

17th March 2006

# A market cost of capital approach to market value margins

- Discussion paper -

## The Chief Risk Officer Forum



## Preface

The Chief Risk Officer Forum (CRO Forum) comprises risk officers of the major European insurance companies and financial conglomerates, and was formed to address the key relevant risk issues. It is a professional group focused on developing and promoting industry best practices in risk management. The membership comprises:

<b>Aegon NV</b>	Tom Grondin	<a href="mailto:tom.grondin@aegon.com">tom.grondin@aegon.com</a>
<b>Allianz AG</b>	Raj Singh	<a href="mailto:raj.singh@allianz.de">raj.singh@allianz.de</a>
<b>Aviva PLC</b>	Sue Kean	<a href="mailto:sue_kean@aviva.com">sue_kean@aviva.com</a>
<b>AXA Group</b>	François Robinet	<a href="mailto:francois.robinet@axa.com">francois.robinet@axa.com</a>
<b>Converium</b>	Peter Boller	<a href="mailto:peter.boller@converium.com">peter.boller@converium.com</a>
<b>Fortis</b>	Luc Henrard	<a href="mailto:luc.henrard@fortis.com">luc.henrard@fortis.com</a>
<b>Generali</b>	Paul Caprez	<a href="mailto:paul_caprez@generaliglobal.com">paul_caprez@generaliglobal.com</a>
<b>ING Group</b>	John Hele	<a href="mailto:john.hele@ing.com">john.hele@ing.com</a>
<b>Munich Re</b>	Charlie Shamieh	<a href="mailto:cshamieh@munichre.com">cshamieh@munichre.com</a>
<b>Prudential plc</b>	Andrew Crossley	<a href="mailto:andrew.crossley@prudential.co.uk">andrew.crossley@prudential.co.uk</a>
<b>Swiss Re</b>	Christian Mumenthaler	<a href="mailto:christian_mumenthaler@swissre.com">christian_mumenthaler@swissre.com</a>
<b>Winterthur</b>	Joachim Oechslin	<a href="mailto:joachim.oechslin@winterthur.ch">joachim.oechslin@winterthur.ch</a>
<b>Zurich Fin'l Services</b>	Andreas Grünbichler	<a href="mailto:andreas.grunbichler@zurich.com">andreas.grunbichler@zurich.com</a>

### Chief Risk Officer Forum Contact Details:

Via E-mail: [secretariat@croforum.org](mailto:secretariat@croforum.org)  
[chairperson@croforum.org](mailto:chairperson@croforum.org)

In the context of Solvency II, there is agreement of the need to measure assets and liabilities on a consistent basis. There is also general agreement that this basis of measurement should be market values. As a result, there has been considerable discussion around the appropriate methods for calculating market value margins for non-hedgeable risks in liabilities. A number of approaches are currently being considered.

For some time the members of the **CRO Forum have been in agreement that a market cost of capital approach to setting market value margins for non-hedgeable risks is the most appropriate**. However, to provide clarity to the Solvency II discussions, we herein build on commonly held high-level beliefs and present a common approach to determining market value margins.

The Chief Risk Officer Forum takes great pleasure in presenting this discussion paper, “A market cost of capital approach to market value margins”, in which the CRO Forum’s proposed approach is outlined. The CRO Forum would like to thank Mercer Oliver Wyman for assisting with the preparation of this paper.

We are hopeful that this paper will help to shape regulatory debate with the ultimate goal being the adoption of this approach within both the standard and internal models solvency assessment.

Chief Risk Officer Forum

## Contents

1. Executive summary.....	4
2. Introduction.....	6
2.1. Purpose of this paper .....	6
2.2. Structure of this paper.....	6
3. Why take a MCoC approach to MVMs? .....	7
3.1. Supports appropriate risk management actions .....	7
3.2. Appropriate reflection of risk .....	8
3.3. Response to a potential crisis.....	9
3.4. Ease of implementation .....	10
3.5. Transparent, verifiable and comprehensible.....	10
3.6. The “use test”.....	11
4. Theory underpinning the MCoC approach: The economic (solvency) balance sheet	12
4.1. Market value of assets (MVA).....	13
4.2. Market consistent value of liabilities (MVL) .....	13
4.2.1. Expected present value of future liability cash flows.....	14
4.2.2. MVM for non-hedgeable risk.....	15
4.2.2.1. Hedgeable risks.....	15
4.2.2.2. Non-hedgeable risks .....	16
4.3. Solvency capital requirement (SCR) .....	16
4.4. Cost of capital (CoC).....	17
5. The MCoC approach to MVMs .....	18
5.1. Step 1: Project the SCR for non-hedgeable risks.....	18
5.2. Step 2: Calculate the capital charge.....	19
5.3. Step 3: Discount the capital charge .....	19
5.4. Illustrative example.....	20
6. Frequently asked questions .....	22
6.1. Circularity .....	22
6.2. Asset liability mismatching .....	22
6.3. Level of risk margin relative to overall liability .....	22
6.4. Tax .....	23
6.5. Operational risk.....	23
6.6. Harmonisation.....	23
6.7. Total portfolio versus different business line .....	23
6.8. Non-life business .....	23
6.9. Small entities .....	24
6.10. Variation in CoC.....	25
6.11. Time horizon.....	25
Appendix A. Expected present value of future cash flows .....	27
Appendix B. Diversification .....	29
Appendix C. Proxy measures for projecting capital .....	30

## 1. Executive summary

Discussions around the appropriate approach to calculating market value margins (MVMs) have been going on for some time at a European level under the Solvency II banner. **Under main consideration are the percentile approach and the market cost of capital (MCoC) approach.**

**The CRO Forum prefers the MCoC approach.** This paper lays out the CRO Forum's proposed approach and clarifies what we believe are common misconceptions about the topic in general. Most importantly, we clarify that **this approach works for both life and non-life business.**

The main reasons for the CRO Forum's preference are:

- It **supports appropriate risk management actions**
- It provides a more **appropriate reflection of risk**, both in terms of risk type and between product groups
- It ensures a better **response to a potential crisis** in the insurance industry
- It allows for simplifying assumptions, which makes this approach **easy to implement**
- It is **transparent, easily verifiable and understandable** by the supervisor and other constituencies.
- It **passes the “use test”** envisioned in the Solvency II framework

In summary, unlike other methods, the MCoC approach to setting MVMs is not just a calculation method, it is a necessary component to the overall solvency and supervisory framework and is aligned with the way in which companies analyse, measure and value risk. The theoretical underpinning of this approach is a market consistent economic (solvency) balance sheet. The main components of the economic balance sheet are the market value of assets (MVA), the market consistent value of liabilities (MVL) and the solvency capital requirement (SCR).

The MVL is derived from the cost of managing the risks underlying the business on an ongoing basis. It consists of:

1. **The expected present value of future liability cash flows, and**
2. **An additional, explicit cost of risk for non-hedgeable risk (the MVM for non-hedgeable risks)**

The MVL therefore also represents the market consistent value at which the liabilities could be transferred to a willing, rational, diversified counterparty in an arms' length transaction under normal business conditions.

The MVM is **defined as the cost of risk, i.e. a risk margin in addition to the expected present value of future liability cash flows required to manage the business on an ongoing basis.** It is estimated by the present value of the cost of future capital requirements for non-hedgeable risks.

Calculation of MVMs using a MCoC approach is straightforward given that the majority of the calculation is prescribed under the standard SCR. This means that **implementation**

**of this approach is straightforward and therefore can be used by both small and large companies.**

**The only parameter in addition to the Standard SCR for non-hedgeable risks that needs to be set is the cost of capital for non-hedgeable risks.** It should be noted that the CRO Forum is willing to assist with a short study to define the appropriate cost of capital.

This paper lays out the CRO Forum's proposed approach and clarifies what we believe are common misconceptions about the topic in general.

## 2. Introduction

### 2.1. Purpose of this paper

As stated earlier, under the development of Solvency II, there is agreement amongst most parties involved that the assets and liabilities should be measured on a consistent basis for solvency purposes and this basis should be market value. In order to determine the market consistent value of liabilities, it is agreed, we need to determine a market value margin (MVM) to be added to the expected present value of future liability cash flows. Discussions around the appropriate approach to calculating MVMs have been going on for some time at a European level under the Solvency II banner. Under main consideration are the percentile approach and the MCoC approach. As previously described in our responses to CEIOPS draft advice <sup>1</sup> **the CRO Forum does not agree with using the percentile method in particular; we do not believe it is consistent with the aim of introducing a risk based solvency assessment.** However, we recognise that the percentile approach was first considered by many at a time when the MCoC was not well known and discussions on this potentially complex issue would indeed benefit from a more explicit articulation of the issues and proposed approaches.

**This paper sets out the CRO Forum's preferred approach, the MCoC approach to MVMs.** Under this approach the MVM is by definition the cost of risk, i.e. risk margin in addition to the expected present value of future liability cash flows required to manage the business on an ongoing basis.

In writing this paper the CRO Forum has been able to converge on a common approach for developing MVMs based on a MCoC approach. The CRO Forum is hopeful that this paper will help to inform and shape the regulatory debate so that the MCoC approach is adopted as the method for deriving MVMs.

### 2.2. Structure of this paper

Chapter 3 of this paper provides an overview of the reasons why the CRO Forum believe that the MCoC approach to determining MVMs is the most appropriate approach for both the standard and the internal model approaches.

Chapter 4 of this paper covers the theoretical underpinnings of the MVM in a market consistent valuation framework. Chapter 5 goes onto describe the specific methods to adopt when putting this theory into practice.

Chapter 6 of this paper answers some of the frequently asked questions and concerns with adopting a MCoC approach.

---

<sup>1</sup> Chief Risk Office Forum, Meeting with EIOPC, Liability valuation for Solvency II, Pillar I, 16<sup>th</sup> February 2006

### 3. Why take a MCoC approach to MVMs?

The two approaches under consideration for determining the MVM of non-hedgeable risks are 1) the percentile (quantile) approach and 2) the MCoC approach.

The idea behind both the percentile and the MCoC approaches is that an insurer should hold sufficient capital to meet a large loss event in the following year. The difference between the two approaches lies in the assessment of how much capital is needed. In particular;

- The **percentile approach** takes the perspective that sufficient capital is needed to ensure that the **liabilities can be met with a predefined confidence level**, while
- The **MCoC approach** takes the perspective that **sufficient capital is needed to be able to run-off the business**.

The CRO Forum strongly prefers the MCoC approach. This chapter outlines the main reasons for this preference:

- It **supports appropriate risk management actions**
- It provides a more **appropriate reflection of risk**, both in terms of risk type and between product groups
- It ensures a better **response to a potential crisis** in the insurance industry
- It allows for simplifying assumptions, which makes this approach **easy to implement**
- It is **transparent, easily verifiable and understandable** by the supervisor and other constituencies.
- It **passes the “use test”** envisioned in the Solvency II framework

We describe each of these reasons in more detail below.

#### 3.1. Supports appropriate risk management actions

The MCoC approach is based on a market consistent valuation framework. It more appropriately differentiates between risks similar to the way in which capital markets differentiate between risks. For example, the distribution of risk differs greatly between an equity investment and an equity option. It is therefore consistent with an economic (solvency) balance sheet and it treats all risks in a consistent manner.

The MCoC approach ensures that the cost of risk is measured purely based on the economic cost of holding capital to support non-hedgeable risks. This ensures that the cost of risk and any allowance for prudence are clearly separated, and that the reserve reflects the best estimate of the cost of managing risk (e.g. retaining or transferring risk to a third party). Margins for prudence should only be reflected in the capital held and not in the technical provision. This allows companies to efficiently manage their risks.

This is not the case with the percentile approach. Prudence may be incorporated in both the reserves and capital which can lead to inefficient management of risks and double counting of risks.

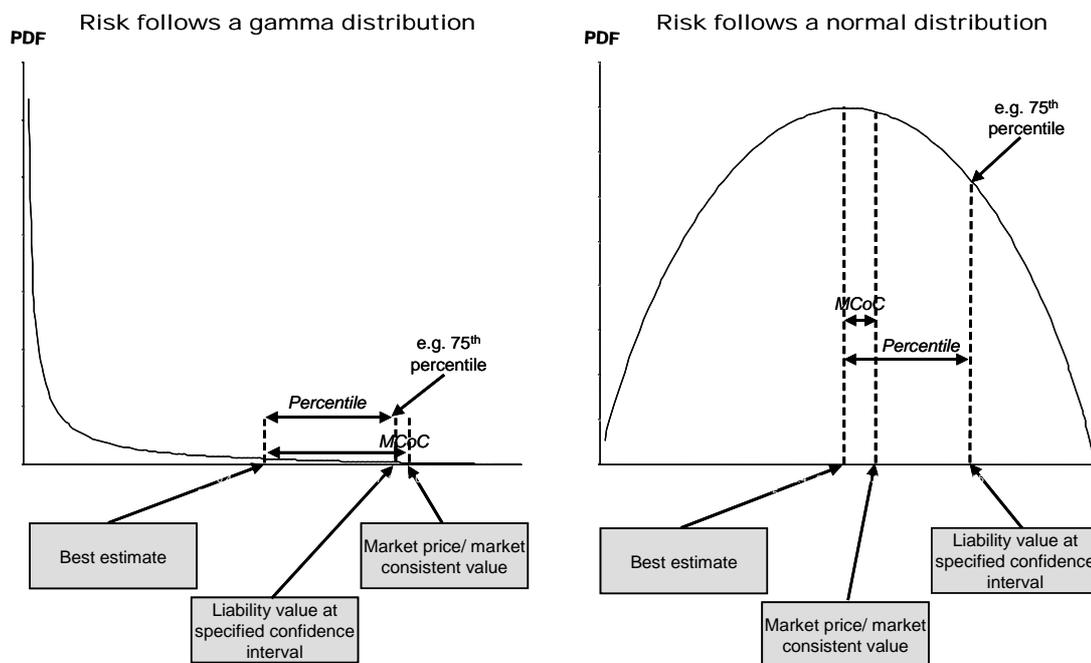
It is therefore fundamentally better for Solvency II that the margin for prudence is only captured in the SCR and not in the MVL.

### 3.2. Appropriate reflection of risk

As a consequence of design, the MVMs calculated using a MCoC approach will always reflect the risk inherent in the product. This is not always true if a percentile approach is adopted because there is no link between the arbitrary percentile value chosen and the market price. In addition, the percentile approach does not refer to each risk type separately.

Figure 1 is used to illustrate that the size of the MVM varies depending on the underlying distribution of the liability. We have used a gamma distribution and a normal distribution to illustrate the extremes.

**Figure 1: Percentile approach (75<sup>th</sup> percentile) vs. MCoC approach**



LON-TC/00511-001

For the long tailed gamma distribution (as shown on the left hand side) the MVM using a MCoC approach corresponds to the 76<sup>th</sup> percentile. For this particular distribution the percentile approach would underestimate the price of non-hedgeable risk. However, if the risk were to follow a normal distribution (as shown in the chart on the right hand side), the MVM is only at the 56<sup>th</sup> percentile compared to the 75<sup>th</sup> percentile that would be used if the percentile approach was adopted. In this case, the percentile approach would greatly overestimate the market price of risk. The MCoC approach therefore ensures that insurers consider the tails of the distributions whereas no consideration is given to the shape of the distribution using the percentile approach.

This is further supported by the experiences of the Australian and the Swiss regulators respectively.

APRA<sup>2</sup> released a report in October 2005 in which it reviewed their version of a constant level approach of 75<sup>th</sup> percentile. The results of the report revealed a number of shortcomings of the approach:

‘The spread of risk margins within each reinsurance class is difficult to explain. For facultative proportional business, the standard deviations are significantly low for both casualty and marine and aviation business at 7.8% and 2.9% respectively. This compares to a standard deviation of 684% for property business. **It is difficult to provide a reasonable explanation to the trend**’.

The issues highlighted in this report therefore raise questions around the appropriate reflection of risk when adopting a percentile approach in practice.

The Swiss Solvency Test (SST)<sup>3</sup> uses a MCoC approach to MVMs. Although the CRO Forum’s proposed MCoC approach differs in several respects from the SST approach, the fundamental concepts are the same and therefore insight can be gained based on the SST experience.

The results of the SST Field Test have shown that MVMs, under a MCoC approach, appropriately reflect the underlying risk inherent in the business.

- ‘The calculation of the MVMs during the field tests were found to be quite stable’ from period to period
- ‘Life insurers writing mainly savings products tend to have relatively small MVM since insurance risk is small compared to market risk’
- ‘Life insurers writing risk products have a large relative MVM since they have a large exposure to biometric risk and a long duration of the run-off portfolio’

We believe this supports the CRO Forum’s belief that MVMs determined under a **percentile approach do not provide an appropriate reflection of risk** whereas MVMs determined under a **MCoC approach will always give a more accurate representation of risk** as a consequence of design.

### 3.3. Response to a potential crisis

When an insurance company goes into run-off one could argue that the best possible action for the policyholders is if an insurer that is a going concern takes over the liabilities. This would therefore be the regulators desired outcome. The best way to ensure that the liabilities of an insurer will be taken over by another is to ensure that there are sufficient financial resources to cover the liabilities. This is exactly the aim of the MCoC approach.

---

<sup>2</sup> Australian Prudential Regulation Authority (APRA), General Insurance Risk Margins Industry Report, 30 June 2004 (issued October 2005)

<sup>3</sup> Philip Keller, Swiss Federal Office of Private Insurers, The Swiss Experience with Market Consistent Technical Provisions – Cost of Capital Approach, February 24, 2006

The SCR ensures that the insurer will be able to survive stressed situations occurring within one year and still be in a position to meet its obligations. It focuses on the market consistent value of assets and liabilities and therefore the calculation ensures that all information received during the year – potential loss and also any potential reassessment of future risk (including run-off) – is properly reflected. In particular, the MCoC approach ensures that after such an event the company will be able to appropriately remunerate either a third party accepting the liability or new capital providers. It achieves this through the SCR for non-hedgeable risks needed to support the liability in future years and hence the MVM, which represents a provision for the cost of holding this capital.

By contrast the percentile approach implicitly forces the insurer to hold part of the capital needed to support the business in future years in the form of a prudence margin. Assuming no new capital is provided following a significant loss event, this prudence margin (at 75% confidence level) will generally not suffice to run-off the liabilities with the level of confidence implied by the SCR. In addition, it does not ensure that there will be sufficient financial resources to cover future capital costs needed to remunerate either a third party accepting this liability or new capital providers. In these cases the percentile approach will imply a lower level of security than the MCoC approach. In all other cases, the percentile approach is likely to result in inefficient capital usage and in many instances higher prices for the policyholder.

### 3.4. Ease of implementation

We believe that the percentile approach is a complex approach to implement, particularly in smaller entities where advanced modelling capabilities do not exist. This is due to the fact that the percentile approach requires stochastic calculations over the whole run-off period in order to determine the appropriate percentile on the distribution of possible liability values.

The MCoC approach has proved to be far easier to implement and the results of the SST have shown that it can be implemented with a relative amount of ease even in smaller entities. This is largely due to the fact that there is only one unknown item, the SCR for non-hedgeable risks and this can be calculated with ease using the standard SCR. This makes the MCoC approach easier for small companies to implement than the percentile approach as it does not require the development of complex stochastic models while still achieving better accuracy.

This makes the MCoC approach significantly more attractive to smaller entities than the percentile approach.

### 3.5. Transparent, verifiable and comprehensible

From the supervisory perspective, one of the key advantages of the MCoC approach is that it is completely transparent and therefore comprehensible. The SCR projections can easily be determined using the Standard SCR applied to non-hedgeable risks, which means there is only one unknown parameter i.e. the cost of holding capital for non-hedgeable risks.

The transparent nature of this approach means that supervisors can easily replicate and verify the MVM calculation. This also applies to companies where internal models have been used as all that is needed to enable supervisors to verify the calculation is for the insurer to show and explain how the SCR is expected to evolve for each non-hedgeable risk.

The percentile approach is not so easily verified. This is because it is not possible for the regulator to use the standard SCR to benchmark the internal models used to determine the percentile value.

In addition to this, the APRA experience has shown that there is a wide variation in the results, when adopting a percentile approach, from insurer to insurer. The MCoC approach is by definition aiming at a market consensus for the risk margin making it much easier for regulators and supervisors to comprehend and manage.

### 3.6. The “use test”

Although the MCoC approach is relatively new in the Solvency II discussion on setting MVMs, it is not new to the insurance industry. It is an approach that has been around for some 20 years and forms the foundation of actuarial appraisal value and embedded value calculations for both life and non-life business. In fact, the CRO Forum members, with their considerable experience, are not aware of any transfer of business from one party to another using the percentile approach. These transactions are always done either directly or at least considering the MCoC approach.

As a result, the MCoC approach is currently being successfully used within insurance companies to analyse risk, assess new business profitability and in effectively pricing risk. In effect, the MCoC approach already passes the “use test” envisioned in the Solvency II framework.

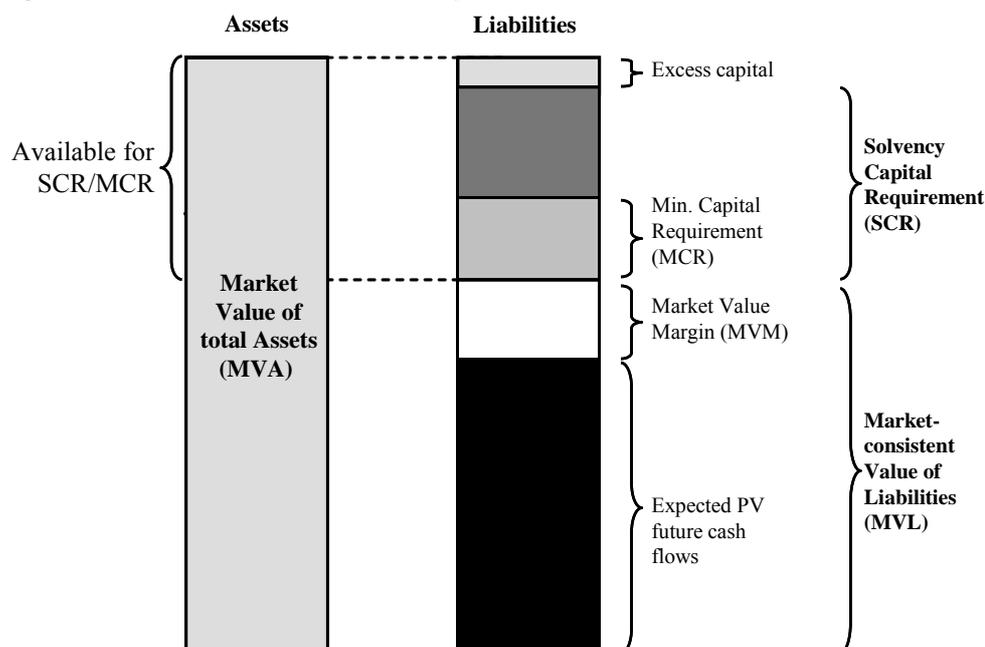
#### 4. Theory underpinning the MCoC approach: The economic (solvency) balance sheet

To fully grasp the CRO Forum's approach to MVMs, it is important for the readers of this paper to understand the theoretical framework from which the approach has been derived. The purpose of this section is therefore to explain the market consistent theory and framework which underpins the MCoC approach to MVMs.

Our suggested framework for solvency assessment is built on a total, market consistent economic (solvency) balance sheet<sup>4</sup>. This means that capital requirements consider risks emanating from both sides of the balance sheet. It is widely recognised that the most appropriate basis for evaluating assets is on a market value basis and therefore, in order to achieve consistency, liabilities are also valued at a market consistent value.

Moreover, the economic balance sheet clearly distinguishes between the underlying asset and liability values and the capital required for solvency purposes.

**Figure 2: The economic (solvency) balance sheet**



LON-TC00511-001

The diagram depicts three main components (and their sub-components) of the market consistent economic (solvency) balance sheet.

1. The market value of assets (MVA)
2. The market consistent value of liabilities (MVL)
  - A. The expected present value of future liability cash flows
  - B. The MVM for non-hedgeable risks
3. Solvency capital requirement (SCR)

<sup>4</sup> For more details see the Joint submission by the CRO Forum and CEA, Solutions to major issues for Solvency II, 10<sup>th</sup> January 2006

These core components are discussed in detail over the next three sections.

The economic (solvency) balance sheet does not explicitly identify the cost of capital; the cost of capital is a parameter used in determining the MVM. An additional section has therefore been included to outline the cost of capital.

#### 4.1. Market value of assets (MVA)

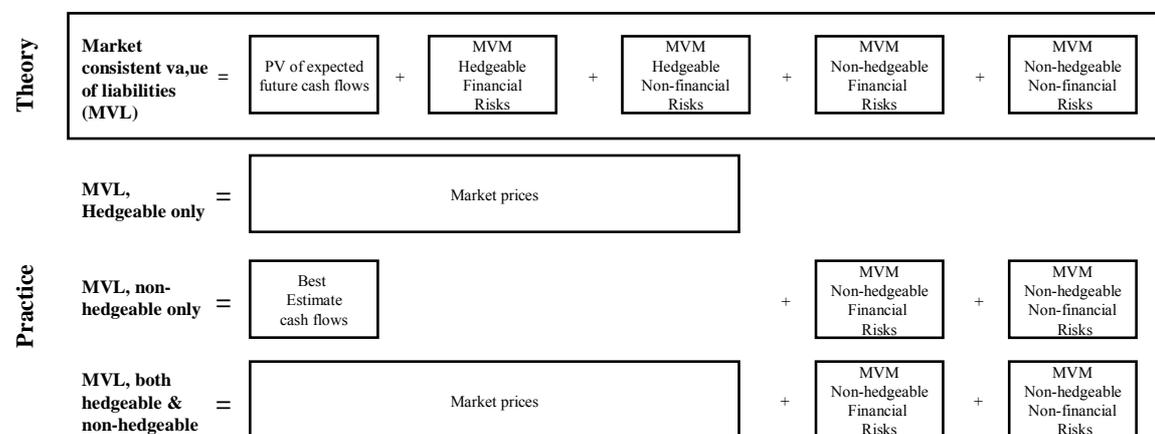
The capital markets provide the MVA. The approach used by capital markets to determine the market values of assets is outside the scope of this paper.

#### 4.2. Market consistent value of liabilities (MVL)

The MVL is derived from the cost of managing the risks underlying the business on an ongoing basis. The MVL therefore also represents the market consistent value at which the liabilities could be transferred to a willing, rational, diversified counterparty in an arms' length transaction under normal business conditions.

In most cases, insurance liabilities are not actively traded on a free and liquid market therefore the market consistent value can not be determined directly from capital markets. The MVL must therefore be explicitly calculated using market consistent valuation techniques. The component parts of the calculation are depicted below.

**Figure 3: Component parts of the MVL calculation**



LON-TCJ00511-001

Market values should be used where available to value the MVL, either for products in their entirety or their constituent parts. Where market values are not available, market consistent techniques should be applied in order to determine:

- The expected present value of future liability cash flows
- The MVM for non-hedgeable risks

Over the next 2 sections we examine each of the building blocks of the MVL calculation where market values are not available, namely the expected present value of future liability cash flows and the MVM for non-hedgeable risks.

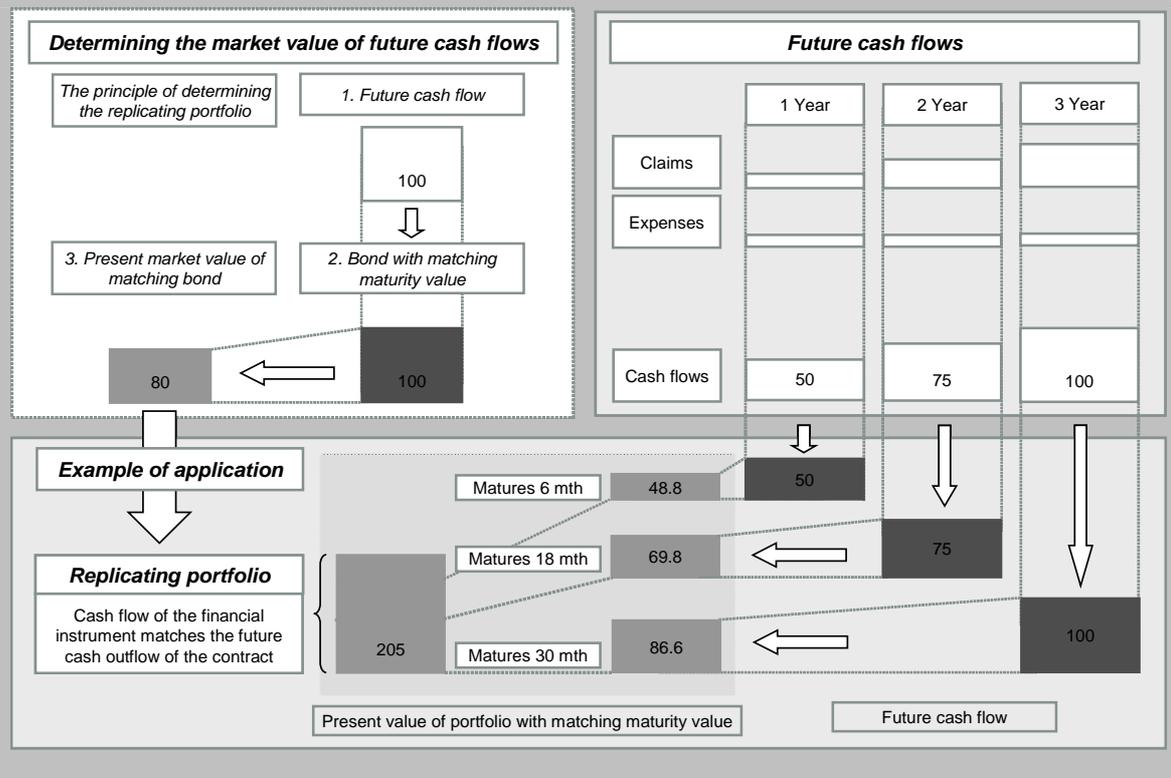
#### 4.2.1. Expected present value of future liability cash flows

The expected present value of future liability cash flows includes premiums, fees, policyholder claims, expenses and commissions. The market consistent value of these future cash flows may then be determined as the cost of setting up a replicating portfolio, the price of which can be determined from observable market prices.

**Figure 4: The replicating portfolio**

One way to assign a market value to a series of cash flows is to construct a replicating portfolio<sup>5</sup> or hedge portfolio of assets. The replicating portfolio or hedge portfolio is simply defined as the portfolio of assets that most closely matches the corresponding liability cash flows. In the absence of arbitrage, and if the liability cash flows could be matched exactly, the market consistent value of the liabilities will exactly equal the market value of the replicating portfolio.

The replicating portfolio must be set up to cover all future cash flows apart from those based on profit. Future cash outflows are assessed net of expected future premium inflows allowing for the expected run-off of policies due to claims, lapses and surrenders.



<sup>5</sup> Other market consistent valuation techniques are also acceptable

Please see Appendix A for a more detailed explanation of how to calculate the expected present value of future liability cash flows.

#### 4.2.2. MVM for non-hedgeable risk

The MVM is **defined as the cost of risk, i.e. a risk margin in addition to the expected present value of future liability cash flows) required to manage the business on an ongoing basis.**

Before calculating the MVM it is important to understand the types of risks affecting insurance liabilities. Figure 5 below shows how risks affecting insurance liabilities can be broken down into four key components and gives examples of the types of risks that fall into each category.

**Figure 5: Types of risk affecting the liability cash flow<sup>6</sup>**

		Types of risk	
		Hedgeable	Non-Hedgeable
Sources of exposure	Financial	<ul style="list-style-type: none"> <li>■ 10 year USD, EUR, Yen cash flow or interest rate option</li> <li>■ 10 year equity option</li> <li>■ Rational lapse behaviour</li> </ul>	<ul style="list-style-type: none"> <li>■ 60 year USD, EUR, Yen cash flow or interest rate option</li> <li>■ 15 yr emerging markets cash flow</li> <li>■ 30 year equity option</li> </ul>
	Non-financial	<ul style="list-style-type: none"> <li>■ Screen or exchange traded CAT risks</li> <li>■ Actively traded securitised risks</li> </ul>	<ul style="list-style-type: none"> <li>■ Most insurance risks, e.g. mortality, property, casualty, etc.</li> <li>■ Irrational lapse behaviour</li> </ul>

LON-TCJ00511-001

**It is only necessary to calculate an explicit MVM for non-hedgeable risks.** In the next two sections we outline what is meant by hedgeable and non-hedgeable risks and what this means for the MVM calculation.

##### 4.2.2.1. Hedgeable risks

A hedgeable risk is a risk which can be pooled or hedged using a replicating portfolio.

In general terms, the cost of hedging is given by the market value of those instruments that the insurer would need to buy in order to fully hedge its position, as this includes expected and unexpected loss costs, transaction fees etc.

Hedging costs are implicit in the observed market price of those instruments the insurer would need to buy in order to fully hedge its position i.e. the replicating portfolio. It is therefore **not necessary to calculate an explicit MVM for hedgeable risks.**

<sup>6</sup> This is not an exhaustive list of the types of risks that fall into each category

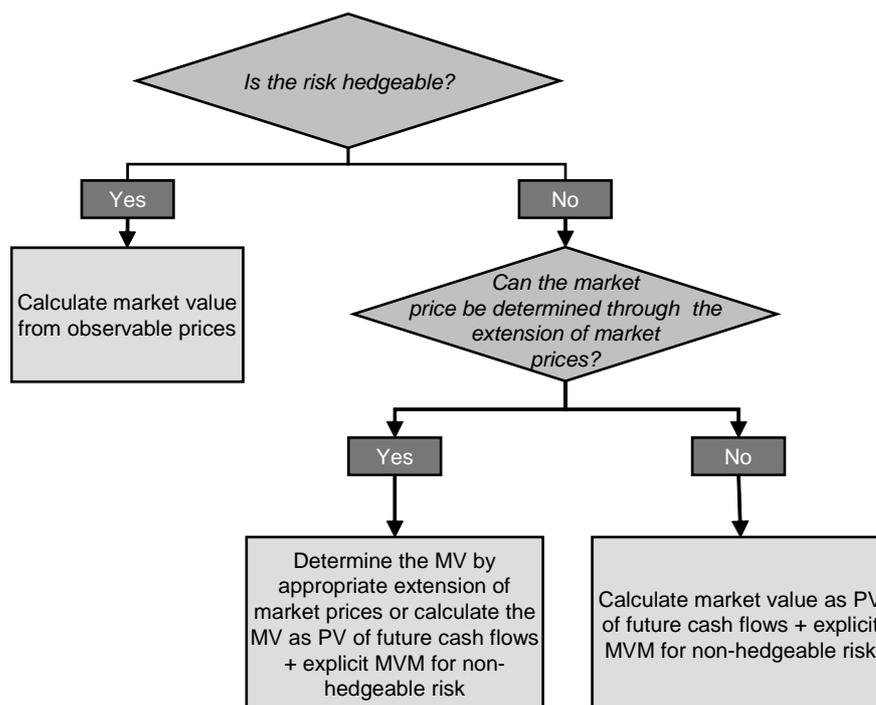
#### 4.2.2.2. Non-hedgeable risks

In theory it is possible to sell any risk for a price. However, in order to be confident with reasonable certainty that the price accurately represents the MVL, the price for the risk would need to come from a deep and liquid market.

Risks for which a deep and liquid market is not available are referred to as non-hedgeable<sup>7</sup>. They are risks for which a market price cannot be observed. As shown in Figure 5, non-hedgeable risks include both financial and non-financial (underwriting) risks.

To compensate an investor for the cost of taking non-hedgeable risks, an explicit MVM in addition to the expected present value of future cash flows is demanded. Under the MCoC approach, the MVM is the compensation required for the cost of holding capital against non-hedgeable risks over the life of the policy. In the context of a solvency framework, the capital held is assumed to be the equivalent SCR.

**Figure 6: Flowchart for determining the appropriate method for calculating the MVL**



LON-TCJ00511-001

### 4.3. Solvency capital requirement (SCR)

There is a lot of work underway to determine the SCR for the Standard Approach under Solvency II. In addition, some companies will use approved internal models in order to determine their SCR. Once the SCR has been determined for all businesses (regardless of approach taken), it will naturally follow that the SCR can also be determined for non-

<sup>7</sup> It is possible that over time non-hedgeable risks will become hedgeable as deep and liquid markets develop

hedgeable risks. This paper therefore need not focus on the determination of SCR, but instead **the projection of what the SCR is for non-hedgeable risk** so that the MCoC approach can be applied.

#### 4.4. Cost of capital (CoC)

The CoC in the context of this paper **refers to the capital charge on fully diversified capital held to cover non-hedgeable risks only.**

This should therefore not be seen as a total company CoC. The components of the total company CoC such as return on franchise value and return on investment portfolio are out of the scope of this paper.

## 5. The MCoC approach to MVMs

In the previous section, the theory underpinning the MCoC approach to MVMs was explained. With the theory in mind, this section goes on to explain how to calculate MVMs in practice using a MCoC approach.

Recall that the MVM is **defined as the cost of risk, i.e. a risk margin in addition to the expected present value of future cash flows required to manage the business on an ongoing basis.**

The CRO Forum endorses a MCoC approach to calculating the MVM. For non-hedgeable risks, this approach ensures that both assets and liabilities are valued in a manner consistent with hedgeable risks. Under this approach, the MVM for non-hedgeable risk is calculated as the present value of the cost of **future** capital requirements for non-hedgeable risks.

To calculate the MVM for non-hedgeable risks the following steps should be taken:

1. **Project the SCR** (net of diversification benefits) for non-hedgeable risks from time 1 until the run-off of the portfolio
2. **Calculate the capital charge** at each projection year (t) as the SCR multiplied by the CoC charge (for non-hedgeable risks) in order to arrive at a MVM(t)
3. **Discount the projected capital charge** to determine the MVM

In order to be able to follow these three steps it is important to understand how to calculate all of the required components.

### 5.1. Step 1: Project the SCR for non-hedgeable risks

In order to determine the MVM the SCR for non-hedgeable risks must be projected for all future time periods i.e. from time 1 until the portfolio has run-off.

Using the standard model or internal models, solvency capital is calculated at time 0 then for most risks, the projected SCR (i.e.  $t=1 \rightarrow$  run-off) can be determined via an underlying driver that is indicative of the risk level. The Standard SCR will define this driver. The SCR profile should be projected based on suitable drivers and these drivers based on forward markets (or expectations) playing out.

Recommendations for appropriate proxy measures to use split by product and risk type are outlined in Appendix C. Instead of the standard approach, companies can also use their own internal models to project capital. If companies opt to use their own internal models then they will need to explain the assumptions and calculation method used to their supervisor.

In line with the thoughts expressed in the discussions regarding Solvency II, the required **SCR at time 0 (subsequently used to project future capital) for non-hedgeable<sup>8</sup> risk**

---

<sup>8</sup> Non-hedgeable risks should include at a minimum life insurance(mortality, morbidity, persistency, expense), P&C insurance (catastrophe, basic losses, large losses, pricing risk), market (interest rate risk, volatility risk), credit (reinsurance) and operational risk

**types would be set at 99.5% Value at Risk for a holding period of one year.** As stated in Section 4.3, companies may use either the standard approach to determining capital for each risk type or their own internal models.

The SCR for non-hedgeable risks should be calculated net of full diversification effects (see Appendix B) within all non-hedgeable risk types. Diversification benefits with risks that can be hedged (e.g. avoidable mismatch risk) should not be included.

For some risks, it is believed by some that a stochastic projection is needed at each future point in time. The vast majority of risks requiring stochastic valuation are financial in nature and therefore the very basis of the valuation is the determination of the market value of the liability.

## 5.2. Step 2: Calculate the capital charge

Once capital has been projected for all future time periods, the next step is to calculate the capital charge at each point in time until run-off. The capital charge for non-hedgeable risks can be explicitly calculated by multiplying the future SCR at each point in time by the CoC for non-hedgeable risk.

**It should be noted that this cost of capital charge only applies to capital that is required for the non-hedgeable risk.** Further, please note that the CRO Forum is willing to assist in a short study to define the appropriate CoC to be included.

## 5.3. Step 3: Discount the capital charge

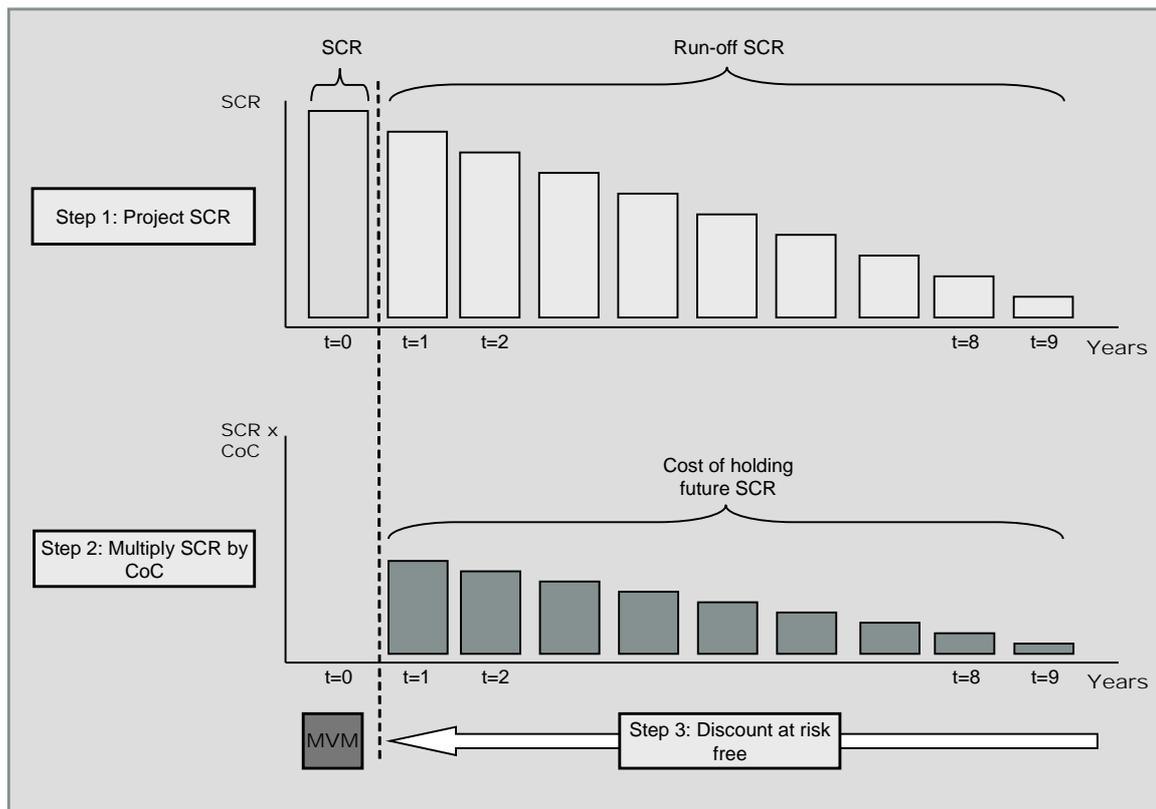
The final step in calculating the MVM is to discount the projected capital charge stream at the risk free rate. In the CRO Forum's June 10<sup>th</sup> 2005 paper<sup>9</sup> on admissibility it was recommended that the risk free rate used for discounting should be set equal to the swap rate.

The three steps taken to calculate the MVM for non-hedgeable risks are summarised in the chart below.

---

<sup>9</sup> The Chief Risk Officer Forum, 'Principles for Regulatory Admissibility of Internal Models,' June 10th 2005

**Figure 7: Calculating the MVM for non-hedgeable risk**



#### 5.4. Illustrative example<sup>10</sup>

An insurance company has sold 500 term assurance policies and the premium on each policy is €50. If the policyholder dies within a 5 year period then a benefit of €1000 is paid. If they do not die within this period then nothing is paid.

The following assumptions are made with respect to all policyholders:

- The probability of dying within any one year is 1%
- The swap rate is 5% (yield curve is assumed to be flat)
- The CoC for non-hedgeable risks used to illustrate the approach in this example is 4%

We now illustrate how the MVM can be calculated following the three steps outlined above.

##### **Step 1: Project the SCR for non-hedgeable risks**

The first step in calculating the MVM is to project the SCR for non-hedgeable risk types.

<sup>10</sup> Simplifying assumptions have been made in this example e.g. future cash flows do not include expense or commission cash flows

The insurance company has calculated that **the diversified SCR with respect to non-hedgeable risks for their portfolio of term assurance products is €2176.**

The insurance company believes that the present value of benefits (claims) is the best proxy measure for projecting the future SCR. This future required capital can therefore be projected by first determining the SCR as a percentage of the present value of benefits<sup>11</sup> and applying this percentage at each point in time. This is illustrated in the table below.

t=	0	1	2	3	4	5
No of policies (start of year)	500	495	490	485	480	0
Premium (at beginning of year)	25,000					
Claims	5,000	4,950	4,901	4,851	4,803	
PV Claims	21,764	17,729	13,543	9,199	4,687	
<b>SCR</b>	<b>2,176</b>	<b>10%*</b> <b>17,729</b>	<b>10%*</b> <b>13,543</b>	<b>10%*</b> <b>9,199</b>	<b>10%*</b> <b>4,687</b>	<b>N/A</b>
		<b>= 1,773</b>	<b>= 1,354</b>	<b>= 920</b>	<b>= 469</b>	
SCR as % of PV of benefits	10%					

### Step 2: Calculate the capital charge

The capital charge is calculated by multiplying the projected SCR at each time period by the CoC of non-hedgeable risks.

t=	0	1	2	3	4	5
SCR	2,176	1,773	1,354	920	469	N/A
<b>Capital charge 4% of SCR<sup>12</sup></b>	<b>87</b>	<b>71</b>	<b>54</b>	<b>37</b>	<b>19</b>	

### Step 3: Discount the capital charge

The MVM can now be calculated by discounting the capital charge at each point in time.

t=	0	1	2	3	4	5
SCR	2,176	1,773	1,354	920	469	N/A
Capital charge (at end of year)	87	71	54	37	19	
<b>Discounted capital charge</b>	<b>87/ 1.05^0.5</b>	<b>71/ 1.05^1.5</b>	<b>54/ 1.05^2.5</b>	<b>37/ 1.04^3.5</b>	<b>19/1.04^4.5</b>	
	<b>= 85</b>	<b>= 66</b>	<b>= 48</b>	<b>= 31</b>	<b>= 15</b>	
<b>Total MVM</b>	<b>245</b>					
PV Liabilities	21,764					
MVL	22,009					

The MVM for the term assurance portfolio is therefore equal to 85 + 66 + 48 + 31 + 15 = €245. Note that at each year in the future the same process would be undertaken for this group of policies in order to determine the MVM at that point in time.

<sup>11</sup> This is a simplified assumption and therefore a simplifying assumption has been used to project capital. In reality would need to project SCR based on proxy measure for each risk type e.g. mortality trend risk

<sup>12</sup> The simplifying assumption is made that the MVM is set up mid year

## 6. Frequently asked questions

This final section of the paper is used to answer some of the most frequently asked questions regarding a MCoC approach to MVM and the implementation issues associated with such an approach.

### 6.1. Circularity

**Question:** Is the calculation of the MVMs circular i.e. you need to know the SCR to calculate the MVM but the MVM should be included in the SCR?

**Answer:** As is shown in figure 2, the MVM and the SCR are determined independently. The SCR is calculated by stressing the MVL over a one-year time horizon. The issue of circularity in the calculation arises because the MVM is calculated directly from the SCR however it also makes up part of the MVL and is therefore assumed to be included in the SCR calculation. Although this is theoretically true, given the relative size of the MVM in comparison to the total MVL the impact of including the MVM in the SCR calculation would be insignificant. Drawing on this observation, the assumption is made that the MVM will have little or no effect on the SCR and can therefore be excluded from the SCR calculation which removes any circularity from the calculation. Although the MVM is not included in the calculation of the SCR it will be included in the absolute level of risk bearing capital (total financial resource).

### 6.2. Asset liability mismatching

**Question:** Should the acquiring insurer be compensated for any avoidable asset liability mismatch (ALM) taken by the defaulting insurer?

**Answer:** Under the CRO Forum's MCoC approach to MVM, no credit is given to the acquiring insurer for ALM risk. ALM risk is a hedgeable risk therefore it is assumed that the acquiring insurer can swap back to the replicating portfolio instantaneously (due to planning in the due diligence process they would undertake in evaluating the target company) and therefore hedge any asset liability mismatch taken by the defaulting insurer.

### 6.3. Level of risk margin relative to overall liability

**Question:** Some regulators and supervisors have expressed concerns over the relatively low level of MVMs which were visible in the results of the Swiss Solvency Field Test.

**Answer:** When considering the MVM relative to the total market consistent value of liabilities it should be remembered that the explicit MVM only corresponds to the MVM charged for non-hedgeable risks.

It is therefore suggested that companies seek to disclose the level of liabilities that is directly related to observable market prices so as to give the regulators and supervisors an indication of the proportion of liabilities for which the MVM is not explicitly stated.

Low margins have also been observed using a percentile approach therefore this is not purely a MCoC issue.

#### 6.4. Tax

**Question:** How is tax incorporated into the calculation?

**Answers:** The liabilities on the balance sheet are set on a pre-tax basis and hence the MVM to be included should be pre-tax as well. This is analogous to how market values are set for assets and is therefore the approach adopted in this paper.

#### 6.5. Operational risk

**Question:** Should operational risk be included in the MVM calculation?

**Answer:** Operational risk is a non-hedgeable risk and should therefore be included in the calculation of the MVM. Appropriate methods for calculating the operational risk component of SCR are not within the scope of this paper.

#### 6.6. Harmonisation

**Question:** How will the inconsistencies that currently exist between internal models affect the calculation of the MVM under this approach?

**Answer:** It was stated in the CRO Forum's June 10<sup>th</sup> 2005 paper<sup>13</sup> on admissibility of internal models that there is already a high commonality between the CRO Forum members' internal models. The CRO Forum has also formulated recommended approaches and ways of benchmarking internal models to address these concerns. In addition to this, the proportion of the MVL that corresponds to the explicit MVM is relatively small. Therefore any discrepancies between internal economic capital models will have a relatively small impact on the results. Therefore this is not a key issue for this paper.

#### 6.7. Total portfolio versus different business line

**Questions:** Should the MVM be calculated at a portfolio level or on different business lines?

**Answer:** The MVM is calculated for each line of business or product groups (where the products have similar risk profiles) for each risk type and then added to the best estimate liability value. This will improve transparency and facilitate companies' analysis of the risks they take. The MVL is then aggregated to a company level.

#### 6.8. Non-life business

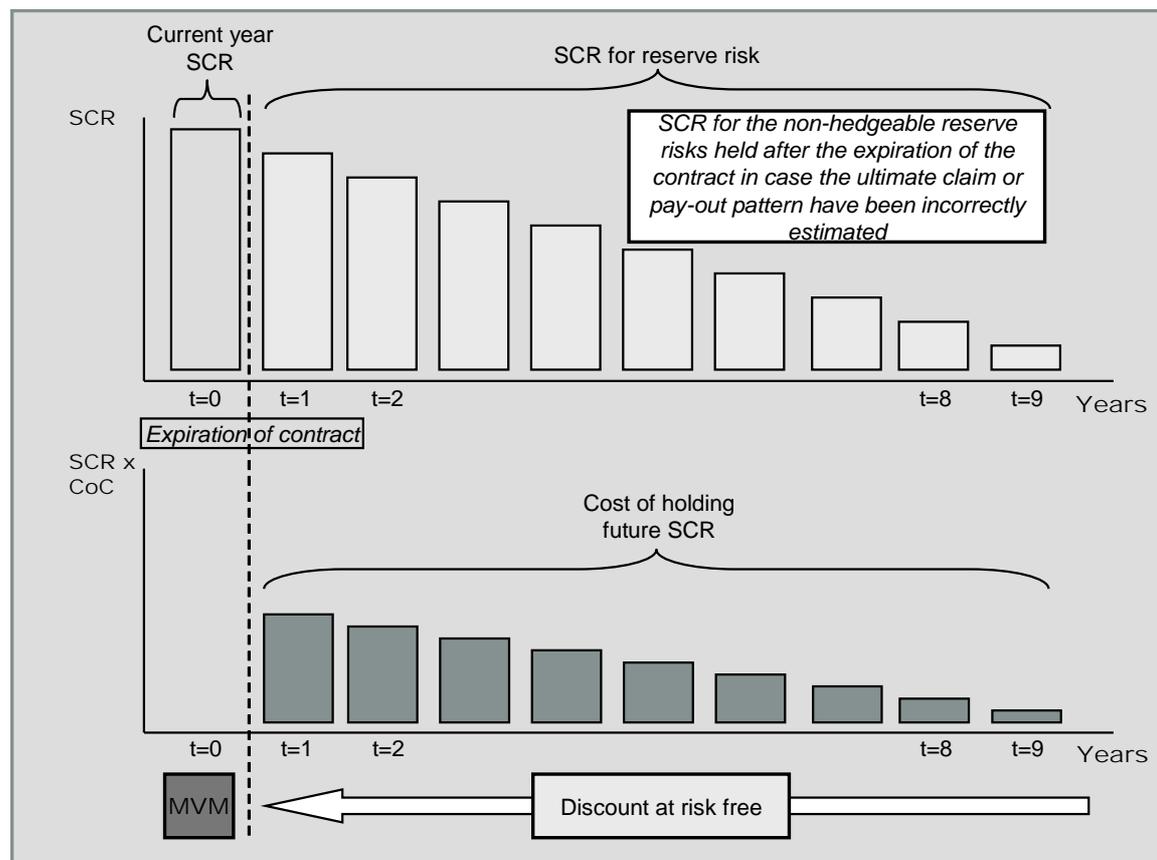
**Question:** Does the MCoC approach work for non-life business?

---

<sup>13</sup> The Chief Risk Officer Forum, 'Principles for Regulatory Admissibility of Internal Models,' June 10th 2005

**Answer:** The MCoC approach also applies for non-life business. For in-force business an SCR for non-hedgeable risk will be set up for the current year to support the insured risk. In addition to this, SCR for the non-hedgeable reserve risks will also be held after the expiration of the contract. This capital is held to cover the risk that reserves may not be sufficient to cover claims either because ultimate claims or the pay out pattern had been incorrectly estimated. The MCoC approach applies to both the current SCR and future SCR (reserve risk) and therefore both contribute to the determination of a MVM. This is further illustrated in Figure 8 below.

**Figure 8: Calculating the MVM for non-life products**



As the risk associated with non-life reserves still occurs over the future, we would expect that these reserves would be discounted in the same way as typically used for life business. This would be the case for both claims risk and reserving risk, although we would expect that for yearly renewable business the discounting applied to claims risk would be minimal given the short policy term.

### 6.9. Small entities

**Question:** How easily can this kind of framework be implemented in smaller entities?

**Answer:** The Swiss Solvency Field Test<sup>14</sup> provides a good example of the success of this type of approach in smaller entities. It was found during the field tests that this kind of approach also works well in smaller entities. This was largely due to the fact that this type of approach lends itself well to simplifying assumptions, which can be used by these smaller companies.

In cases where the small entity does not have the ability to build internal models, the standard SCR approach can be adopted in order to determine the SCR for non-hedgeable risks (allowing for full diversification benefits between non-hedgeable risks) i.e. by setting the capital requirements for all other risks equal to zero. The rest of the approach will be identical for both companies using internal models and small entities using the standard SCR approach.

#### 6.10. Variation in CoC

**Question:** Should the CoC for non-hedgeable risks vary between risks, businesses or reference market?

**Answer:** The cost of capital for non-hedgeable risks reflects the excess return over risk free rates that an acquiring company would require to compensate them for the cost of holding capital to run-off the business. The CRO Forum suggests that in most cases, this risk margin (MCoC) should not vary by risk type or business, as any difference in risk should be reflected in the SCR. However, there may be some risks where it is easier to reflect some difference in uncertainty by altering the MCoC as it may be felt it cannot be as effectively reflected in the SCR. Since the SCR for non-hedgeable risk will differ between risk types, even if a constant cost of capital for non-hedgeable risk is used, the MVM will automatically differ under the MCoC approach thereby better reflecting risk.

With regard to the reference market in which the products are sold, it is possible that the price of risk may vary between countries due to uncertainty in the market. However, most of this uncertainty is due to the difficulties in hedging unwanted risk and therefore will already be factored into the SCR and MVM, as these risks are not hedgeable. In these cases, the MCoC would not vary. However, there again may be some reference markets where it is more appropriate to capture some of the uncertainty in altering the MCoC rather than reflecting all differences in risk in the SCR. The CRO Forum does however suggest that the cost of capital for non-hedgeable risks is reviewed periodically.

#### 6.11. Time horizon

**Question:** Does the MCoC approach only take into account one year worth of risk?

**Answer:** One common misconception regarding the MCoC approach is that because the SCR used to calculate the MVM is measured using a one-year shock approach that the MVM only takes account of one year worth of risk and everything after the first year is ignored. This understanding is incorrect.

---

<sup>14</sup> Philip Keller, Swiss Federal Office of Private Insurers, The Swiss Experience with Market Consistent Technical Provisions – Cost of Capital Approach, February 24, 2006

The SCR represents the change in liability value between expected future liability cash flows and worst-case (99.5% percentile) cash flows. These worst-case cash flows reflect not what we can observe in any one year but rather how far off we can be in estimating our expected liability cash flows over their entire life. The SCR ensures that the insurer will be able to survive a stressed situation occurring and remaining in place for the life of the business (not simply one year). The SCR profile is then estimated over the life of the business always assuming the worst-case event could happen at any time.

At each year in the future the SCR is projected, the cost of holding the SCR is determined and the present value of these costs is the MVM. This ensures that even if the worst-case outcome were to occur, there would be enough expected profit in the business to remunerate either a third party accepting the liability or new capital providers.

As experience unfolds and the company realizes they need to change expectations for future liability cash flows, the SCR is also re-determined based on this new information and again projected into the future for the purpose of determining the MVM under the MCoC approach. This ensures that the MVM and SCR are always market consistent and “right-sized” to withstand a worse-case outcome.

The multi-year nature of the MCoC approach to MVM is illustrated in the example outlined in section 5.4.

## Appendix A. Expected present value of future cash flows

### Products without optionality

All cash flows that occur with certainty are totally risk free and can be replicated with risk-free assets of a similar term. The present value of such cash flows should therefore be discounted at the swap rate for the appropriate term. To discount at any other rate would not be consistent with the risk in the cash flows and inconsistent with the replicating asset portfolio concept.

The market consistent framework assumes that there is no reward for holding diversifiable risk. In other words, shareholders will only require an additional return for the risks they take that cannot be diversified away. This assumption implies that any cash flows that are not risk free but where risk is diversifiable, should be treated as risk free and hence discounted at the swap rate. This assumption flows through to the treatment of the MVM for non-hedgeable risks, where it is assumed that if the liabilities are transferred then the second party that takes on the liabilities has a well-diversified portfolio, and therefore does not need to hold capital against such risks. In an efficient market, a well-diversified counterparty will be able to offer better terms for assuming a liability than a counterparty that is not well diversified (and hence would have to hold capital against such risks).

This assumption also implies that expected cash flows that are subject to non-diversifiable risk e.g. systematic (market) risk should be discounted at a rate that reflects the risk inherent in the cash flow. The risk-adjusted rate used for discounting contains a risk premium that investors would demand for investing in an asset that replicates the respective cash flows. The greater the expected return driving such a risky cash flow (and hence the higher the cash flow), the greater the discount rate applied to the cash flow. An alternative approach to projecting and valuing market-driven cash flows is the *certainty equivalent* technique. This is a form of risk-neutral valuation where the risky cash flows are projected assuming that all underlying assets earn the risk-free rate, or in other words that the reward for risk for all assets is zero. This generates cash flows that are fully risk adjusted, such that they can then be discounted at the risk free rate.

The outcome of a certainty-equivalent valuation, or more generally of a risk-neutral valuation, is assets and liabilities that have been fully adjusted for the cost of risk. In CAPM terms, this means that the net valuation position fully accounts for the market price of risk.

## Products with embedded options or guarantees

For products that contain options or guarantees using the certainty equivalent approach becomes a very complex process. This is due to the non-linear, asymmetric relationships with market returns that exist in these products.

It is therefore necessary to determine the value of the liability using option pricing methods such as closed form formulae e.g. Black Scholes or, when the options and guarantees are more complex, through risk neutral Monte Carlo simulation. In order to achieve market-consistency, both methods should be calibrated to reproduce the prices of traded assets (e.g. options) that best reflect the characteristics of the liabilities being valued.

## Appendix B. Diversification

In the CRO Forum's paper on diversification<sup>15</sup>, four levels of diversification were set out.

- **Level 1 – Within risk types:** the diversification observable in a homogenous insurance portfolio. Examples of this level of diversification would be: 1) adding more unrelated risks to the portfolio reduces the volatility of the claims results, or 2) investing in an index of common shares rather than a single company reduces the volatility of investment returns
- **Level 2 – Across risk types:** 1) the combination of two classes of insurance such as motor insurance and household insurance within one company or 2) the diversification of insurance risks and market risks, where claims results are unrelated to investment markets
- **Level 3 – Across entities, within a given geography:** two or more insurance companies within an insurance Group (who may offer different or identical products). While this is an extension of levels 1 & 2, it is recognised separately given the realities of today's insurance markets in terms of regulation and legal structure<sup>16, 17</sup>. Also, different entities will face different issues surrounding the transferability of capital
- **Level 4 – Across geographies or regulatory jurisdictions:** the consolidation of entities operating in different geographies. Also an extension of the intra- and inter-risk diversification in levels 1 & 2; however the practical realities of separately incorporated or regulated insurance companies make this distinction relevant

---

<sup>15</sup> The CRO Forum, A framework for incorporating the diversification in the solvency assessment for insurers, June 10<sup>th</sup> 2005

<sup>16</sup> Regulation is often developed separately for life and P&C businesses.

<sup>17</sup> Insurance Groups often comprise different brands, acquired through the years, which frequently remain separately licensed and incorporated insurance companies.

Appendix C. Proxy measures for projecting capital<sup>18</sup>

		Products					
Non-hedgeable risk type		Death protection	Survivorship protection	Savings	Accident & health	P&C property	- P&C liability
Life insurance	Mortality <sup>19</sup>	Net amount at risk	PV of benefits	Economic liability	Net amount at risk	n/a	n/a
	Morbidity	n/a	n/a	n/a	Net amount at risk	n/a	n/a
	Persistency	Economic liability	Economic liability	Economic liability	Economic liability	n/a	n/a
P&C insurance	Natural Catastrophe	Net amount at risk	PV of benefits	Economic liability	Net amount at risk	Premiums	Premiums
	Basic losses	Net amount at risk	PV of benefits	Economic liability	Net amount at risk	Premiums	Premiums
	Large losses	Net amount at risk	PV of benefits	Economic liability	Net amount at risk	Premiums	Premiums
	Expenses	PV of premium	PV of benefits	PV of benefits	PV of benefits	PV Premiums	PV Premiums
	Operational	PV of benefits	PV of benefits	PV of benefits	PV of benefits	Premiums	Premiums
Credit	Reinsurance	Economic value of business ceded					

<sup>18</sup> The adopted standard approach will govern what is used as a driver as the methodology will define the driver at time 0 and therefore in the projection or required capital. Under no circumstances should this be viewed to replace internal company models for the projection of economic required capital and associated costs of holding capital.

<sup>19</sup> The IAA solvency report split mortality and morbidity risk into three categories: 1) uncertainty (which can be further split into trend uncertainty and level uncertainty) 2) volatility risk 3) calamity risk. Individual proxy measures can be determined for each of these three sub-categories

		Products					
Non-hedgeable risk type		Death protection	Survivorship protection	Savings	Accident & health	P&C property	- P&C liability -
Market risk	Non-hedgeable Interest rates	PV of benefits	PV of benefits	PV of benefits	PV of benefits	PV of benefits	PV of benefits
	Volatility risk	Economic option value	Economic option value	Economic option value	Economic option value	Economic option value	Economic option value

1