in future net growth rates for these two classes of fund due to their different tax treatment.

We also separate the two previously mentioned non-linked funds handled on a unitized basis: firstly, because there is a long-term, quantifiable difference in the rate of increase in unit prices and, secondly, because the liabilities associated with these funds, being of a special nature, are matched against specific, special assets in the Assets Model.

For all of these reasons Products Model makes use of only four funds, two unit-linked and two non-linked, unitized funds. They are:

unit-linked:

Investment Managed Fund;
Pension Managed Fund;

non-linked unitized:

Building Society Related Fund;
Deposit Administration Fund.

Prices are projected for each of the above funds and for each renewal management charge (0%, $\frac{3}{8}$%, $\frac{1}{2}$% or $\frac{3}{4}$%) and unit type (capital or accumulation) within the funds. The levels of renewal management charge and capital unit charge have a significant effect on margins, of course.

Projection and Analysis of Products

The model groups associated with a product are processed month by month through the projection period. The reasons for using a month as the unit time period for Products Model are as follows:

—There are seasonal fluctuations in the levels of new business, both past and future, which give rise to seasonal variations in the premium income flow and total cash flow. These, in turn, cause ripples in the emergence of surplus and margins;
—The use of Products Model to reconcile and analyse the actual results for a year will be a more accurate and useful exercise if the emergence of surplus and margins can be seen month by month;
—The administration systems operate on a monthly cycle and so the model of such systems should be in harmony;
—Marketing division work to monthly targets.

The calculations carried out for each month of the projection period fall into five broad categories:

—The calculation of cash revenue components; i.e. the receipts to and payments from the company during the month;
—For linked products, the calculation of unit revenue components; i.e. the allocation, cancellation and deduction of units in the linked funds according to the occurrence of particular events, e.g. premium receipts or deaths;
—The calculation of the closing in-force distribution at the end of the month; i.e. the movement of all model groups through the month adjusting the 'stock' data for the various increments and decrements;
—The calculation of the valuation liabilities arising from the closing in-force distribution;
—The calculation of surplus and margins for the month.

The actual calculations required vary from product to product. An example would be:

Cash revenue:
- premium income;
- initial commission;
- renewal commission;
- initial expenses;
- renewal expenses;
- death claims;
- surrender payments;
- investment income.

Unit revenue:
- allocations from premiums;
- allocations from changes in actuarial funding factors;
- cancellations for deaths;
- cancellations for surrenders;
- deductions for mortality;
- deductions for expenses.

Analysis of allocable amounts (supplement to unit revenue):
- amounts allocated from premiums;
- amounts allocated from actuarial underfunding;
- basic premium for allocation.

Calculation of closing in-force distribution:
- number of contracts;
- basic premiums;
- guaranteed sums assured;
- units allocated.

Valuation of closing distribution:
- unit liabilities;
- surrender charges;
- discounted cash flow reserves.

Surplus and margin.

Surplus and Margin

The company builds up its financial analyses in terms of margins. Margin is corporate spending power. Some of this spending power is utilized to pay commissions and expenses.

Surplus is what remains after all commissions and expenses have been paid.

At the total company level surplus is the sum of all margins, less the sum of all commissions, less the total expenses projected in the Expenses Model.

At the individual product, or even model group level, surplus is calculated margin, less commissions, less expense *loadings* for the product or model group.

The expense loadings are also from Expenses Model. They are best estimates of the components of the overall expenses which are attributable to each product, product version, rider benefit, etc.

In its projections, Products Model modifies the initial 'year 1' loadings to allow for time. For example, if the expected cost of renewal servicing for a linked individual pension plan is £20 per annum in year 1 of the projection, the system will escalate this cost in each subsequent year. The rates of escalation are parameters in the Table Maintenance System.

The sum of all expense loadings in Products Model is a very useful comparator with the total actual expenses expected. In year 1 they should be very close together because of the way initial loadings are calculated. In later years, the loaded expenses will grow directly in proportion to business volumes and expense inflation. They therefore provide a useful ceiling to manage against. Within the company then, Products Model loaded expenses are used to develop expense budgets, broken down across products, divisions, departments and teams. This approach to budgeting we refer to as the 'Affordability Approach'. The budgets are the 'Affordable Budgets' if we are to maintain current levels of profitability.

The Reports

The quantity of information reported by the model is substantial. However, this arises mainly from the way in which the data and results are grouped. For the main projection results there are, in fact, only eight basic reports required. They are:

—portfolio statistics (at the base date and a small number of other dates selected by the user—so called 'snapshot dates');
—portfolio by duration analysis:
  by numbers of contracts;
  by premium;
—cash revenue accounts, surplus and margins;
—summary analysis of margins;
—unit revenue accounts;
—analysis of amounts allocated;
—analysis of valuation liabilities (at the end of each projection year);
—valuation diagnostics (which show the detailed derivation of the valuation reserves at any selected date for any selected model group).

The printing of the reports and the actual contents are subject to control by the user. For example, reports can be analysed by sales outlet or by year of commencement of the business, or both.

There are also a small number of reports providing both controls and management information. These include:

—unit conversion report (to enable the user to confirm that all existing unit funds were found correctly and converted correctly to an equivalent value of model fund units of the appropriate type and renewal management charge category);
—new business premiums analysis.

7. ASSETS MODEL

The model we will now discuss is Assets Model. It enables us to change our point of view and look at the company's business as a collection of assets and asset-related information, rather than as a collection of liabilities, the point of view used in Products Model.

The overall assets are held within a range of separately identified and accounted funds. These funds form a hierarchy. Firstly, we can divide them into those that relate to shareholders and those that relate to policyholders. The Policyholder Funds, for example, can then be divided into each main tax classification: Life Assurance Fund, Pension Business Fund, Permanent Health Insurance Fund, General Annuity Fund. In turn, each of these may have a linked component and a non-linked component—and we could continue further if we wished.

The company's opening asset structure, together with the work done in Equity Model and Products Model, enables us to understand how big each of these funds is, principally in terms of how big the liabilities will be at each month end in the future.

We now have to set about the process of developing a picture of the asset mix which makes up each of those totals in the future, and from there the 'investment accounting' items which flow from those assets.

The Assets Model operates across a calendar year—which corresponds to our taxation year. Its structure is:

—two similar sets of information which depict the asset and liability situation within each fund in the hierarchy, as at the beginning and end of each year;
—a series of subsequent calculation forms which generate the investment accounting information and then collect it into summaries.

The device used to depict the asset and liability situation is the Matching Rectangle. Matching rectangles are a very powerful tool for understanding the interactions within a life and pensions company. They also provide an excellent control on the interface between the work of accountants—which largely relates to assets—and to the valuation work of actuaries—which largely relates to liabilities.

A matching rectangle is a balance sheet which is not presented simply as two columns. Instead it has been broken out more fully into a two dimensional table in which the row and column totals correspond to the liability and asset entries in a traditional balance sheet.

The extent of the break-down depends upon the task being performed. For example, we might use just one column to depict gilts. If we need something more focused, we might use four columns, one for indexed gilts and three for short-, medium- and long-term traditional gilts, respectively. At the extreme, we could use a column for each individual gilt stock—Treasury 10% 2001, and so on. (In our asset modelling, when forecasting, we have found the four column approach sufficient, although for other purposes—analysis of surplus, for example—we use the individual stock approach.)

The matching rectangle shows the collection of assets used to match each classification of liability. We next need to look at *how we decide* which *particular* collection of assets is appropriate for each liability classification.

Broadly, there are two situations. In the first the liabilities drive the assets. Typically, this happens because the liabilities have a very rigid, guaranteed shape. An example would be a level, sterling denominated annuity which is in payment. The fixed nature of the liability very significantly restricts the assets which produce a well matched position, free from investment fluctuation risk. Normally, the actuaries of the office would use immunization analyses to ascertain appropriate asset mixes. These are communicated to the investment managers who purchase and manage assets within these heavily restricted profiles. Modelling these situations is relatively straightforward. We know the opening position. We know the future liabilities and we know the appropriate asset profile for each liability classification. The future asset structure is therefore easily predictable.

The second situation is where the assets drive the liabilities. Typically, this happens because the contract is free from guarantees. An example would be a unit-linked investment contract with no investment performance guarantee. In this case there is a very high level of investment freedom. Forecasting future asset positions is more difficult here. The approach we adopt is to start from the known current asset structure and the projected future cash flows for each liability classification, which are known from Products Model. By discussing these with our investment managers, we can incorporate their ideas and future investment intentions. From there we can build up a picture of future asset structures.

Current year

The first year of the forecast is normally the current year, and so some actual experience exists. For example, if we were making a projection now this would include 1989, and we already have six months of the year behind us.

For this reason, Assets Model can cater for two periods in the year, separated by what we call the 'viewpoint date', the date up to which actual experience is included. In the example of a forecast being prepared now, the viewpoint date might be 30 June.

In practice, the current year always requires most work in preparing projections—especially with regard to the period up to the viewpoint date. Tying together opening assets, cash flows, including income and gains, and assets held

at the viewpoint date needs care. However, the work leads to a good understanding of the movements that have occurred in the funds and is a good discipline!

Income and Gains

Now that we have an opening and closing matching rectangle for each part of the funds hierarchy, we can proceed to calculate the income and gains anticipated for each fund.

The main steps are first to calculate the mean amount of asset, then to estimate the various components of income and gain for each asset type and fund, and from there the amounts of income and gain. (The current year needs extra work since it is a combination of pre-viewpoint date actual information and post-viewpoint estimated.)

The income and gain components the model uses are:

Income:

franked;
unfranked: Non-Schedule A;
unfranked: Schedule A.

(Schedule A relates to income from properties, where special rules apply to capital allowances and property expenses.)

Gains:

realized: chargeable;
realized: non-chargeable;
unrealized: chargeable;
unrealized: non-chargeable.

Perhaps a couple of examples will help to explain how this works. There are some exceptions, but broadly speaking we use a central estimate of 11% p.a., pre-tax, as the total investment return for longer term forecasting.

Using this rate and taking as our asset a bank deposit, the unfranked, Non-Schedule A component would be the whole 11% and the other components zero. Taking instead a typical United Kingdom equity, the franked income component might be 4%, and the remaining 7% would be expected as gain. Its distribution across the four gain components would depend on the expected rate of turnover in the fund—which influences realizations—and the current Capital Gains Tax base and expected rate of increase of RPI—which influences chargeability to CGT.

8. TAX AND SURPLUS MODEL

Having calculated the various income and gains items for each fund, this

information—together with that from other parts of the modelling system—can be utilized to prepare full Corporation Tax calculations.

In quick summary, the main requirements to calculate the tax charge are:

from Assets Model:	income and gains
from Equity Model:	surplus and dividend objectives
from Products Model:	margins, liability totals, annuity payments, commission payments. . . .
from Expenses Model:	allowable and disallowable expenses.

In addition we need some other specific inputs:

—the components which make up the opening deferred taxation reserve;
—tax rates: current and future;
—factors to relate income accrued to income received;
—Schedule A: expenses and capital allowances;
—and a number of other items.

Mean Fund Basis

Armed with all this information, the first step is to redistribute the income and gains items. Up to this point, these have been calculated and held according to fund of origin.

However, for Corporation Tax purposes, the total income and gains are deemed to arise proportionately across all the various funds which have to be separated for tax purposes. Thus, irrespective of the actual mix of assets, each fund is allocated income and gains according to the proportion which its liabilities contribute to the overall total liability.

The proportions are called mean fund apportionment factors. The redistribution is easy to make, but it introduces distortions to the tax charge position. In practice, my own office uses its deferred tax reserve to minimize the effects of the distortions, as well as to reserve for taxable items which have not yet fallen into current charge.

Profits from the Pension, Permanent Health and General Annuity Funds are taxed under Case VI, using mean fund basis income and gains.

These mean fund Case VI profits are obtained by taking margins, reversing the matched basis income and gains items which contributed to margins and adding mean fund income and gains. Once these 'crude' Case VI profits have been calculated, the model can move on to deal with a series of offsets and allowances which are permitted by the tax legislation.

After these, we have the final, taxable contributions from pension, permanent health and general annuity business.

These taxable contributions, together with income and gains from life business, commissions and expenses, can then be followed through the series of computations which are used to assess the current tax charge for the year.

Without explanation, these steps are:

—calculate the notional Case 1, minimum taxable amount;
—calculate the *I* minus *E* taxable amount;
—calculate the Advanced Corporation Tax position by comparing dividend payments with the shareholders' franked investment income credits;
—calculate the tax payable, setting the taxable amount across the various tax rate bands which apply. (In practice this works by utilizing expenses first against those taxable items which carry the highest rate of charge.)

After these steps are completed, the closing deferred taxation reserve is calculated from the opening reserve and the movements in its components during the year.

It is at this stage that we can now compute the surplus for the year. It is:

margins (on a matched basis)
less commissions and expenses
less the current tax liability
less the increase over the year in the deferred tax reserve
plus the amount of tax charged directly to unit funds. (This final item is easily calculated using the linked funds income and gains components.)

There is an iterative step in this work, and this would be taken from the stage we have now reached.

In the first pass through the Assets Model, it is assumed that the surplus for the year is the surplus objective. Also, the closing deferred tax reserve is taken to be the opening reserve, unchanged.

We now have much better estimates. Overall accuracy can thus be improved by updating these two entries in the closing asset matching rectangles. This is relatively straightforward, but can be made even more so by assuming that any differences are invested in deposits. This leaves all income and gains items unchanged, other than non-Schedule A, unfranked income, which has the simplest impact on the tax calculations.

Running through the Asset and Tax Models a second time gives an improved answer. In theory we could then iterate again, if required. In practice, convergence is very rapid and the second pass answer is normally well within the bounds of the forecasting error present in other aspects of the forecast.

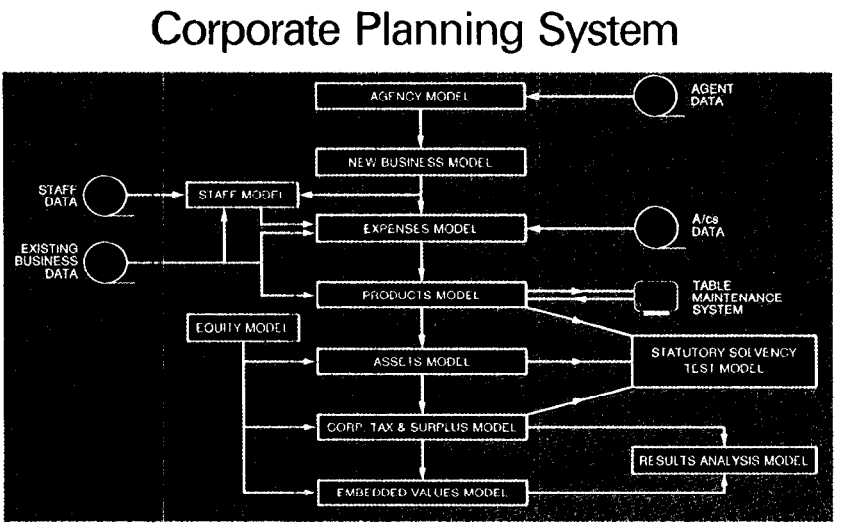
9. ACCURACY

Mentioning forecasting error leads to some brief, closing comments about the accuracy of the modelling process.

Over several years now, the system has produced forecasts of high accuracy. This proven accuracy, together with the depth of detail which can be provided as background to any analysis, has won the confidence of the Board and senior management. Results and forecasts are now credible, valued and—perhaps most important of all—acted upon.

Within its life the system has served to highlight potential future difficulties, helped to develop solutions to problems and improved the management information available to support close, timely planning. It has more than paid for itself and will continue to be a very valuable asset for the future.

APPENDIX


Corporate Planning System
AGENCY MODEL
AGENT DATA
NEW BUSINESS MODEL
STAFF DATA
STAFF MODEL
EXPENSES MODEL
A/cs DATA
EXISTING BUSINESS DATA
PRODUCTS MODEL
TABLE MAINTENANCE SYSTEM
EQUITY MODEL
ASSETS MODEL
STATUTORY SOLVENCY TEST MODEL
CORP. TAX & SURPLUS MODEL
RESULTS ANALYSIS MODEL
EMBEDDED VALUES MODEL