Development of Risk and (Market) Valuation Models:

From Measurement to Management

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Projection models built by insurance companies have historically fallen into two distinct categories; those that focus on the company's value and those that consider the company's risk and return measures. Embedded Value (EV) models are a prime example of the former and ALM models of the latter. Recent market pressures like IAS, Solvency II and the current focus on guarantees and other embedded options are blurring the picture between these disciplines and an integrated approach is emerging.

Computational constraints have tended to result in companies building 'stand-alone' models for different purposes. For example, a company may build and maintain an EV model, an ALM model and, more recently, a model used to assess the impact of IAS. Quite apart from representing a significant maintenance cost, these models require an enormous volume of implicit and explicit assumptions. Consequently it can be extremely difficult to combine the insights provided by each of these models in a consistent and understandable manner. In some cases it is even necessary to combine ALM and EV type measures, e.g. return on capital questions. To prevent using two inconsistent models, you have to either allocate questions arbitrarily as EV or ALM questions or develop an integrated model.

Fully integrated models (FIM) have been developed to assure that a consistent set of assumptions is used throughout the company. This can be done in two ways:

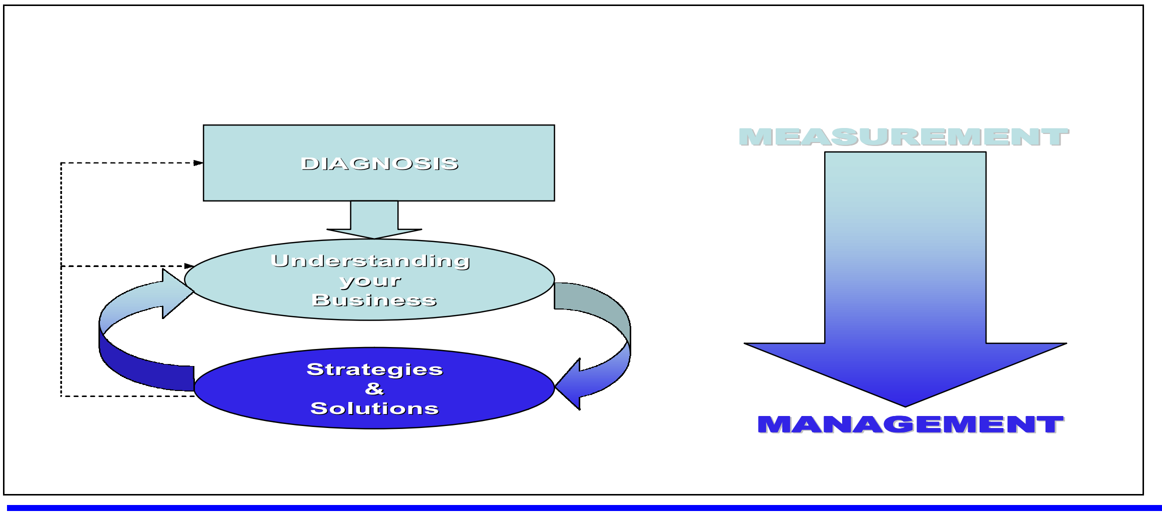
- By creating one model capable of calculating the full range of required results.
- By using a modular approach of fully integrated components.

The power of fully integrated models lies in the consistency of the value and risk message that they provide.

This paper will show that by creating an integrated model companies are able to:

- Better understand, in depth, the value and risk profiles of their business.
- Glean a fuller appreciation of the drivers of value and risk within the business.
- Investigate the effect of different management strategies.

The use and benefits of an integrated model will be demonstrated by considering a three phase approach. During the first phase, the risk and value measures are calculated and the diagnosis is set. The second phase focuses on understanding these results, i.e. understanding the business. In Phase 3, strategies and solutions are determined.



Introduction

The development of projection models can be viewed from two distinct perspectives; complexity and sophistication. Models are more complex in respect of the economic reality of their inherent projections. Deterministic models have moved via scenario analysis to stochastic models and they now also include dynamic management decisions. The move from (discounted) profits and simple risk/return measures to dynamic solvency and projected balance sheets shows the improved sophistication of later models. In this chapter we give a short description of these parallel model developments, create a framework around them and use this framework to classify different models.

From Deterministic to Dynamic Stochastic Modelling

Deterministic Models

A deterministic projection model projects a single estimate of the future. A classic example is an EV model. Value is measured by looking at the future profit cash-flow and discounting this at an appropriate Risk Discount Rate (RDR). The RDR is set depending on the risk associated with this cash-flow. There are several problems associated with this approach:

- There is no agreed approach on how to determine the RDR.
- The value of embedded options within insurance products is usually ignored. (For most products, this can be addressed relatively easy using a Black-Scholes approach.)

Finally, the average scenario might present a relatively good prediction of the future but fails to offer an insight into the potential of a combination of circumstances leading to a bad outcome (e.g. insolvency).

Scenario Testing

Using scenario testing techniques, this methodology is taken one step further by partly addressing the last point of the previous paragraph. Instead of a single (economic) future, several futures are considered. This gives a feel for the sensitivity of the calculated result to those variables being tested and allows the user to analyse the risk and reward of specific scenarios. However, this methodology says nothing about the likelihood of any of the scenarios actually occurring. It is therefore possible to quantify the impact of a particular future scenario but not the probability of the scenario actually happening. Furthermore, with complex models it is very difficult to choose the most appropriate scenarios. Since it is difficult to predict which circumstances will be the most painful, there is a possibility that the chosen set of scenarios does not cover the full range of risks.

Stochastic Modelling

Stochastic modelling techniques allow the user to overcome some of the problems with scenario testing. In a stochastic model a large number (usually between 500 and 5000) of stochastic simulations with specific statistical properties are used. Each of the stochastic simulations represents a possible economic future. By running the model for each simulation a set of results is obtained which can be analysed statistically. The number of structurally different outcomes should be so large that it is unlikely that any potentially risky combinations of (economic) circumstances have been overseen. Significant effort needs to be invested to ensure that the stochastic model deals with the fluctuations in economic variables properly. Checking stochastic models thoroughly is very important as bugs may not be noticed due to the complexity of the models.

Dynamic Decision Making

When using stochastic models it is usually not satisfactory to use a static management strategy. Companies behave differently in prosperous times relative to their behaviour in an economic crisis. For example, ignoring the more defensive strategies taken in adverse economic circumstances may lead to an overestimation of the risks associated with the business. A more realistic model needs to allow for the expected behaviour of management in a given economic or commercial environment. As a result decision rules within models were added to reflect actual management behaviour under fluctuating economic circumstances. These dynamic decision rules reflect management behaviour regarding areas such as asset allocation, bonus strategy and new business pricing. Dynamic decision rules can also incorporate customer behaviour such as new business volumes and lapse rates. A number of significant issues arise when implementing dynamic decisions rules:

- Management strategy is not formalised for the full range of possibilities, as described by the range of stochastic simulations. A business plan, for example, is usually set according to a base scenario. When introducing dynamic decisions, management is required to set out what their strategy might be in extreme circumstances as well as the base scenario. These strategy guidelines are then programmed in the model and the results reviewed. Usually some fine tuning is needed hereafter as it is very difficult to asses management actions in extreme scenarios. This process of carefully considering management action under every type of environment can in itself have a significant mitigating effect on the risks the company faces if properly embedded.

- Historic data on customer behaviour under different economic scenarios is often not of sufficient quality to calibrate the model. To calibrate dynamic lapse rates, we would need data on historic lapse rates for different product types in different type of economic circumstances. It is rare to find this level of detail and so assumptions have to be made on the basis of relatively poor historical information and an assessment of rational behaviour in extreme circumstances. Currently there is little clarity on how best to set these assumptions. However, we expect to see a rapid improvement in the estimation of assumptions relating to customer behaviour in the future as more and more companies are investigating this subject.

- Outcomes from a dynamic stochastic model are sometimes hugely difficult to interpret. It is therefore essential that the models have the ability to switch (parts of) the dynamic functionality on and off. This way one can start with a simple deterministic run and increase complexity so that each part of functionality can be tested and its effects analysed.

The process of dealing with these issues has a chastening influence on the risks faced by the organisation. We believe that due to the obvious advantages and the changing regulatory environment, the use of full dynamic stochastic models will be far more common.

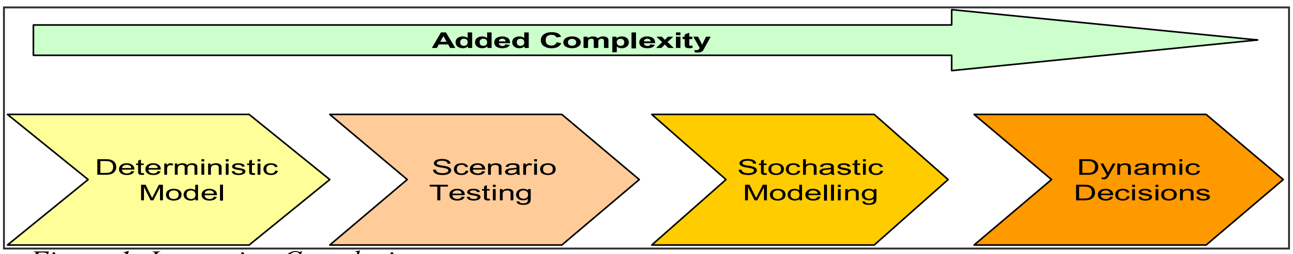


Figure 1: Increasing Complexity

From Calculating (Discounted) Profit to Producing Realistic Balance sheets

Asset/ Liability Management (ALM)

Most ALM models use a risk/return framework. Risk is measured as the probability of ruin (or a related adverse situation). Return is measured as the average investment return (for example from a shareholder point of view). Equity has a higher expected return relative to other asset classes; leading to a tendency for maximisation of the equity exposure under a certain risk tolerance. From a corporate finance perspective it is very doubtful that this is the optimal solution since the risk of holding equities simply result in a higher corporate cost of capital, which offsets the risk premium you would hope to earn. Further, the risk/return framework does not give any weight to the severity of the ruin or the downside risk. Looking at the risk of ruin, a €1000 shortage represents a ruin but a €1000.000 shortage also represents a ruin. For this reason, many people feel that risk of ruin alone is not a satisfactory measure for the risk a company faces.

Downside Risk Measures

These criticisms led to the development of a range downside risk measures. Value at Risk (VaR), Risk Based Capital (RBC) and Economic Capital are usually considered the most appropriate. The disadvantage of (most definitions of) VaR is that it is not a multi-period measure, so you have to pick a single arbitrary horizon. VaR also misses some effects that a RBC measure does pick up, for example the need to finance products that start off low risk but can become capital intensive in years 3 and after (e.g. with profit regular premium products). In addition RBC can also allow for some businesses that are capital generating to support other lines in future out of retained earning. Following this line of reasoning, Risk Based Capital and Economic Capital should be considered as most appropriate. Even though RBC and EC do not have a uniform definition, they are similar in that for a specific risk tolerance, the amount of capital needed to stay solvent over a specific period is calculated. A definition of RBC could be 'the capital needed in excess of the regulatory capital to stay solvent over a 1 year period with a 99% probability'. As the risks taken by the company increase, so does the required capital.

We are beginning to see a greater number of companies implementing these types of risk assessment model within their businesses. Regulators are also moving in this direction. Solvency II, the European intended solvency framework, is based upon dynamic solvency. In the remainder of this paper we will refer to RBC when we are talking about dynamic solvency in this context.

There are also other measures that attempt to capture downside risk. For example, downside deviation. This measure combines elements of risk of ruin and RBC. Since regulators are pushing in another direction, we will not expand on this.

Valuation on Market Value

Lately, there has been a strong focus on the measurement of cash-flows on market value. There are two interrelated issues:

- *Valuing cash-flows on market value*: Under the proposed IAS rules, valuations have to be performed at market value. Discounting must be undertaken using the correct allowance for risk. Within a stochastic model this can be done by either using a risk neutral method or by using deflators. Deflators are, in effect, stochastic discount factors which differ per simulation as they allow for investment risk and the time value of money. Using deflators means that the simulations of returns and other economic outputs reflect real world distributions. This is particularly useful when you are also interested in looking at distributions of results from the stochastic model. Using a real world distribution enables the probability of insolvency to be directly evaluated from the model. In this approach risk neutral probabilities are used rather then real-world probabilities. This risk neutral approach leads to the same value as the deflator approach but as it is not based on real probabilities the underlying cash flows can not be used for e.g. an ALM analysis.

- *Valuing embedded options*: Insurance products contain many embedded options. These are product features that have certain option like characteristics, for example guaranteed profit sharing rates, guaranteed surrender values or conversion rates. Being out the money, these used to be considered of little value and little effort was put into valuing them or into establishing a hedge strategy to negate their risk. In the current low interest environment many of these embedded options are in the money or close to it. These risks now represent a real threat to the solvency of a wide range of companies and, consequently, insurers are investing significant effort to quantify and mitigate them.

(Projected) Realistic Balance Sheets

As a direct consequence of IAS and Solvency II, the need arises for (projected) realistic balance sheets. Here, the balance sheet of a company is projected forward using market values rather then book values. This includes using best estimates of assumptions and the value of embedded options. The realistic balance sheet shows the present value, or deflated value, of the balance sheet per time period. The realistic balance sheet method will also be useful to derive Fair Value/IAS balance sheets and Economic Capital or Risk Based Capital measures for future years.

At the moment there is no standard technique to produce realistic balance sheets that is market practice. Insurance companies in the UK start producing realistic balance sheets for the FSA this year; as a consequence we expect a standard to arise in the near future.

Placing the Models in Perspective

Two Dimensional Matrix

By combining the two parallel movements in model developments, the shift towards a dynamic stochastic model and the move to projected balance sheets, and by putting them on two axes we can construct a framework which can be used to visualise the recent development in models.

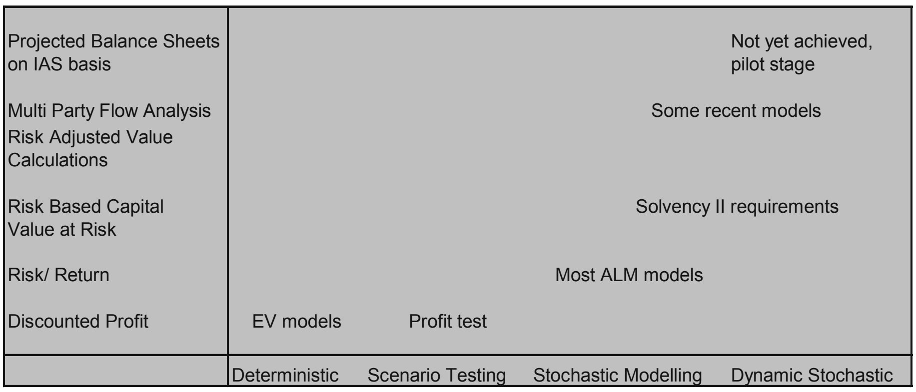


Figure 2: Two Dimensional Matrix

In this matrix we have classified models in a consistent manner with the previous paragraphs in this chapter. On the horizontal axis, we have placed the move from deterministic models to dynamic stochastic modelling. On the vertical axis, the development in understanding and measurement of risk, return el that it gives a good insight in the way recent developments are interrelated.

Due to the recent market pressures like IAS, Solvency II and the current focus on guarantees and other embedded options, models tend to move diagonally to the next level. This leads to fully integrated models (FIM), having the ability to cover the different points on the diagonal axis. A FIM will allow management to analyse and compare a full array of value and risk measures to come to a greater understanding of the risks and value associated with the company. In addition, it will meet regulatory requests, like the FSA demand for realistic balance sheets and the Dutch regulators request for solvency tests based on a holistic model.

Moving to the Next Phase

When the necessary fully integrated model is in place, risk and value measures can be calculated. Those results need to be analysed and interpreted by management to set the right strategy in a holistic manner. In Phase 2 we will discuss this process of analysing and interpretation by focusing in the understanding of the key drivers of a company.

Analysing the Model Output

The increasing need for more complex and sophisticated models together with the problems associated with maintaining stand-alone models will result in pressure on companies to build integrated models capable of an increasing array of outputs. In respect of the matrix described in Phase 1, this is represented by an upwards diagonal pressure from left to right. However, whatever model/ methodology is chosen, it should be considered as a tool within the entire risk analysis, value management and business planning process.

Before considering complex management strategies and trying to come up with solutions to problems, a thorough analysis of model output regarding the current or central strategy is necessary. It is imperative to get a deep multi dimensional understanding of the business to lay a foundation on which to build on. We can do this by investigating the real drivers of risk, return, value and business planning. This serves some important purposes:

- Understanding drivers of the business by performing sensitivities, to be in a better position to choose strategies that will be used for testing and analysing purposes.

- Understand how the model relates to the 'real world' and how real world assumptions impact upon on the results of the model. This way we avoid the pitfall of "zooming in" on features of the model rather than optimising our 'real world' strategy. A classic example is where ALM studies based on economic scenarios with a strong mean reversion come up with an asset allocation strategy that uses this feature. Buying equity after a sharp fall and selling after a sharp rise results in a high expected return with low associated risk. By looking at recent economic developments we can see the inherent risks of such a "double or nothing" strategy. A model that properly relates to the real world would allow for the inherent risks of this strategy and hence would not propose this approach.

Understanding the Key Business Drivers

Developing knowledge of the key drivers of the business is critical to future planning and strategy formulation. This might be done using one or more of the following approaches:

- *Testing extreme scenarios*. By investigating the scenarios with the most adverse outcomes, it is possible to find out which economic circumstances are causing these outcomes and the reasons why they have the greatest impact.
- *Analysis of Change (AoC)*. To understand how a value or risk measure has developed over a defined time period an Analysis of Change is often used to help break down the change in value of a company or block of business over a period between its constituent parts.
- *Sensitivity Analysis*. To quantify the impact of changes in assumptions such as the asset mix, expenses or sales volumes. These analyses help to determine those factors to which a company's Value is most sensitive and as such are key business drivers.
- *Multi Party Flow Analysis*. In order to understand the distribution of value and the movement of value between the various stakeholders of the company, a Multi Party Flow Analysis is a key tool.

These steps are set out in more detail in the remainder of this section.

Testing Extreme Scenarios

Running several extreme deterministic scenarios provides insight in consequences of changes in the variables being tested, eg in the economic return variables.
This quick and relatively easy method is often used in practice, the New York Seven being a famous example.

The Dutch regulator is currently developing a method for setting solvency requirements that will replace the current rule of thumb requirements. This method is based on different scenario tests, for eg mortality, investment return and reinsurance.

Analysis of Change

In EV calculations, an Analysis of Change is used to understand the change in EV moving from one year to another. The movement in EV is broken down into its constituent parts and analysed against how the company expected EV to change at the start of the period. The exact number and types of categories between which EV movements are allocated is, in effect, a decision the company makes but is often constrained by the type and quality of management information collected by the company.

Below we can see an example of an Analysis of Change in an EV environment.

Euro mln	Value in Force	Net Asset Value	Total
1. Start value (beginning of period)	200	100	300
2. Modelling Changes	+ 25	0	+ 25
3. Changes assumptions a) expense b) asset mix c) mortality d) persistency e) other	- 10	0	- 10
4. Effect of deviations during the period	+ 5	- 20	- 15
5. Value added by New Business	+ 7	- 3	+ 4
6. Unexplained	- 1	3	+ 2
7. Reported Value (end of period)	226	80	306

Table 1: Analysis of Change for an Embedded Value

These techniques can also be applied to dynamic solvency analyses like RBC. As such, an analysis is made of how RBC has moved over the period of investigation by separating it into it different constituent categories. This method has not yet been widely used but, as companies begin to use RBC techniques more frequently, the need for understanding movements in RBC will grow and hence these techniques should become more common. This is very much the pattern seen a number of years ago with EVs. An Analysis of Change can be seen as back testing. In the new regulatory environment, we expect "back testing" to be a requirement for internal models. Both Basel II and "het Financieel Toetsingskader" (FTK), the Dutch version of Solvency II, specifically mention this in recent discussion documents.

Below, an example is shown where we can see how the movement in RBC might be split into different categories. There is considerable scope for the management of companies to choose their own categorizations and the table below simply sets out an example.

Euro mln	Risk Based Capital
1. Start capital requirement (beginning of period)	100
2. Modelling changes	
3. Effect of deviations during the period	
4. Non economic assumption changes a) expense b) asset mix c) other	a) b) + 15 c)
5. Economic assumption changes (incl. changing the economic scenarios)	+ 7
6. Including one year New Business	+20
6. Unexplained	
7. Reported Value (end of period)	142

Table 2: Analysis of Change Risk Based Capital

This AoC gives an idea of the main causes of the change in RBC needed over a time period and therefore is a tool to find the main drivers of the RBC.

Sensitivities

Sensitivity testing is a way to quantify the effect of a change in assumptions on the results. This is a long established technique used by insurance companies in order to gain a better understanding of how sensitive the EV is to movements in underlying assumptions. Amongst others, the effects of a change in lapse rates, mortality rates and investment return can be calculated. By analysing these results, insight can be developed in the main drivers of value for the business.

When performing sensitivities in a stochastic model we are only interested in sensitivities with a stochastic component. We could for example look at the impact of a different asset mix or different sales volumes on the risk and return measures. Of particular interest in a RBC framework is the understanding of what drives the capital requirement of the business and so sensitivities are designed to help determine the cause.

Example of significant drivers of value in a RBC environment are:

- Economic simulations used
- Asset mix and/ or strategy
- Number of years of new business included
- Expense levels

Sensitivities can be used to investigate the impact of different drivers on the results. An example of this is shown below. Please note that each sensitivity has only one change in assumptions relative to the central analysis.

Euro mln	Results	Difference with central	% Difference with central
Central end 2002 – no NB 42% equities	142		
Sensitivity - last year's stochastic simulations	95	-47	-33%
Sensitivity - 10% equities	127	-15	-16%
Sensitivity - 30% equities	88	-54	-43%
Sensitivity - 1 year NB	162	20	23%

Table 3: Sensitivity Analysis Risk Based Capital

This sensitivity analysis can help us to find the most important drivers of RBC and can be used as a starting point for management to determine future strategies.

Multi Party Flow Analysis

I have a simple explanation [for the first Modigliani-Miller proposition]. It's after the ball game, and the pizza man comes up to Yogi Bear and he says, 'Yogi, how do you want me to cut this pizza, into quarters?' Yogi says, 'No, cut it into eight pieces, I'm feeling hungry tonight.' Now when I tell that story the usual reaction is, 'And you mean to say that they gave you a (Nobel) prize for that?'"

--Merton H. Miller, from his testimony in Glendale Federal Bank's lawsuit against the U.S. government, December 1997

A technique used to understand how value is divided between all stakeholders having an interest in the company is the Multi Party Flow Analysis. Comparing such analysis for different strategies, we can see the transfer of value between the different stakeholders associated with each change of strategy.

A possible split of stakeholders would be:

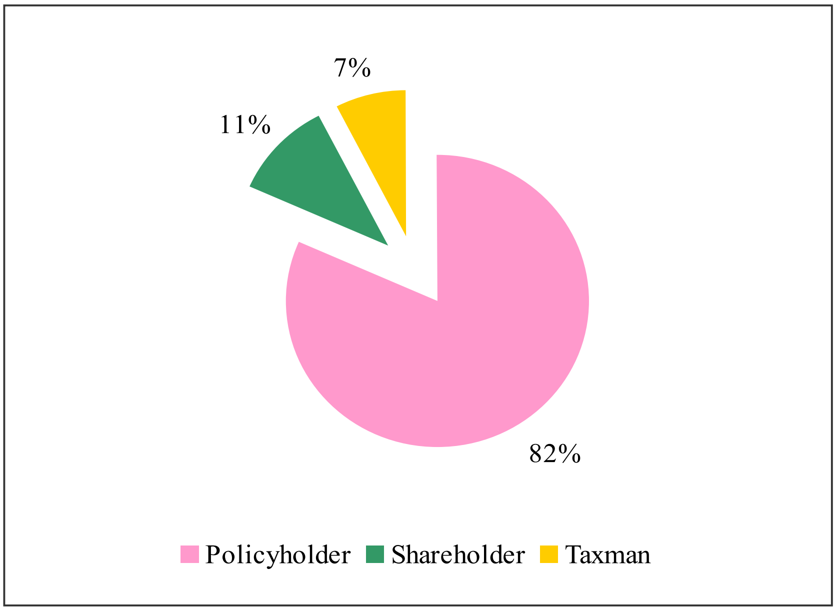
- Policyholders, paying a premium and receiving benefits.
- Shareholders, providing capital injections/receiving dividends
- Government, tax is paid by the shareholders and policyholders.
- Expense receivers, costs are made to run the company like wages, rent, etc.

Looking at the value within a life insurance company to all the stakeholders under different management strategies enables management to take more informed decisions. The value of the company for each stakeholder is calculated by breaking down the cash flows into components and attributing these components to the appropriate stakeholders. Once all the cash flows are generated we can put a value on each party's stake in the company. The following example will illustrate this:

Example:
Consider a ten year single premium unit linked product with a 2% pa guaranteed return. The annual management charge is 2% and the tax rate is 25%. After a premium payment of 100, we start with a fund of 100. The added value of each party's stake should equal the initial value of the fund and should therefore equal 100. The policyholder will receive some of the fund value in the form of benefits in return for past premium payments. The shareholder has supplied an initial amount of capital and will receive part of the profits in return.
The government receives income from tax.

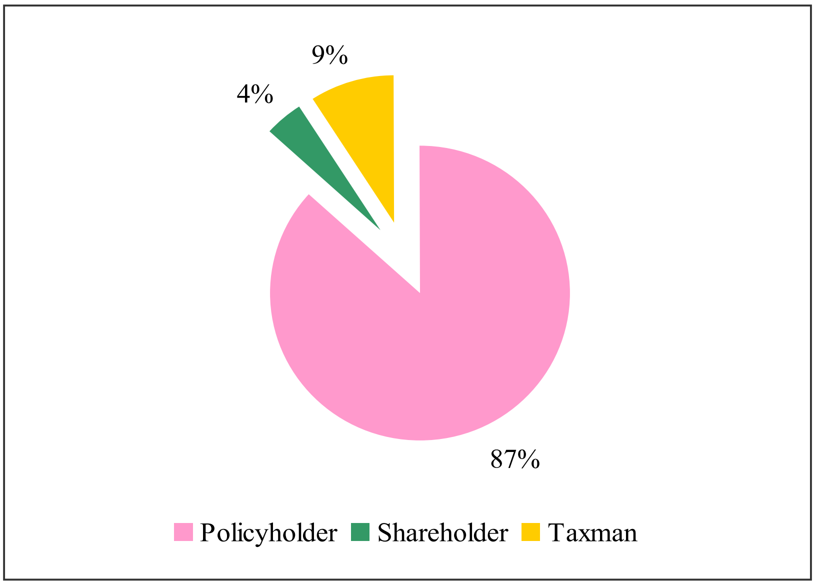
Example Multi Party Flow Analysis

Let's start with a guaranteed rate of zero. If we calculate the value attributed to each stakeholder, we see that 82% is attributed to policyholders, whereas 11% goes to shareholders, and 7% goes to the taxman.



Multi Party Flow Analysis 1

If we were to increase the guaranteed return to 2% pa, the guaranteed minimum payout to the policyholder becomes 122 so the value attributable to each stakeholder changes. We see that the policyholder and taxman gain, at the loss of the shareholders.



Multi Party Flow Analysis 2

We could repeat this analysis for other scenarios, e.g. changing the management charge, and hence are able to investigate the effect on all stakeholders.
Looking at a cash flow analysis allows us to answer the question 'How does the original fund value get allocated between the stakeholders for the 2% p.a. guarantee example?'

Cash flow	Policyholder	Shareholder	Taxman	Total
Premium	-100			-100
Maturity Outgo	86.37			86.37
Tax			9.29	9.29
Profit Transfer		4.34		4.34
Total	-13.63	4.34	9.29	0

Table 4: Cash-flow Analysis

The analysis uses the values of the future cash flows:

- The policyholder pays a premium of 100 and receives a maturity benefit worth 86.37.
- The shareholder receives profit of the value of the management charge less the cost of the guarantee.
- The taxman receives his tax.

The total for each stakeholder shows the value of their cash flows. The cost to the policyholder is 13.63, which is transferred to shareholder (in the form of profit) and to the taxman. We have allowed for all the cash flows and the policy does not generate money overall. Instead it simply transfers money between stakeholders. Hence the sum of the cash flows is zero.

Looking at the cash flows is useful. However, what we are really interested is the *transfer* of value between the stakeholders. This technique lets us understand what factors are driving the transfers of value and therefore adds another dimension to the previous cash flows analysis.

Transfer	Policyholder	Shareholder	Taxman	Total
2% pa Guarantee	13.93	-13.93		0
Management charge	-18.27	18.27		0
Tax	-9.29		9.29	0
Total	-13.63	4.34	9.29	0

Table 5: Transfer analysis

There are 3 factors that cause a transfer of value between the stakeholders:

- The 2%pa investment guarantee is a cost for the shareholder but a benefit for the policyholder. The existence of this guarantee therefore causes a transfer of value from the shareholder to the policyholder.
- The management charge is transfer of value from the policyholder to the shareholder.
- The payment of tax is a transfer of value from the policyholder to the taxman.

The total value for each stakeholder is the same as in the cash flow analysis. However, the total for each transfer factor should always be zero, since it is a transfer between stakeholders rather than an item of cash flow.

We need to determine all the stakeholders participating in the contract and all the cash flows between them. We need to take particular care if there is an initial value (e.g. capital support or existing asset shares) and a residual final value (e.g. capital repayment to the estate). We can then place a value on the stake of each stakeholder.

The above example shows that a multi-party analysis is useful as it requires *all* the cash flows of each stakeholder to be valued. This improves the understanding of both actuary and management of the factors that drive the distribution of value between stakeholders and allows them to make sensible strategy options.

It is desirable to maximise values for particular groups (e.g. shareholders and/ or policyholders) and minimise values for other groups (e.g. the taxman). Strategies such as changing the guarantee in a contract or changing the investment strategy of the fund can therefore be investigated from a new perspective. We will focus on these strategies in the following chapter.

Phase 3

Management Strategies and Solutions

Phase 1 and 2 should give management a clear picture of:

- the value of the business (Phase 1),
- the risks inherent within the business (Phase 1),
- the key drivers of risk and value within the business (Phase 2) and
- how value is shared between the different stakeholders within the business (Phase 2).

In Phase 3 we will look at management strategy and solutions for risk and value management. There will be some overlap between Phase II and Phase III, as you might consider a sensitivity as a form of management strategy but the type of management actions discussed in this chapter are usually slightly more complex.

We do not aim to give a complete overview of strategies that might be employed by management. The aim of this section is to give a brief description of some regularly used techniques. We will focus on both asset and liability strategies (i.e. asset allocation, matching / hedging and profit sharing strategies).The insights provided by both leads to a combined approach which can be used to formulate business solutions such as traffic light approach, business planning and product design.

Asset Allocation

Asset allocation is the purpose for most ALM studies. This is usually done by maximising equity exposure, under a certain constraint, to increase the average return. In other words, if you allow for a certain level of risk of ruin and your objective is to maximise investment income. This objective was usually reached by maximising the equity exposure until the specified maximum level of ruin is met.

Introducing downside risk measures and MPFA changes the picture. Maximising equity exposure is replaced by maximising value for particular stakeholder(s) under certain risk and capital constraints. The level of capital, the structure of profit sharing arrangements and options embedded in the product now become the main drivers of asset allocation.

Considering a product with a guaranteed profit sharing rate. Maximising equity exposure will maximise average portfolio return but at the same time maximises its volatility. This increases the capital required and the value of the guarantee. This non-linearity in combination with the fact that bad results have a higher weighting than good ones if we use risk adjusted discounting, leads to the result that maximising equity exposure could actually result in minimising shareholder value. So, contrary to previous conclusions, new insights demonstrate equity exposure in the portfolio may not be a benefit for shareholders. As bonds may be more heavily taxed than equities, a MPFA may reveal that an investment strategy with a higher proportion of bonds reallocates wealth between policyholders and the taxman.

Matching / Hedging

In most countries insurance companies and pension funds are required by regulation to match assets and liabilities in some way. Some, mainly European, countries take a different approach. Here companies can create a deliberate mismatch to try to increase profitability. Due to the current volatility in equity markets, this is less popular and companies have an increased focus on matching the liabilities.

In other cases, products have discretionary components making them ambiguous. It can be unclear how to match these products. Examples are UK style With Profit contracts and pension agreements were the pension-deal is not fully formalised. In these instances, matching strategies might be used to minimise capital requirements under the new regulatory regime (Solvency II and IAS).

Products with embedded options are another area where hedging strategies can be of great use. The stabilising effect of matching/ hedging on the volatility of cash-flows can be used to achieve several objectives. For example, IAS 19 states that companies should include their pension fund in the balance sheet. Stable pension cash flows are desirable as most companies do not feel that there should be great fluctuations in the balance sheet due to the pension liabilities of the company. This goal can be facilitated by using matching/ hedging techniques.

A common pitfall is for companies to calculate the price of the embedded options and holding a reserve for this amount rather than purchaging the associated cover. This approach has similarities to setting aside the equivalent premium for fire insurance instead of taking out the policy. The cost each month is similar but there is a real problem when your house burns down. As the understanding of embedded options has increased a lot lately, companies seem to become more aware of this pitfall and are now putting in a more serious effort to hedge positions.

Profit Sharing Strategies

In case of a discretionary bonus system, it is very useful to have a clear picture of the effect of moving within the range of bonus strategies. It should not be forgotten to link these strategies to customer behaviour like lapse rates and new business volumes. Minimising profit sharing might be optimal in the short term but if this has a huge effect on new business volumes it will not optimise value. On the other hand, in adverse scenarios this might keep the company solvent. In some cases shadow companies are modelled to predict the behaviour of competitors. Again, testing and formalising this kind of strategies has a huge mitigating effect on risk in itself.

Some old profit sharing arrangements are not sustainable in the current low interest environment. Sometimes these can be adjusted after regulatory approval. It is of great help if one can show a clear picture of a range of possibilities, including the impact of the transfer to the various stakeholders to the regulator.

Traffic light approach

A good risk management tool is the “traffic light approach”. This approach pulls together the full range of management strategies. Actions are subdivided in a red, amber and green range, relating to bad, normal and good periods. The level of free assets is often used as the indication of health for a company. The strength of this method lies in the clarity. As long as the company is in the green range, it runs its business as usual. When amber is reached, a set of defensive measures is implemented. These could be: lower profit sharing rates, a shift to more defensive investments, less aggressive new business strategy, etc. In the red range, more extreme measures can be taken like moving further into fixed interest, slashing bonus rates, cutting dividend, etc. In each situation, there is a full set of management actions; these actions are tested, its effects analysed and the total package has been approved before the actual crisis has occurred. This way, the company does not lose precious time when the economic environment changes for the worse and no effort is wasted on actions that do not give the desired effects.

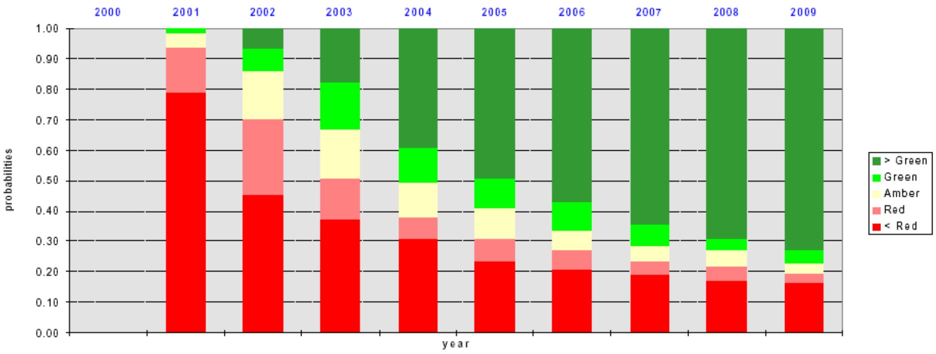


Figure 3: Traffic Light Approach

In the picture, the y-axis represents the level of free assets and the x-axis the time horizon. We see the probability of movement over time between red, amber and green. In this example, we can see that for the chosen strategy the company moves (on average) from a very risky starting point to a more stable situation.

Excluding blocks of business

In some cases, an optimal strategy contains a hedge or match that provides real cover but does not provide regulatory cover since the instruments used are not allowed for. This can be a real dilemma; if the real cover is replaced by a lesser matched asset the company exposes itself to real risk but the current situation does not provide sufficient cover from a regulatory stance. There are several ways of overcoming this problem. Re-insurance or a Special Purpose Vehicle can be used to overcome regulatory issues. This way of exploiting regulatory arbitrage is unfortunately needed in some cases.

Product design/ business planning process

It is desirable to design products using the same techniques as those developed in the risk management process. When working from a clean sheet, it is possible to design products keeping in mind value, (future) capital requirements and potential pitfalls like embedded options. Several companies now use stochastic profit testing in the product design process. This is a very important step to a fully integrated risk and value management function.

For similar reasons, it is good practice to submit the business plan to some consistency tests before putting it in place. The capital requirements, transfers of value due to strategy changes and effect on expenses are examples of using a fully integrated model in the business planning process.

So, by using a fully integrated model for strategy analysis, product design and business planning, a holistic management approach is emerging. The solutions that are found will be valid in both risk and value management perspective. It can further be consistent with new developments like IAS and Solvency II including country specific purposes like current legislation around realistic balance sheets in the UK and solvency tests in the Netherlands.

Summary and Conclusions

This paper describes classical and more recent risk and value measurement models and places them in a framework. This framework is used to show how a move from value and/ or risk measurement to management is possible by using a three Phase approach. We also look at recent developments and how these fit in the framework.

In the first Phase, the framework is used to classify different models by placing models in a two dimensional coordinate system. The first axis measures models on a scale from deterministic to stochastic/dynamic (increasing the complexity of the projected cash flow models). The second axis places models on a scale from embedded value to realistic balance sheet on a projected basis (increasing the complexity of risk and value measures). An integral model is able to deal with the various combinations in this framework.

When an integral model is in place, output needs to be analysed. Phase 2 helps us understanding the (risk and value) profile of the business. Sensitivities can be used to get a feel for the drivers of value and risk. An Analysis of Change can be used to analyse a difference in value or capital requirement over a certain period and for back testing. To understand how the value of a company is divided between different stakeholders and to analyse the transfers of value between stakeholders that take place after a change in policy, the Multi Party Flow Analysis can be used.

Phase 3 looks at a range of strategies and solutions. Asset and liability strategies are discussed and combined to give management tools for setting strategies and finding solutions. By using this 3 Phase approach and a Fully Integrated Model management will be in a much better position to manage, rather then measure, risk and value and meet requirements for both local and international developments.

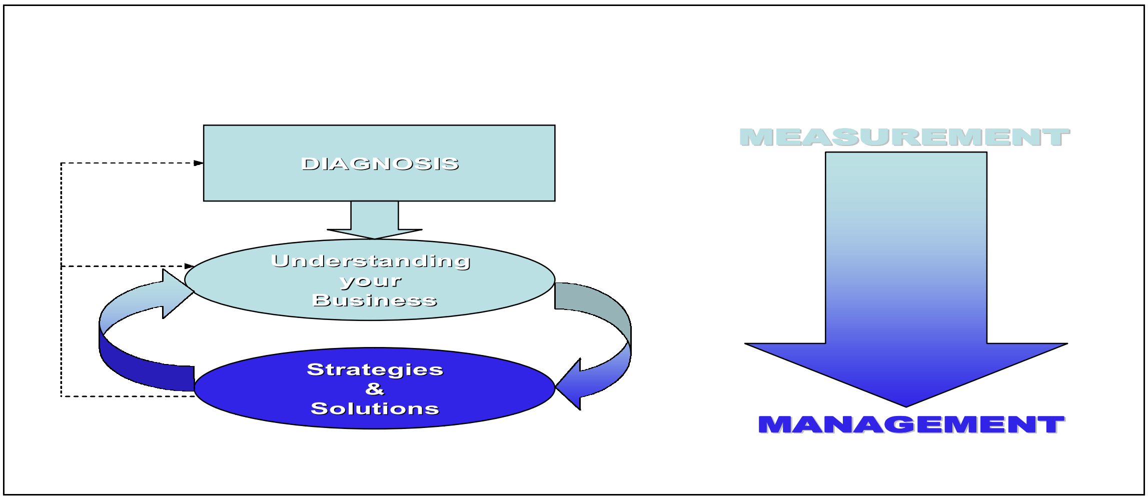


Figure 4: From Measurement to Management

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