Institute of Actuaries of India

Report of the Committee to draw the road map for moving towards Economic Capital and Market Consistent Embedded value for life insurance industry in India

(Chairman: Dr R Kannan)

Mumbai

June 8, 2009

Foreword

"Economic capital" and "Market-consistent embedded values" (MCEV) are important buzzwords in the insurance lexicon gaining prominence following the recent global financial crisis which has severely damaged several stalwarts of the insurance industry. With the ongoing speculation about possible IPO's by insurers, the concepts of MCEV and economic capital are gaining prominence in our country and will no doubt continue to be eagerly reported by the financial press in the coming months.

This report goes a long way to demystify these concepts and is a valuable addition to the library of anyone interested in the future of insurance industry not only in our country but also globally. I am confident this report will be a constant source of reference for practitioners in the industry and also other stakeholders including analysts, rating agencies and the financial press.

I must thank the Chairman of the Committee Dr. Kannan, Member(Actuary), IRDA for raising the profile of these important concepts within not only the Institute of Actuaries of India but also in the wider community nationally. Dr. Kannan has been and continues to be a tireless proponent of the need for India to embrace modern global financial concepts with suitable adaptation to our local circumstances. I must on behalf of the Institute thank him for his continuing endeavors.

Turning first to the concept of economic capital the report sets out the various methodological decisions that need to be made in order to compute economic capital together with relevant international practice. These are critical issues affecting both the use of economic capital and the quantum of the same and I would like the readers to peruse the various decision points carefully.

The report then goes on to discuss the area of MCEV setting out the components of value and then discussing the applicability of the various MCEV principles in the Indian context. Some of the Principles require additional technical advice for a robust calculation and these have been classified as "Category 2" by the authors including the challenging areas of assumptions setting and market- consistent calibration of stochastic models.

Given the various technical challenges involved in the computation of both economic capital and MCEV which the report alludes to, we at the Institute stand ready to assist in the development of standards in these areas.

This report represents an important step in the enhancement of solvency and shareholder value reporting in India and I thank Dr. Kannan and his Committee members for the production of this high quality report.

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8th June, 2009

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Sir,

Please refer IOAI office order dated December 23, 2009. I have great pleasure in submitting the report for the consideration of the Institute.

I thank each and every member of this committee for their excellent cooperation and contribution. In particular I thank Mr. Mark Saunders, Mr. Varun Gupta and Mr. B. N. Rangarajan for their significant contributions and initiatives.

We thank the European CFO Forum for allowing us to use the principles they have developed.

I also thank Sri A.V. Rao and Sri S. Karthikeya Sarma of IRDA for editing the report.

(R. Kannan)
Chairman
Committee on Economic Capital

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Chapter I

1. Introduction

1.1 Economic capital

In view of the recent developments in the macro economic scenarios across the world, it has become essential to find ways to improve capital efficiency of the insurance companies without threatening solvency. Too much capital will reduce the capital efficiency and too little capital may threaten the solvency. Economic capital is a way of ensuring proper balance between capital adequacy and capital efficiency. Economic capital is the amount of capital required to keep the balance sheet solvent on a going concern basis under a stress event.

SoA Practice guide on Economic Capital defines the economic capital as "*Sufficient surplus to cover potential losses at a given risk tolerance level over a specified time horizon*."

Typically, economic capital is calculated by determining the amount of capital that the firm needs to ensure that its realistic balance sheet stays solvent over a certain time period with a pre-specified probability. E.g. the economic capital may be determined as the minimum amount of capital required to make 99.9% certain that the company remains solvent over the next year, or the probability that the loss from the business exceeds say Rs.100 million is below .001% over the next business year.

It is important to note that economic capital is not a capital resource (how much capital available for a company) but it is a measure of capital requirement.

The word ‘economic’ indicates the fact that it measures risk in terms of economic realities rather than potentially misleading regulatory or accounting rules. This word also indicates that part of the measurement process involves converting a risk distribution into the amount of capital that is required to support the risk, in line with the institution’s target financial strength (e.g. credit rating).

Regulatory capital is the amount of capital a regulator has determined an institution needs to hold, but is generally not as specific to the institution as economic capital would be. The regulatory capital for particular risks would be calculated more broadly, and the definition of risk would be a systemic one, rather than an institutional one.

1.2 Importance of Economic capital

1. Solvency & Capital efficiency:

A company needs to have a degree of comfort in its ability to withstand extreme events. It is not efficient for a company to hold enough capital for every conceivable contingency, but neither is it efficient to run the risk of insolvency with too frequent events. Economic capital, if assessed properly indicates the appropriate level of capital required to meet the liabilities including a sufficient cushion for events of extremely low probability but having a high impact on the economic solvency of the company. It ensures solvency of the company to a reasonable confidence level and also capital efficiency. It recognises that the assessment of capital requirement is unique to each company depending on its risk profile, resources available, operational efficiency etc.

In an environment, where there is strong regulatory framework in place, the companies need to maintain regulatory capital even if it is calculated on broader assumptions than economic capital.

2. Benefits of diversification:

Economic capital takes account of reduction in levels of aggregate risks of the company due to diversification of business across different types of risks and lines of business. This increases the capital efficiency as the capital assessment is not a mere arithmetic summation of reserves required for each type of risk or line of business separately.

3. Decision making process:

Economic capital enables a company to make decisions which involve quantitative risk reward trade-offs. If each part of the economic entity is required to make an appropriate return on economic capital, and economic capital is appropriately allocated between the lines of business in proportion to their risks (all risk, including operational and strategic), then the high risk parts of the company will naturally require a higher return to compensate for the risks they are taking with the firms money. Effectively economic capital enables a company to have a *common currency of risk*. This will mean that decisions across many different business and risk types can be made with the intention of making the same return on a given unit of risk.

4. Economic Capital as part of Enterprise Risk Management:

Economic capital forms an indispensable part of the management of a company. It is important to understand the risk and reward trade offs inherent in taking a decision. Economic capital can be a common currency of risk if measured consistently.

Reviewing the performance of each year needs to review the risks taken, and their rewards, as well as the profit performance. This will help the business more deeply understand the risks taken, compared with the risk appetite, and the rewards that were available. And once reviewed, the cycle starts again – with a new plan, new assumptions about risk and reward. A robust economic capital framework that combines the measure of risk and reward as the main measurement of value added in the group is the best way to match the management of risk and reward in a financial services institution.

5. Allocation of Capital:

Proper systems of economic capital estimation and management enable the insurance companies to determine the amount of capital required for different lines of business, to allocate the available capital in the most efficient manner among these lines of business and to take the benefits of diversification.

6. Solvency-II framework:

In view of the above, Solvency-II framework for European Union also proposes that the Solvency capital requirement should be determined as the economic capital ensuring that the probability of ruin restricted to 1 in 200 years. Economic capital should be calculated on the basis of the true risk profile of those companies, taking into account of the impact of possible risk mitigation techniques, as well as diversification effects.

1.3 Market Consistent Embedded Value (MCEV)

Clearly related to the economic capital concept is the embedded value. There are different ways of measuring the value or profitability of an insurance company in

traditional reporting system. e.g. Statutory earnings figure or GAAP earnings etc. However, these suffer limitations such as not capturing the overall profitability of new business and not reflecting accurately the underlying risks in the business.

The embedded value overcomes many of such deficiencies. Embedded value can be considered as an indication of the value of the in-force business of the insurance company. It is more useful especially when mergers and acquisitions take place and in assessing the true value of an insurer although the final price may also reflect other factors including the expected value of new business, market conditions and strategic considerations. EV can be defined as "the value of the realistic future profit stream from the company's existing business together with the value of any net assets separately attributable to shareholders." To the embedded value if we add the value of the profits from future new business, it gives an estimate of appraisal value of the company. Embedded value is very useful in many ways like profit reporting for published accounts, profit reporting for internal management accounts, management incentive schemes, business unit management, financial planning and inter-company comparisons, valuing a company for merger or sale, demutualisation, floatation of proprietary insurers on a stock market, assessing the fair share price for an existing quoted insurer and in determining a "shadow" share price for an unquoted insurer for various purposes. Determining the movement in the embedded value and tracing back the causes of changes in various components of the embedded value will give insight into the position of the company and the areas which need special attention for

improvement. However, the traditional method of determination of the EV suffers from the following limitations.

- EV is not directly based on the risk characteristics of the cash flows being valued. Instead, a risk discount rate is used to reflect the over all risk levels indirectly.
- It is difficult to allow exactly for the risks from guarantees and options, asset/liabilities mismatch, default risks on corporate bonds and for economic cost of capital in the risk discount rate.
- The allowance for non-market risks is also via an implicit allowance in the risk discount rate, rather than by more objective means. The allowance may therefore fail to reflect the company's own view of the risk capital required to support the business.

Market Consistent Embedded Value (MCEV) tries to overcome most of these limitations. In a market-consistent valuation all projected cash flows are valued in line with the prices of similar cash flows that are traded in the open-market. For example, the cash flows arising from equity are valued in line with the market price of the equity. Additionally, liability cash flows are valued in line with the traded assets they closely resemble. A fixed liability due in five years would be valued in line with a five year zero coupon bond. For cash flows where no exact traded price exists, a combination of economic theory and numerical analysis (interpolation or extrapolation) is utilised to arrive at a value. The key factor for determining the value is the no arbitrage principle, and a figure is arrived at that prevents switching between asset classes to create any value.

At its simplest, MCEV of an insurer is the difference between the market value of the assets and the value of the liabilities assessed on a market-consistent basis (the estimated value of these liabilities if they were traded, by reference to observed values of similar or replicating traded assets). The liabilities include payments to policyholders but also any payments to other parties other than shareholders, hence including expenses and tax, with the latter perhaps represented by a "deferred tax liability" item. The distinguishing characteristic of MCEV is the way the underlying components are valued, particularly in terms of the allowance for risk.

MCEV provides a more objective solution to the risk discount rate dilemma, enabling assets, liabilities and other capital related costs all to be valued in line with the market. At the same time, policyholders' options and guarantees are taken into account on a basis consistent with the pricing of options in financial markets. Certain cash flows should be valued at risk-free rates, although the definition of what is a risk-free rate is open to some debate.

MCEV techniques are especially valuable for companies implementing hedging programs to manage market risk. MCEV is increasingly being applied in countries such as the UK, Netherlands and Switzerland where regulators are starting to move towards a market-consistent basis for valuation and capital requirements. It is being used to validate product pricing, to evaluate hedging strategies, incorporate reconstructions, and as a basis for negotiation in company purchases and sales.

1.4 With reference to India

Effects of recent recessionary developments have had a considerable impact on the Indian economy. The rates of interest have come down significantly. Also, it is

becoming increasingly challenging to raise capital. The products need to be offered at competitive premium rates and at the same time enough business is needed to keep the insurance business viable. If stipulated solvency margin is defined in terms of economic capital, this may reduce capital strain for the companies and enable the companies to write more new business for a given level of free assets. Similarly, depending upon the risk inherent in products and operations of insurers, the capital requirements might increase.

Use of economic capital is consistent with use of Market Consistent Embedded Value which, along with the value of new business written, will be a good starting point for dealing with mergers, acquisitions of insurance companies and in determining the share price at the time of the initial public offering. Economic capital may be treated as one of the major factors in credit rating of a company and is considered in determination of embedded value. Also, moving towards economic capital conforms to the emerging global practice in this regard. However, proper systems of determination of economic capital are still to be established and insurers have to pay due attention.

As explained, insurers have to prepare themselves for undertaking various calculations on Economic Capital and Market Consistent and Embedded Value. This calls for not only robust IT systems, but also the availability of skilled personnel in various departments of the insurance companies. The experience of other countries clearly indicates that insurers take some time in preparing for this. In order to identify various building blocks in the working of economic capital and market consistent embedded value, the Institute of Actuaries of India has appointed a committee under

the Chairmanship of Dr. R. Kannan, Member (Actuary) in Insurance Regulatory and Development Authority (Please see annexure – I for the list of members).

The report is divided into two parts while, Part – A deals with Economic Capital and Part – B deals with Market Consistent and Embedded Value.

Chapter II

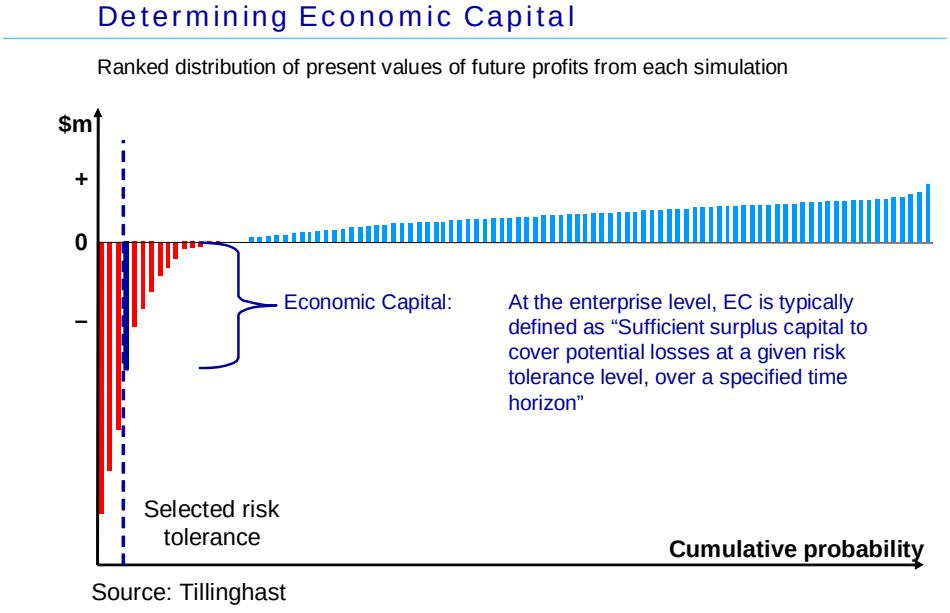
Part A – Economic Capital

The term "economic capital" is typically used to refer to a measure of required capital under an economic accounting convention – where assets and liabilities are determined using economic principles.

Economic Capital is different from the regulatory capital in the sense that EC is based on calculations specific to the company's risks while regulatory capital is based on formulae that takes into account the industry averages that may or may not be suitable to any particular company.

At its most basic level, Economic Capital can be defined as **sufficient surplus** to cover potential losses, at a **given risk tolerance level**, over a **specified time horizon**.

Graphically the Economic Capital can be illustrated as follows:



There are other alternative definitions of EC:

1. Sufficient surplus to meet potential negative cash flows and reductions in value of assets or increase in value of liabilities at a given level of risk tolerance, over a specified time horizon.
2. Excess of the market value of the assets over the fair value of liabilities required to ensure that obligations can be satisfied at a given level of risk tolerance, over a specified time horizon.
3. Economic Capital is defined as sufficient surplus to maintain solvency at a given level of risk tolerance, over a specified time horizon.

While Definitions 1 and 3 refer to sufficient surplus, Definition 2 instead focuses on the characteristics of market value of assets and fair value of liabilities that define this surplus. All these broad definitions imply that all risks are to be taken into account. Although the definitions vary slightly, some common themes that tie them together are:

- Sufficient surplus to cover adverse outcomes;
- A given level of risk tolerance and risks covered;
- A specified time horizon.

2. Key Decisions in Calculation of Economic Capital:

In calculating EC there are some key decisions to be made and the approach taken should reflect the nature of the company's risks as well as management's risk tolerance and objectives. These key decisions include the following:

Decision 1. Time Horizon

- One Year, or
- Multiple year, or
- Runoff of portfolio

Decision 2. Measure of Risk

- Value at Risk (Probability of Ruin) or
- Tail Value at Risk (Conditional Tail Expectation (CTE))

Decision 3. Type of risks should be considered?

- Insurance
- Operational
- Market
- Credit
- Liquidity

Decision 4. Quantification Methodology / Approaches to implementation

- Stochastic simulation
- Stress Testing
- Factor Based
- Statistical Correlation

Decision 5. Aggregation/Diversification

- Additive
- Variance / Co-variance
- Stochastic

Decision 6. Target level of security (e.g. 0.5% or 0.1% of Value at Risk (VaR)).

Decision 7. Risk Neutral Vs Real-world in projections

3. Considerations in making these decisions

3.1. Time Horizon

There are many approaches with variety of combinations of Decisions that are given above. However, in practice two broad methodologies have emerged as the most common:

a. A liability run-off approach.

b. One-year mark-to-market approach.

These two approaches can broadly be defined as follows:

Liability run-off approach:

Under this approach EC represents the current market value of assets required to a pay all future policy holder benefits and associated expenses at the chosen security level (expressed on a VaR or CTE basis) less the current value of the liabilities on a mean or best estimate basis.

One-year Mark to Market approach:

Under this approach EC represents the current market value of assets required to ensure that the market consistent value of liabilities can be covered in one-year's time at the chosen security level (typically expressed on a VaR basis) less the current market-consistent value of the liabilities.

Comparison of the two approaches:

Liability Run-off approach	One-year Mark-to-Market approach
The liability run-off method is typically performed using a stochastic simulation approach as described below: • A set of future scenarios for the run-off of the business is defined, asset/liability cash flows are projected and balance sheets are developed for each scenario. The scenarios would include specifications for economic and demographic conditions, including risk drivers such as interest rate scenarios and asset default rates. Mortality levels and other insurance risk drivers may also be included in the stochastic scenario generation process, although this is less common among life insurers. • Under each scenario, the level of assets required at the beginning of the scenario to satisfy all obligations through to the end of the projection is determined. The level of "required assets" for all scenarios is then ranked to form a distribution. • EC is defined by applying the chosen	The one-year mark-to-market approach is based on the following main steps: • An economic balance sheet is developed as at the valuation date on a mark-to-market basis, i.e., with assets at market values and liabilities on a market-consistent basis. The difference between the value of assets and value of liabilities gives the economic value of net assets, i.e., the available capital at the valuation date measured on an economic basis. • For a number of scenarios, assets and liabilities are projected forward for one year, at which point a projected economic balance sheet (on a mark-to-market basis) is developed. The resulting projected economic value of net assets (positive or negative) is then discounted to the valuation date using the projected earned investment return over the year. • A negative discounted value quantifies the additional initial asset value the

risk metric (e.g., VaR or CTE) to this distribution of total required asset levels and deducting the current value of the liabilities, measured on the selected basis (typically mean or best estimate).	insurer needs to hold to ensure it remains solvent on a mark-to-market basis at the end of the year under that scenario. A positive discounted value quantifies the excess initial asset value over the amount needed to ensure solvency on a mark-to-market basis at the end of the year. The discounted value (of the projected economic value of net assets) is therefore subtracted from the market value of assets at the valuation date to give the required assets for that scenario.

Considerations in selecting the time horizon

The factors to consider in selecting the appropriate time horizon include the following:

3.1.1.Risk profile of business:

The appropriate time horizon for EC should be selected taking into consideration the risk profile of the business.

The run-off approach directly models all risks that emerge over a longer time horizon being the run-off of the portfolio. Also, as it is normally based on stochastic modelling it allows a wider range of potential scenarios including the effect of management actions available during the run-off period than what is allowed under a one-year stress approach. However, if the business is exposed to a wide range of risk types it can be difficult to select models that consistently measure all the different risk types. Moreover, the results can be very dependent on the management actions assumed and it can be very difficult to allow for and effectively calibrate management actions such as investment strategy, bonus policies for participating business over a long period of time and wide range of scenario paths. In addition, in an environment where management actions change fairly frequently, making assumptions as to

management actions may be considered speculative. A further issue is that the run-off approach, based purely on the projected assets and liability cash flows, may ignore interim capital requirements (e.g. to meet the statutory solvency margin). Therefore, if these are ignored, there is an implicit assumption that capital can be raised at interim dates, which may not be the case. The alternative is to reflect interim solvency measures in the EC calculation.

The one-year mark-to-market approach examines a short period (i.e. one year) during which adverse experience emerges and during which there is an explicit assumption that limited management actions are taken. At the end of the one-year period there is an assumption that the risks can be "closed out" by transactions at market prices (under the stressed conditions), either through risk reduction (e.g. hedging) or risk transfer (e.g. reinsurance or sale). The lack of available options to transfer or hedge the risks or data on market prices for non-hedgeable risks may be regarded as a potential weakness of this approach.

The one-year approach relies on deterministic adverse scenario analysis to examine longer term risks and their management. This has a weakness in that it is reliant for its completeness on management's scenario selection (as opposed to using a stochastic scenario generation process), but has a strong advantage in allowing management to make a realistic assessment of all the risk management actions it might take in such a scenario. Management can then make a conscious choice between taking such action and holding additional capital, additional to the one-year mark-to-market EC, effectively to cover their preference not to take such management action.

A one-year approach for EC means that all risks should be measured consistently over the same time horizon, thus ensuring consistent aggregation of risks. However, this is dependent on an appropriate calibration and, if a stress test approach is used, the completeness of management's selected scenarios.

It is important to note that the selection of either the one-year or run-off approach for EC does not mean that companies do not recognise the need to address shorter or longer term risks and their potential impact on the company. For example, even

where companies use a run-off approach for EC, they may carry out additional analysis of the effect of instantaneous stresses on the economic or statutory balance sheet. Similarly, companies using a one-year approach may carry out scenario analyses to assess the emergence of risks over a longer period.

3.1.2. Communication and link to decision making processes:

A one-year approach is generally viewed as being easier to understand and explain, especially to non-technical audiences. For example, it is generally easier to explain and understand the meaning of an X% fall in equities than the type of assumptions and distributions underlying the Economic Scenario Generator used for the run-off approach.

It is also generally considered easier to link decisions, such as investment strategy and risk limits, and performance more directly to the EC calculated using the one-year approach. For example, if the EC analysis using the one-year approach indicates a significant mis-match to interest rates, it should be relatively straightforward to explain and take actions to mitigate this risk based on this information. Similarly, the one-year approach normally includes the expected new business for the year, thereby capturing the effect and implications of selling new business on EC requirements.

At a conceptual level, the liability run-off method can also seem relatively easy to understand. However, at a slightly deeper level in particular, the interactions of assumptions, modelling of management actions etc, make this approach to calculate EC relatively difficult to explain.

3.1.3. Calibration of confidence level and interaction between time horizon and confidence level:

The appropriate target security level should be consistent with the time horizon. It is generally viewed as easier to calibrate EC to a target security level under a one-year approach where, for example, the security level can be calibrated to an annual probability of default for corporate bonds.

Calibration of a liability run-off approach to an external data source is more difficult as:

- The block of business (and therefore the risk exposure) will typically be reducing over time, and
- The projection would typically not include all risks for all time periods; in particular new business may be excluded or only included for a limited period.

Therefore, there will not typically be external statistics available with which to calibrate the target security level under liability run-off method. Moreover, different lines of business run-off over different periods and may need different calibrations. Therefore, it may be difficult to select, and explain, the target security level used for the run-off approach.

3.1.4.Ease of stress calibration and calibration of management actions;

Given a target security level, it is generally easier to calibrate, and justify, a stress (or a stochastic model such as an ESG) over a one-year period than over the run-off of the business. However, the difficulties of this calibration should not be under-stated. One important point to note is that for the one-year approach, the stress for liability risks such as mortality is normally a combination of poor experience over the one-year period and a change in best estimate assumption at the end of the year. Therefore, the stress normally reflects full emergence of information regarding future experience for the risk over the one-year period.

Both approaches will require the calibration of management actions over the run-off of the business, although the calibration is for slightly different purposes. For a one-year mark-to-market approach, it may require only a limited number of management actions be modelled over the one-year period. However, where the business has options and guarantees, the calculation of the mark-to-market balance sheet at the end of one-year will need to reflect management actions over the lifetime of the business. For the run-off approach, management actions will need to be calibrated across a wide range of different run-off paths and the selected calibration can have a

significant effect on the calculated capital requirements. Therefore, the calibration needs to be reviewed for reasonableness under normal and extreme conditions. One further issue with the calibration of management actions is where these depend on interim solvency measures such as the statutory solvency position. The calculation of interim solvency measures across a large number of stochastic scenarios can be computationally very intensive.

3.1.5.Implementation considerations:

The implementation of either time horizon options is likely to require stochastic modelling of the liabilities. For the run-off approach a stochastic model is required to project the assets and liability cash-flows. For the one-year approach, a stochastic model may be required if the risks are assessed stochastically and for the valuation of the options and guarantees.

The complexity and computing requirements of the model will depend on a range of factors including:

- The management actions and policyholder behaviour included in the model;
- Whether a stochastic or stress test approach is used to analyse each risk – A stochastic analysis of the risk combined with the mark-to-market valuation of any options and guarantees can require "stochastic on stochastic" calculations.
- Whether interim solvency measures are included in the model;
- The asset classes and investment strategy in the model.

One- year mark-to-market approach – Stochastic or Stress testing approach:

The one-year mark-to-market approach can be implemented using a stochastic simulation approach as for the runoff method. The steps described above are performed for a large number of scenarios perhaps 10,000 or more given the higher security levels that would typically be used in a one-year approach. This gives a distribution of required assets by scenario, from which the overall level of required assets can be determined (i.e., by calculating the chosen measure at the target confidence level). The EC requirement is

then determined by deducting the initial market-consistent value of the liabilities from the required assets.

It is also common to implement the one-year mark-to-market approach using **stress tests** instead of stochastic simulation. This has tended to be more common for business with significant financial options and guarantees where the market-consistent value of liabilities requires the use of a risk neutral stochastic valuation. To implement a one-year stochastic approach to EC would therefore lead to computationally challenging **"stochastic on stochastic"** calculations (although replicating portfolio techniques have now been developed to overcome this).

With a stress testing approach to implementation, the full multi-dimensional distribution of required capital described is not developed. Rather a limited number of stress scenarios are run, where the scenarios have each been calibrated to the chosen security level. Scenarios are chosen to explore each of the key risks, and the capital results for each risk are typically combined using a correlation matrix approach. In some cases a number of multi-risk scenarios may also be considered, again calibrated to the chosen security level, to examine potential non-linearity in risk interaction.

It is important to note that even under the one-year approach; **a runoff projection is still required**, since a terminal value of liabilities at the end of the one-year horizon is needed. The future uncertainty surrounding the risk beyond the one-year horizon (including the cost of capital required to support that uncertainty) is captured within the market-consistent value of the liabilities at the end of the year.

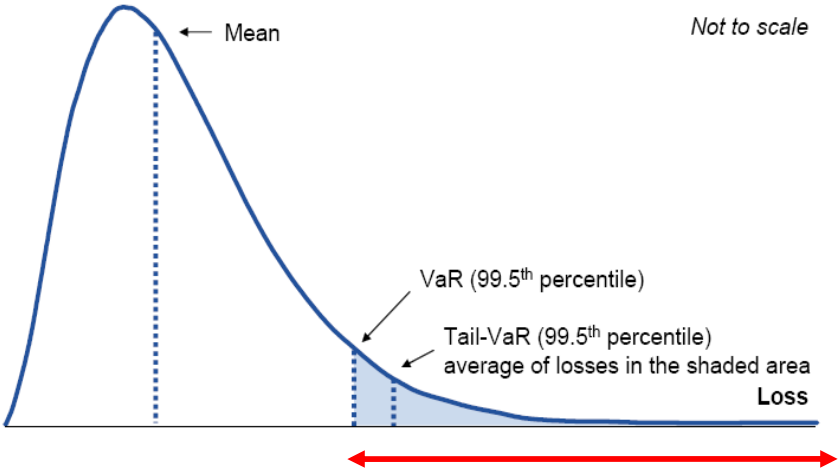
While the one-year mark-to-market approach originated with the banking industry, it has also been adopted by many European multinational insurers and their global subsidiaries, which include many significant North American insurers. It is now being adopted as the basis for insurer solvency regulation across Europe (currently in the U.K. and Switzerland, expanding throughout Europe under Solvency II). A number of the largest North American insurers are also adopting this approach to EC calculations.

3.2. Measures of Risk: Insurance companies commonly use two types of risk measures, namely Value at Risk (VaR) and Tail Value at Risk (TVaR) or Conditional Tail Expectation (CTE) in the assessment of economic capital requirements. We set out definitions of the measures below:

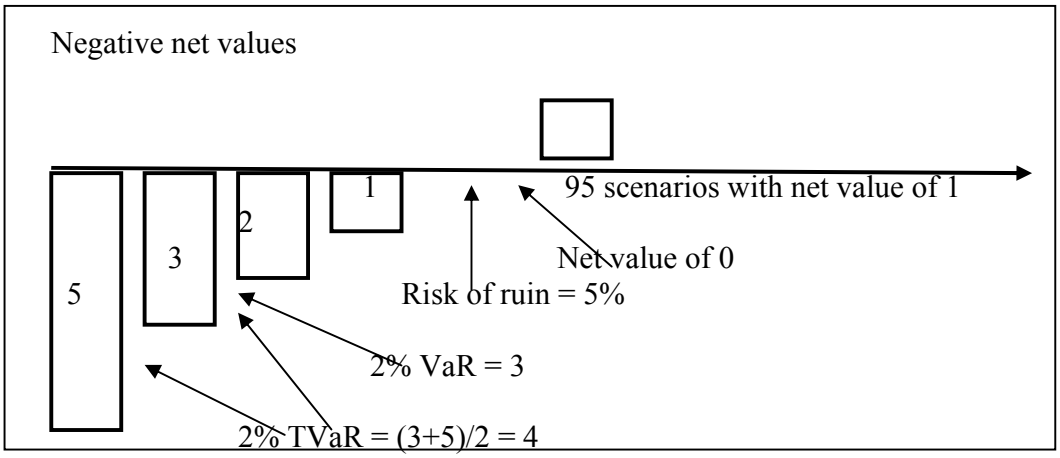
3.2.1. Value at Risk (VaR): It is the maximum potential loss (i.e. decrease in available capital) under a certain probability of ruin (α %), over a certain time horizon (x years). Assuming VaR equals 100, the probability for ruin to occur in the x following years will amount to α %, provided the company holds 100 of capital. VaR enables the company to precisely assess the likelihood of the adverse scenario, knowing the initial amount of its own funds.

3.2.2. Tail Value at Risk (VaR): It is the expected loss that will affect the company under ruin circumstances, given that ruin occurs with a certain probability (α %) and over certain time horizon (x years). Assuming TVaR equals 115, it means that in the worst cases (α % situations in which ruin occurs in the x following years), the company will lose 115 in the average. If the company holds 115 of capital, it should therefore survive the worst-case scenarios roughly half of the time.

The figure below represents how VaR and TVaR are derived from a probability distribution with a 99.5% confidence level (i.e. with a 0.5% ruin probability), over one-year.



To clarify the concept further we give any example based on 100 scenarios.



3.2.3. Comparison of VaR and TVaR:

The following table summarizes the respective merits of the two approaches.

Perspective	VaR	Tail VaR
Theoretical qualities	VaR is not a "coherent" measure, which means it does not respect all actuarial qualities for such a measure. In particular, it is not "sub additive": VaR (risk A + risk B) might be higher than the sum of VaR (risk A) and VaR (risk B), which is not logical since there	TVar is a coherent risk measure; it is therefore recommended by the International Actuarial Association. In particular, it is sub-additive. Therefore, unlike VaR, TVaR never underestimates the level of exposure.

	should be risk mitigation between A and B. Under certain circumstances, VaR may underestimate the level of exposure. On the other hand, from a practical perspective, VaR in the tail region of the distribution (e.g. 99.5%) would be roughly sub-additive.	
Day to day risk management	VaR is easy to explain to top management and other stakeholders. It is therefore easy to implement throughout the company and to embed in the company's risk culture (so as to improve risk management). 99.5% VaR focuses on the worst 9950th loss out of 10 000 simulations: it is the worst scenario under "normal" circumstances. It does not focus on extreme events.	TVaR requires more mathematical background to be understood and implemented. It is more difficult to embed in the company's culture. 99.5% TVaR focuses on what happens in the 50 worst scenarios out of 10 000 simulations: it tackles large risks and extreme events. Such risks often trigger bankruptcy: studying them should improve extreme events management and limit the probability of insolvency.
Implementation	VaR refers to "normal" circumstances (see previous	Companies often lack the necessary data to simulate

	box): it is easier to collect data and make realistic assumptions. Since VaR refers to one worst-case scenario (the 99.5% confidence level), it is easy to design a proxy stress-test to calculate VaR. You just have to define the 99.5% scenario.	extreme events (e.g. an event like Katrina happens only once in 35 years, so it is impossible to conduct proper statistical analysis). Companies sometimes have to make haphazard assumptions to assess TVaR, so results are potentially marred with a significant modelling error.
Consistency with the other financial sectors	VaR is the most commonly used risk measure in all financial sectors. For instance, banks use VaR to assess market risk.	99.5% TVaR is similar to an "expected loss under default", where default corresponds to breaching the 99.5% percentile. Such a concept is used under the Basel II most advanced approach to credit risk ("loss given default" or LGD).
In place within companies / administrative burden	VaR is already often used by direct insurers (77% of respondents to a worldwide SOA survey)	TVaR is the preferred risk measure of reinsurance companies, which often have already developed internal models.

Conceptually, VaR is relatively simple to understand and use. It is widely known and used, especially in the banking industry, and is the approach favoured in Europe under Solvency II. VaR is also generally consistent with the majority of the calibration data

available from rating agencies, which tends to focus more on the probability of default rather than the loss given default.

Computationally, CTE is generally more demanding to calculate accurately than VaR and can be more difficult to calibrate to historical data (due to a relative lack of data from rating agencies). It is the approach prescribed by the U.S. regulator in C-3 capital calculations. To achieve an accurate CTE result requires knowledge of the shape of the risk and loss distributions in the extreme tail of the distribution, which can be difficult to justify (given that the focus is typically on events that occur very rarely). VaR is less demanding of accuracy of modelling in extreme scenarios and requires fewer scenarios to achieve a stable result. However, it can result in inadequate, possibly even zero, levels of capitalization for low probability, high-loss lines of business — for example, in higher-level coverage for reinsurance or earthquake protection.

It should be noted that CTE (x) is generally greater than a (x + ½ (100-x)) percentile coverage i.e.

CTE (90) is generally greater than VAR (95).

3.3. Type of risk should be considered?

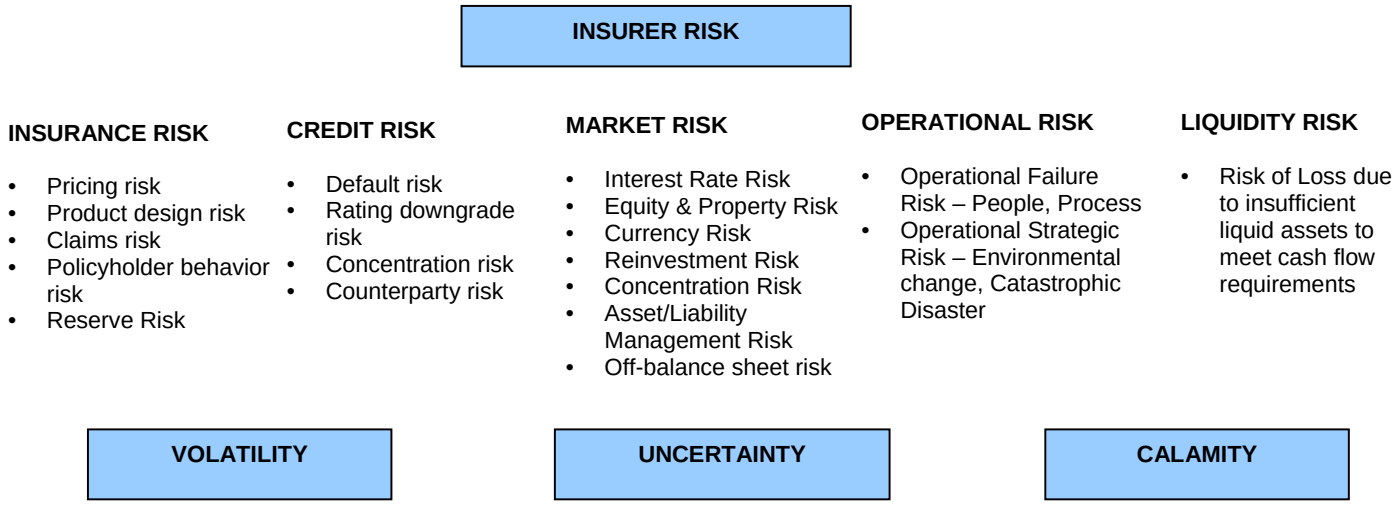
Defining risk is a difficult task as the context in which it is used varies. For example risk may be defined as the chance of an event that will have an adverse or positive impact on business objectives. In the context of investment performance as well better performance compared to the benchmark is also regarded as a risk.

Within the broader ERM framework economic capital is calculated so that it is sufficient to cover a certain level of possible losses arising out of the risks taken by the enterprise. The focus for EC is therefore only on downside risk.

Since EC needs to reflect an adequate level of capital to cover possible losses the insurer needs to consider all the risks that it is exposed to. A robust categorization of risks is set out in IAAs paper *"A Global Framework for Insurer Solvency Assessment"*.

3.3.1. Risk Categories

The IAA paper categorizes risks into five risk types: insurance risk, credit risk, market risk, operation risk and liquidity risk.



3.3.2. Insurance Risk

Insurance risks are associated with the insured events covered by the various product categories as well the processes associated with conducting the insurance business. The main risk drivers for life insurers are:

- Mortality
- Morbidity
- Persistency
- Lapse risk

Examples include Insurance process risk, pricing risk, product design risk, claims risk, economic environment risk, net retention risk, policyholder behaviour risk and reserving risk.

3.3.3. *Credit Risk*

Credit risk is the risk of default and change in the credit quality of issuers of securities, including:

- corporate bonds in the insurers' investment portfolio
- counterparties such as on reinsurance contracts or banks on hedging
- over-the-counter derivative contracts
- intermediaries to whom the company has exposure

Examples include direct default risk, downgrade risk, indirect credit or spread risk, settlement risk, sovereign risk, concentration risk and counterparty default risk.

3.3.4. *Market Risk*

Market risk results from the volatility and uncertainty inherent in the market value of future cash flow from insurer assets and liabilities. Market risk is driven by exposure to movement in variables such as interest rates, inflation, stock prices, property prices, commodity prices and exchange rates.

Examples include interest rates risk, equity and property risk, volatility risk, currency risk, basis risk, reinvestment risk, concentration risk, asset/ liability management risk and off-balance sheet risk.

3.3.5. *Operational Risk*

Operational Risk is the risk of loss resulting from inadequate or failed internal process, people, and systems or from external events. Operational risk is the potential for any disruption in the enterprise's operational processes. Such disruptions may arise from isolated events, for example rogue trading or accounting mistakes, or wide ranging events such as inappropriate sales practices, systems failures, and disruption due to terrorist activities or natural calamities.

Operational risk can be broadly categorized as operational failure risk and operational strategic risk. Operational failure risk arises from the potential for failure in the course of operating business. Note that such failures may occur outside the operations function. Operational strategic risk arises from environmental factors such as new competitor that changes the business landscape, changes in regulatory or tax environment, natural disasters, effect of environmental changes such as global warming that are outside the control of the enterprise.

3.3.6. *Liquidity Risk*

Liquidity risk is exposure to events that may cause:

- Insufficient liquid assets from the pool of assets supporting policy liabilities to meet cash flow requirements of the policyholder liabilities when due
- Assets to be sold at excessive costs to meet policyholder liabilities when due

Losses in such situations may arise as the enterprise may have to borrow unexpectedly or sell assets at unanticipated prices. Liquidity risk depends on the profile of both the assets and the liabilities. Unexpected demand for liquidity may be triggered due to credit rating downgrade, adverse publicity or an economic downturn.

3.3.7. Modeling Considerations

The risks discussed above can be viewed along three key aspects:

- Volatility risk
- Uncertainty risk
- Extreme events

Volatility Risk

Volatility is the risk of random fluctuations in either the frequency or the severity of an uncertain event. The theory of the Capital Asset Pricing Model along with the efficient

market hypothesis suggests that the volatility in returns associated with individual securities can be diversified away by investors by holding a small proportion of the security. However, volatility can affect the position of individual insurers and particularly policyholders who generally cannot diversify away volatility risk. Also, insurance liabilities exhibit an inefficient market and therefore the volatility risk cannot be ignored.

Mortality risk is typically assumed to be diversifiable but this may not hold true for small companies. Thus smaller companies will face more volatility risk than larger companies on account of mortality and should hold more capital per unit of liability for the same target level of security compared to a larger company.

Uncertainty Risk

Uncertainty involves the risk of using the wrong model to estimate the claims (model risk) or from an inaccurate estimate of the parameters used from the models (parameter risk). Uncertainty risk is an example of non-diversifiable risk since it cannot be reduced by increasing the portfolio size.

Extreme Events

Extreme events include the risk of low frequency high severity risks. Models may not capture the tail of the distributions appropriately for example by underestimating the 'fatness' of the tails. It may be caused by catastrophes leading to a large number of claims, market crashes or extreme movements in interest rates.

3.4. Quantification Methodology / Approaches to implementation

Risk measurement can be done using several approaches including:

- Stochastic simulation
- Stress Testing
- Factor Based

Stochastic simulation is typically used along with the run-off approach. It allows management action to be included notwithstanding the complexity of choosing the relevant actions over the projection period. It also allows a more precise impact of the correlations of the risks. Risk aggregation is easier to implement and is embedded within the stochastic approach.

Stress testing is more commonly adopted along with the one-year approach although the stochastic simulation approach can be adopted as well. Aggregation of the EC from the various risks is done subsequent to the individual calculations. Each of the measurement approaches is illustrated with examples using various risks.

3.4.1. Stochastic simulation

Interest rate and equity risk

A number of theoretical models for interest rates and equities are available which can be used to develop projected values for interest rates and equities. Some of these can be implemented relatively easily, but this exercise can often become complex, particularly when there is a need to integrate with other risks. Once the set of economic scenarios has been generated they can then be run through cash flow-based projection model used for calculating EC. The market value assets less the market value liabilities of the scenarios can be ordered and using the predefined confidence level, the level of EC for these modeled risks can be determined. In following this approach, consideration needs to be given to the interaction of interest rates and other risks such as policyholder behavior through excessive lapses or additional premium payments.

Credit risk

For credit risk stochastic simulation requires the ESG to generate returns, spreads or default rates. Data input would require correlations between asset classes and ratings.

Mortality/ morbidity risk

Where stochastic models are used, they are typically run as stand-alone models, separately from the modeling of other risks. A stochastic approach requires the specification and parameterization of distributions for the different aspects of mortality risk. A fully integrated stochastic approach may also be possible, where mortality is modeled together with other risks. This has the advantage of allowing modeling for interactions between mortality and other risks, such as economic risks. However, run times are usually a limiting factor.

Lapse risk

Although stochastic modeling of lapses is certainly possible (and can be seen as being similar to modeling mortality stochastically), most insurers do not use this approach.

3.4.2. Stress testing

Stress tests are typically used along with the one year mark to market approach.

Interest rate

Using the stress test approach, different interest scenarios have to be defined, where these scenarios are calibrated to the target security level. One technique to calibrate the interest rate stresses is principal component analysis (PCA), which derives a few factors, or components, that explain most of the historically observed volatility in an interest rate data series. These principal components can then be used to specify interest rate scenarios that correspond to the target security level (e.g., 99.5th percentile) on the interest rate distribution. The first three principal components are often used, which are seen to explain the historically observed interest rate "shifts" (i.e., movements up and down), "tilts" (i.e., changes in the slope of the interest rate curve) and "twists" (i.e., movements where the short end and long end of the curve move in the opposite direction to the middle range of the curve).

Interest rate implied volatilities, which affect the time value of options and guarantees, are also normally stressed under the one-year mark-to-market approach.

Equity risk

For equities a certain drop in equity markets over a specified time horizon can be taken. Additional stress tests may be run on equity volatility. Once the scenarios have been specified, the cash flow projection models are run under each scenario and the EC relating to interest rate and equity risk determined from the stressed results.

Credit risk

The stress test approach is most commonly used with a one-year mark-to-market EC calculation, and so for credit risk the focus is usually on spread risk. In some respects, the analysis of credit spreads is similar to that for interest rates, but with the added dimension of differing credit qualities. Analysis could be done on calculated credit spreads or on the credit curves directly. As for interest rates, principal component analysis is one technique that can be used for this analysis to assist in the specification of the stress scenarios. Once the scenarios have been defined, the determination of EC is relatively straightforward using the economic balance sheet approach. Under this approach, companies sometimes use a load to the spread scenario as a proxy to allow implicitly for default risk and migration risk.

Mortality/ morbidity risk

A stress testing approach is often applied. This determines EC by calculating the financial impact of a selected group of stress mortality events. The adverse events are selected so that they target desired percentiles on the underlying mortality distributions. Depending on the relative significance of mortality risk for the insurer, one or more of the risks are sometimes combined into a single scenario. This can shorten the time taken to calculate EC, but can pose some extra challenges in the calibration.

Lapse risk

It is common to use selected stress events for lapse risk. This involves both the inherent lapse risks, which can be modeled independently, and one high lapse and one low lapse scenarios, modeled as a multiple of the base lapse rates.

Operational risk

A scenario-based approach may be used typically focusing on low frequency and high impact operational risks which result in large financial consequences therefore driving the overall level of EC for this risk.

3.4.3. Factor Based

Factor based approaches have been used for some of the risks faced by insurers such as credit risk, liquidity risk and operational risk

Credit risk

Factor based models are typically considered too crude to base management decisions upon for the spread risk and default risk. Companies can consider the factor based approach for other sub-categories of credit risks such as counterparty default risk and concentration risk. This can identify the risks that are most worth exploring toward a next level of sophistication. Counterparty default risk can also be modeled directly, in a manner similar to the modeling of default risk.

Liquidity risk

Insurers have traditionally relied on factor-based approach for liquidity risk. Such an approach does not address the dynamic nature of the risk, particularly in stressed scenarios where the interaction with other risks may be particularly significant.

Operational risk

The Basel II framework set out parameters for the banking sector with EC for operational risk representing about 15% of the total EC. It further stated parameters of 12% for less risky companies and 18% for more risky companies. Factor based approach for operational risk applies a factor on some business values or drivers.

3.5. Aggregation of economic capital requirements

Aggregation of economic capital requirements involves combining the EC requirements for each individual risk or group of risks to calculate the aggregate EC for the solo entity or for the insurance group. The simplest approach for calculating the aggregate EC requirements would be sum up the requirements for each risk. However this approach ignores any diversification between the individual risks and may materially overstate the capital requirements.

This part is divided into the following sections:

- What is risk diversification and sources of diversification for insurance companies

- Why should diversification be reflected in EC requirements
- Methods for aggregating EC requirements

3.5.1. What is risk diversification and sources of diversification for insurance companies?

Risk diversification is the effect of being exposed to a number of risks events (e.g. a loss from a claim) that are caused by different risk factors. Unless the events are fully correlated, we expect the variability from a portfolio of risk events to be less than the sum of the variation for each individual risk event.

Risk diversification plays a critical role in the economics of insurance businesses. For example, insurers have traditionally pooled mortality and morbidity risk, reducing the variability of claims and enabling the insurer to offer protection to the policyholder.

Sources of diversification for insurance companies can be classified into the following three levels:

- **Level 1-Within risk types**: the diversification observable in a homogeneous insurance portfolio. Examples of this level of diversification would be 1) adding more unrelated risks to the portfolio to reduce 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**: the diversification from being exposed to different risk factors. Examples include 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**: Two or more insurance companies within a group.

We note that for a solo Indian insurance company, only the first two levels of diversification are relevant.

Risk aggregation is concerned with aggregating capital requirements across individual risk types as the approach to calculating the capital requirement for each individual risk should reflect the level of diversification within a risk type (e.g. the approach and stress used to calculate the equity risk capital requirement will be different if the company holds a diversified portfolio of equities relative to holding only one equity).

3.5.2. Reflecting diversification in EC requirements

The simplest approach to calculating aggregate EC requirements would be to sum up the requirements for each individual risk. However, this would ignore any potential diversification benefits, if these exist, and may not promote better risk management.

Recognising diversification benefits better reflects overall risk profile (as long as calculated appropriately) and provides a link between measuring capital requirements and management as diversification is central to the risk management and should improve security of the company.

However, the recognition of diversification benefits should allow for the interaction between risks, particularly the impact of combined risk events and how the risks interact under adverse conditions.

3.5.3. Methods for aggregating EC requirements

To determine the aggregate EC requirements while allowing for diversification requires assumptions to be made about the relationship between different risks for different lines of business.

The two main methods for aggregating capital requirements are:

- Stochastic modelling; and
- correlation matrix.

In stochastic modelling, capital requirements can be directly determined for groups of risks. Under this approach, much of the aggregation by risk has already taken place in the scenario generator. The most prevalent example of this is using an integrated economic scenario generator to model interest rate and equity risk and, potentially, other

market risks. In this case, the economic scenario generator is used to calculate the combined capital requirement for the modelled market risks.

Under a stress testing approach, a correlation matrix is used to aggregate the capital requirements for each risk type. A correlation matrix describes the dependency among the individual risks. The correlation matrix may be divided into separate matrices for correlations between risks in a category (e.g. equity and interest rate within market risk) and correlations across risk categories (e.g. market risk and insurance risk).

Irrespective of the approach used to aggregate risks, assumptions are required for the correlation between risk types. What differs is where in the process the correlations are applied (e.g. in the aggregation or in the calculation of the capital requirement by risk type) and whether they are applied implicitly or explicitly.

In the determination of the correlation parameters, it is important to consider how the dependencies may behave differently in the extreme scenarios, as considered for EC calculations, relative to the dependencies under normal conditions.

Even more so than in calibrating the stresses for individual risks, there is limited data for calibrating correlation assumptions under extreme conditions. This is particularly the case in the Indian insurance market where data is extremely limited. Therefore, determining the correlation assumptions can be a subjective process and the effect of using different correlation assumptions should be understood. Moreover, where the correlation of different risk factors is implicit in the scenario generator, the underlying correlations should be understood and, where possible, validated.

A copula is a general way of formulating a multivariate distribution that can be used to describe the dependence and covariance between different risks. Copulas are used by a large number of firms worldwide for reflecting the interrelations between risks in aggregating the EC requirements.

A further consideration in aggregating the capital requirements is whether there any interactions between different risk types such that the financial impact of the event occurring simultaneously is worse than the events occurring separately. For example,

even though a company may consider interest rate and longevity risks as independent, for a company with annuity business, the impact of longevity improving and interest rate falling together may be significantly worse than these events happening separately.

An advantage of using stochastic modelling to calculate the EC requirements for groups of risks is that it automatically captures directly the impact of more than one risk occurring at the same time. Under a stress testing approach, the "non-linear" impact of combinations of different risks can be estimated by using scenario analysis.

Finally, in considering the aggregate EC requirements firms should consider the fungibility of capital within the company. While this is more of an issue for groups including a number of legal entities, it may be a significant consideration where there are restrictions on distribution of capital from the participating to the non-participating fund.

A simplified Bucketing approach for allowing for diversification between risks is discussed as part of **Appendix 2.**

3.6. Target Security Level

The calculated level of EC is designed to provide a target level of protection to policyholders, determined in such a way that this target can be communicated meaningfully to all the relevant stakeholders (including regulators and rating agencies). This target security level forms one component of the company's risk appetite.

There is no prescribed way in which such a target security level should be expressed, although it is logical to relate it in broad terms to other measures of financial strength and resilience, such as rating agency assessments (AAA, AA, A, etc.) of the company's corporate debt (if any) and insurance financial strength rating, of which policyholders (or at a minimum their agents) will be aware.

In structuring such a target security level, it is worthwhile to observe certain characteristics of insurer and corporate bond default experience, perhaps most notably that the probability of default increases with the duration of exposure to the company. That is, there is a higher probability that a 10-year corporate bond will default at some point during its term than a 5-year bond of the same rating. Thus it would appear reasonable to adopt a similar approach for insurance policyholders, namely to offer a higher level of security, over the full term of their policies, to short-term policyholders than to long-term policyholders. Indeed, targeting the same level of security for policyholders of all durations seems doomed to failure.

In calibrating such a target security level, the most natural approach might be to relate it to insurer's financial strength rating by deriving a probability of default, or an expectation of loss on default, from historical experience of insurers of that financial strength rating. However, there is relatively little data available on insurer defaults (as there have been relatively few) to perform such a calibration, and consequently most companies have instead referred for EC calibration purposes to the much larger body of data available in relation to corporate bonds. The level of security provided to policyholders is thus set to be broadly equivalent to the level of security available to holders of corporate bonds of the chosen rating category. This provides an approach that is justifiable in broad terms, can be calibrated to a fairly extensive dataset and can be communicated to the relevant stakeholders.

The use of corporate bond default data is sometimes criticized, and these criticisms usually relate to the issue raised above concerning the relevance of corporate bond loss data to insurers' financial strength.

In addition, rating agency historical default statistics do not reflect economic insolvency; rather they typically reflect accounting measures of insolvency together with cash flow or financing shortfalls. It is possible that the declaration of insolvency under such measures might be avoided in many circumstances where use of an economic measure would show insolvency; therefore, rating agency default statistics might be understated compared to those that would result from an economic assessment, and an EC calculation calibrated to such statistics will be overstated/ understated.

In theory, corporate bond default data could also be used to calibrate a cost of ruin measure such as CTE, although there is less detailed data available as to historical losses given default. In addition, it can be argued that such loss data may not be appropriate in calibrating CTE measures for EC purposes as policyholders may reasonably have a significantly lower expectation of loss given default than the corporate bondholders in a similarly rated company (corporate bonds typically ranking behind corporate debt in the event of insolvency). In practice CTE measures are typically calibrated judgmentally, taking into account guidance from regulators.

We give confidence levels in use for various regulatory regimes in the table below:

Solvency assessment model	**Target confidence level**
Solvency I	None specified
2002GDV (Germany)	99.78% (assumed equivalent to BBB rating)

NAIC (United States)	None specified; although confidence levels are embedded in the calculation factors
S&P	None specified; the capital requirements are a function of the desired debt rating. A Capital Adequacy Ratio of 100% to 125% is required to attain BBB rating.
Jukka Rantala[1]	99.5%
FSA (UK)	99.5% assumed equivalence with BBB rating
FTK (The Netherlands)	99.5% for life insurance; 97.5% for pension funds
SST (Switzerland)	CTE(99%); Average loss of the largest 1% outcomes
Australia	None specified
Canada	None specified
Basel II (Banking)	Insurance not explicitly specified in Accord, but considered equivalent to 99.9% for Operational Risk advanced approach; 99% for Market Risk and 99.5% for Credit Risk

Source: Comité Européen des Assurances (CEA) Solvency Assessment Models

4. International practices in economic capital and developments in regulatory capital requirements

This section outlines current international market practice in calculating economic capital requirements highlighting expected areas of development and how selected regulatory supervisory regimes are moving to a more risk-based approach including using economic capital techniques.

4.1. Developments in economic capital techniques

International practice with respect to EC methodologies has changed significantly over the last several years. In particular, the key trends emerging are:

- EC methodology is moving towards a one-year VaR approach based on the market-consistent balance sheet;

[1] Model developed by Mr. Jukka Rantala, formerly Chairman of the CEA Solvency II Working Group, in the context of the CEA's work on a Standard Approach.

- While a significant minority of companies are still focusing on calculating EC and developing their EC methodologies, the focus is gradually shifting towards applications of EC and using it as a basis for decision making and performance management; and

- Regulatory capital regimes in certain markets are developing to be more in line with economic measures of risk and capital. In particular, the pillar 1 capital requirements under the Solvency II framework directive in Europe are based on a 1-year Value-at-Risk measure of capital requirements.

Many of the findings are based on the 2008 Towers Perrin ERM survey, which included responses from over 350 global insurance executives. Additional details of the survey can be found at www.towersperrin.com.

4.2. Prevalence of EC Calculation

According to the 2008 Towers Perrin ERM survey, 57% of companies currently calculate economic capital, while a further 28% are considering or planning to calculate EC. The results show significant differences in the prevalence of EC by size of company and by region. In particular:

- Almost 85% of large companies and nearly 70% of medium sized companies calculate EC, whereas less than 40% of small companies do so.[2]

- Companies in the U.K (87%), Bermuda (73%) and Continental Europe (70%) have embraced calculating EC more than those in the U.S. (44%) and Canada (37%). Asia/Pacific (59%) lies between those extremes.

4.3. EC Methodology

Overall, a significant minority are still focusing on calculating EC rather than using it in the management of the firm. 37% of respondents indicated that calculating EC is an area

[2] Company size terms:
Large – Annual revenue in excess of US$10billion
Medium - Annual revenue between US$1 billion and US$10billion
Small – Annual revenue less than US$1 billion

where significant work is needed with just 10% of insurers believing they have appropriate capability in place.

Improvements to EC calculations are focused on getting the basics right, with insurers looking to enhance modelling methodology for individual risks (46%), improve data quality (45%) and extend the risks covered by their models (42%).

EC methodology is moving toward a one-year VaR approach, with the majority (56%) using a market-consistent terminal balance sheet (i.e. calculating the capital requirements based on the market-consistent balance after one year)

68% of respondents use a one-year risk assessment period. This is an increase of 12% from 2006. In North America, where this approach is less common, 57% of respondents use a one-year risk assessment period. A one-year assessment period is used by 85% of large insurers while 35% of medium-sized and 39% of smaller companies use alternative measures.

67% of respondents use VaR as the primary risk margin and use of VaR is relatively constant across large (75%), medium-size (69%) and smaller (61%) companies.

4.4. Applications of EC

As companies develop EC methodologies and models, the focus moves towards how EC can be applied to support decision making. However, only a relatively small proportion of companies (33% of respondents) feel that they have appropriate or reasonable capabilities for using EC in decision-making.

At present, the main application of EC is for capital adequacy assessment (e.g. comparing available capital to required economic capital) and capital management with 44% of respondents currently using EC for this purpose and a further 35% planning to use EC for capital management in the next 24 months.

Other areas where companies are applying EC include:

- Asset/Investment strategy including hedging

- Reinsurance purchasing;
- Product pricing
- Strategic planning and capital allocation.

44% of the respondents to the survey cited using EC in decision making as a priority for 2008-09.

4.5. Developments to EC methodology and models

A significant proportion of companies are still focusing on improving the calculation of EC and even those with reasonable capabilities in place are looking to enhance the data quality or the modelling the methodology in place. For example, companies are looking to improve the following areas:

1. Improving data quality underlying the EC stresses and aggregation (e.g. the data used to parameterise the risk distributions and correlations)

2. Moving from a stress test approach for individual risks to a stochastic approach where more than one risk are considered together, allowing for the appropriate joint distributions of these risk factors.

3. Extending the risks covered. In particular, operational risk is considered a weak area by the majority of insurers.

For life insurance companies, the process of calculating the EC results can require a large number of stochastic runs requiring considerable run-time and man-power. Moreover, as companies seek to improve the methodologies, the complexity can increase significantly. Therefore, companies are also looking to improve the timeliness of the results and to automate as much as possible the process required to produce the results. This can involve significant upgrades in the computer systems, the data processes and the financial modelling software used to calculate the EC results. Also, companies are investing significant time and effort to document EC methodology and processes.

4.6. Developments in regulatory capital requirements

Regulatory capital frameworks in many countries have moved or are moving to a more risk-based approach. Capital requirements under the most advanced of these frameworks are based on approaches similar to those used by companies to determine economic capital. Regulators are also increasing the focus on risk management more generally, including risk governance, systems and processes.

In this section we provide an overview of the Solvency II framework currently being developed in Europe and a brief summary of selected other risk-based regulatory frameworks.

4.6.1. Solvency II

The aim of Solvency II is to introduce a common insurance regulatory framework across the European Union that matches capital requirements to risks and encourages proper risk management. This addresses a number of issues with the Solvency I framework which is perceived as too simplistic and does not appropriately reflect the risks in the business. The Solvency II framework is expected to be implemented for year-end 2012 reporting.

Solvency II will be based on economic principles for the measurement of assets and liabilities. It will be a risk based system; risks will be measured on consistent principles and capital requirements based directly on this measure, with allowances for risk diversification and mitigation.

The framework will therefore result in:

- An integrated approach to determining insurance provisions and capital requirements; and
- A comprehensive framework for risk management, requiring companies to establish systems, process and controls for risk management.

The aim of Solvency II is not to increase overall capital levels, but rather to ensure a high standard of risk assessment and efficient capital allocation. It should also contribute to

increased transparency and help in the development of a level playing field across Europe.

The Framework Directive

The high level principles and requirements of Solvency II are set out in the Framework Directive ("FD"). This was originally published by the European Commission on 10 July 2007, with an update published on 26 February 2008.

The content and wording of the FD must be agreed by the European Parliament and European Council after lobbying on behalf of various stakeholders and there may be further revisions before the FD is approved.

The Solvency II Framework

The Solvency II framework has been defined using a three pillar approach.

Pillar 1 defines the financial resources that a company needs to hold to be considered solvent; it provides a quantitative assessment of the liabilities and capital requirements of the company, as well as the assets available to meet them.

Pillar 2 defines more qualitative requirements supplementing Pillar 1. It defines the framework of supervisory control, focusing attention on aspects of internal risk management.

Pillar 3 addresses risk disclosure requirements. The requirement to disclose risk and capital information will foster discipline within the market, and enable risk dialogue with stakeholders.

The key elements of each of the three pillars are discussed below.

Pillar 1

Pillar 1 uses a market consistent balance sheet approach to valuing assets and liabilities with the capital requirements based on the underlying risks of the business.

Asset Valuation

Assets will be valued at market value.

Liability Valuation

Technical provisions will be made up of the sum of a best estimate and a risk margin.

Best estimate liabilities will be calculated using market consistent techniques. Where cash flows from insurance obligations can be replicated using market instruments for which a market value is directly observable, the market value of the liabilities shall be determined on the basis of the market value of those financial instruments; else best estimate liabilities will be determined using a mark-to-model approach.

The best estimate liability will include a valuation of policyholder contractual options and guarantees, including lapses and surrenders. This should be realistic and based on current and credible information. Allowance should be made for the impact that changes in future economic conditions might have on lapse and option take-up rates.

Risk margins will be calculated using a cost of capital approach based on the required capital for the risks and an assumed level of capital charge, where the capital required is the SCR.

Capital Requirements

Two required capital thresholds are defined under Pillar 1:

1. Solvency Capital Requirement ("SCR")

Supervisory action will be triggered if a company's resources fall below this level.

Calculated using either the relatively simple Standard Approach or using an internal model (See section ***The SCR*** for further details).

2. Minimum Capital Requirement ("MCR")

Level at which supervisors can invoke severe measures. (See section ***The MCR*** for further details.)

Eligible Capital or Own Funds

The total amount of eligible capital available to meet capital requirements is made up of basic and ancillary own funds, depending on the source of the capital (e.g. shareholder equity or debt) and whether it is subordinate to policyholder claims. The eligible capital is classified into different tiers to determine eligibility for meeting SCR and MCR.

Pillar 2

Pillar 2 defines the supervisory review process ("SRP") and the conditions governing business.

Supervisors are required to review and evaluate the strategies, processes and reporting procedures, including:

- The system of governance in place;
- The qualitative elements under Pillar 1;
- Compliance with requirements for full and partial internal models; and
- The adequacy of methods used to identify emerging risks.

Based on its review of these elements, the supervisor may set a capital add-on in addition to the SCR if:

- The risk profile of the company deviates significantly from the assumptions underlying the SCR, either as calculated using the standard approach, or where certain risks are not adequately captured by an internal model; and
- There are perceived material failures in processes, systems, controls and strategies which cannot be corrected quickly.
- Capital add-ons will be reassessed at least on an annual basis and removed once deficiencies are remedied.

Under Pillar 2, companies need to have in place effective systems of governance, which provide for sound and prudent business management. This covers specific requirements

relating to risk management, internal controls, the internal audit function, the actuarial function and control over outsourcing arrangements.

The risk management system must include strategies, processes and reporting procedures to monitor manage and report on all risk exposures of the company. It must also be integrated into the organisational structure and business processes of the company.

As part of the risk management system, all companies must regularly conduct an own risk and solvency assessment ("ORSA"). This must be an integral part of the business process, and be taken into consideration in strategic decision making, i.e. it must cover all business and strategic risks, as well as the risks covered by the Pillar 1 capital requirements.

The ORSA should include, as a minimum:

- The overall solvency needs of the company (having regard to specific risk profiling, company risk appetite and tolerance limits and company strategy);
- Compliance with requirements relating to technical provisions and Pillar 1 capital requirements on a continuous basis; and
- The extent of any deviations between the company's risk profile and the assumptions underlying the SCR.

Pillar 3

Pillar 3 defines the disclosure requirements, both for supervisory purposes and public disclosure.

For supervisory purposes, the company will be required to provide sufficient information for the supervisor to carry out its assessment under Pillar 2. This will include details of:

- The system of governance applied;
- The business of the company; the risks the company faces and the risk management system; the valuation principles applied; and
- The capital structure, needs and management.

Companies will be required to disclose publicly an annual report on their solvency and financial condition. This will include details of:

- The business and its performance;
- The system of governance; risk exposures, concentrations, mitigations and sensitivities; the valuation bases and methods applied for solvency purposes; and
- A description of capital management, covering the structure, amount and quality of own funds, the amounts of the MCR and SCR as well as details of any non-compliance.

Separate disclosure of any capital add-on with its justification from the supervisor is also required. This may not be required for a transitional period of five years.

The SCR

The SCR will be calculated, once a year, using either the standard formula or an internal model.

Standard formula

The SCR will be calculated on the assumption that the company will carry on its business as a going concern, and be calibrated to a 99.5% value-at-risk ("VAR") measure over a one year period.

The SCR is the sum of:

- A basic SCR;
- A capital requirement for operational risk; and
- An adjustment for the loss absorbing capacity of technical provisions and deferred taxes (i.e. potential compensation for unexpected losses through a simultaneous decrease in technical provisions and deferred taxes, including allowance for the risk mitigating effect provided by future discretionary benefits).

The basic SCR includes modules for:

- Life underwriting risk - mortality, longevity, morbidity, expense risk, lapse risk and catastrophe risk;
- Non-life underwriting risk - premium, reserve and catastrophe risk);
- Health underwriting risk - premium, reserve, expense and epidemic risk;
- Market risk - interest rate, equity, property, spread, currency and concentration risk; and
- Counterparty default risk.

A correlation matrix is used to combine the capital charges derived from each of these modules.

With supervisory approval, companies can replace a subset of the parameters used to determine the capital charges for underwriting risk with company specific parameters.

The operational risk component will take account of earned premiums and technical provisions. It will be limited to 30% of the basic SCR.

The overall methodology for the calculation of the SCR is similar to a simplified economic capital calculation. However, it does not include any capital requirement for the effect of implied volatilities on the cost of options and guarantees and the approach for operational risk may not accurately reflect the underlying risks in the business. Also, research carried out by the CRO Forum[3] indicates that some of the proposed stresses for each risk can be materially different from those underlying companies' internal models.

Internal models

Companies may replace some or all of the standard SCR formula with their own internal model calculations. However, the use of full or partial internal models to calculate (elements of) the SCR is subject to supervisory approval. Post approval, major changes to the model will also require approval.

[3] CRO Forum Internal models benchmarking study, dated 30 January 2009

Companies may be required to develop an internal model, if their risk profile deviates significantly from that underlying the standard formula, making it inappropriate.

Once their internal model has been approved, a company will not be able to revert to using the standard formula, except in justified circumstances, and with approval of the supervisor.

Internal model approval criteria include:

- Use test - insurers must demonstrate that the internal model is widely used in their decision making processes and plays an important role in the system of governance. The frequency of calculation must be consistent with the frequency of use.

- Statistical quality test - the internal model must comply with specific technical criteria set out in the FD, for example, the methods used should be based on adequate actuarial and statistical techniques, and data must be accurate, complete and appropriate.

- Calibration standards - although the time period and risk measure used can be different to those underlying the standard approach, the level of protection provided to policyholders must be equivalent to 99.5% VAR over one year. Companies must be able to calculate results on this basis, or demonstrate that the required level of protection is met.

- Profit and loss attribution - companies must review the causes and sources of profit and loss each year for each major business unit, and demonstrate how the categorisation of risk in the model explains these profits and losses.

- Validation standards - regular validation processes need to be implemented, including effective statistical processes to ensure the capital requirements are appropriate. Sensitivity testing is required and an assessment needs to be made of the accuracy, completeness and appropriateness of the data.

- Documentation standards - methodology, assumptions and statistical analyses underlying the internal model need to be fully documented to demonstrate compliance with the FD.

If a company ceases to comply with these requirements, they must either present a plan to restore compliance within a reasonable timeframe, or demonstrate that non-compliance is immaterial.

The MCR

The following principles will apply to the calculation of the MCR:

- Auditability;
- Calibration to a one year VaR measure with an 80-90% confidence level; and
- An absolute floor, the level of which varies between life, non-life and reinsurance companies.

The approach to calculating the MCR has not yet been fixed. It could be derived:

- Using a simplified modular approach;
- As a proportion of the SCR; or
- A combination of the above.

Transitional arrangements have been incorporated in the FD, so that companies that meet the existing Solvency I capital requirements automatically have one year to comply with the MCR before authorisation is withdrawn.

Group supervision

The FD includes a substantial section on group supervision and introduces the concept of a group supervisor.

For certain aspects, and subject to certain conditions being met, groups can elect to be supervised at the group level, rather than the local level, under the group support regime. In this case, the group will be required to cover the group SCR, but each insurance subsidiary need only cover its MCR. Permission for this would only be granted if:

- Supervisors are satisfied with the group's risk management and internal controls procedures;
- There is a legally binding agreement to transfer funds up to the group support amount; and
- There are no practical or legal impediments to transferring funds.

Recent coverage has indicated that the group support regime will be excluded from the first phase implementation of Solvency II, but will be revisited in 2015. The impact on capital requirements and diversification benefits for groups is currently unclear, but further comment will be possible on publication of the final text of the FD.

Conclusion

Solvency II aims to align more closely regulatory capital requirements with internal economic capital requirements and to widen the scope of regulatory supervision from the calculation of reserve and capital requirements to overall risk management. The techniques underlying pillar I of Solvency II are similar to the economic capital techniques used internally by companies and the requirements under pillars II and III should provide additional insight for the regulators and other stakeholders into the emerging risks for each company and how these are being managed.

4.6.2. Individual Capital Adequacy Standard (UK)

The Individual Capital Adequacy Standard (ICAS) regime was introduced by the Financial Services Authority (FSA), the UK regulator, in 2004. The framework requires companies to regularly assess the level and quality of capital required such that there is no significant risk that they will be unable to pay liabilities as they fall due.

As part of the ICAS regime, companies must assess regularly the capital required consistent with a one-year 99.5% VAR. However, companies can use either a one-year or multi-year time period with the confidence level adjusted appropriately, with the approach chosen depending on their risk exposures. In practice, many companies have considered both a one-year and multi-year approach although most life companies

present a one-year approach. The capital assessment should include all significant risks and particular focus is placed on how risks interact in adverse scenarios.

The overall approach to calculating the capital requirements for each risk, the calibration of the required stresses and the aggregation of the capital requirements is not specified under the ICAS framework. However, the approach and calibration of capital requirements is subject to review by the FSA. The review also places significant focus on risk governance and processes and the use of the internal capital assessment as a key decision-making tool by senior management.

Having reviewed a firm's assessment of its capital requirements and its risk management framework, the FSA forms a view on the capital that is adequate given the firm's risk profile; the Individual Capital Guidance (ICG). The ICG may include "add-ons" in addition to the company's own internal capital assessment where the FSA considers the ICA insufficient or if there are shortcomings in the overall risk management framework.

The FSA is continuing to work on improving the efficiency and effectiveness of the ICAS process and how to implement the transition to Solvency II.

4.6.3. North American Insurance Commissioners' Risk Based Capital Framework (US)

The U.S. is implementing a more modular approach to setting risk-based capital requirements. At present, risk-based capital requirements for most products and risk categories are calculated using a factor based approach applied to selected risk drivers. However, The North American Insurance Commissioners (NAIC), with the support of the American Academy of Actuaries (AAA), is introducing a Principles-Based Approach (PBA) to calculating reserves and statutory capital requirements. The Principles, as set out by the AAA, are as follows:

- Capture all the benefits and guarantees associated with the contracts and their identifiable, quantifiable and material risks, including the "tail risk" and the funding of the risks.
- Utilise risk analysis and risk management techniques to quantify the risks and is guided by the evolving practice and expanding knowledge in the measurement

and management of risk. This may include, to the extent required by an appropriate assessment of the underlying risks, stochastic models or other means of analysis that properly reflect the risks of the underlying contracts.

- Incorporates assumptions, risk analysis methods and models and management techniques that are consistent with those utilised within the company's overall risk assessment and evaluation processes will be included in the risk analysis and cash flow models used in the PBA. Examples of company risk assessment processes include economic valuations, internal capital allocation models, experience analysis, asset adequacy testing, GAAP valuation and pricing.

- Permits the use of company experience, based on the availability of relevant company experience and its degree of credibility, to establish assumptions for risks over which the company has some degree of control or influence.

- Provides for the use of assumptions, set on a prudent best estimate basis, that contain an appropriate level of conservatism when viewed in the aggregate and that, together with the methods utilised, recognise the solvency objective of statutory reporting.

- Reflects risks and risk factors in the calculation of reserves and capital that may be different from one another and may change over time as products and risk measurement techniques evolve, both in a general sense and within the company's risk management processes.

This principle based approach is being implemented on a modular basis with the implementation split by product group (e.g. traditional life business, variable annuity), risk category (e.g. asset or insurance risk) and whether focusing on overall capital requirements or the level of mathematical reserves.

The capital requirements under the Principles-based approach will be set equal to the CTE90 level (i.e. the average loss of worst 10% of the distribution of total asset requirements) calculated over the run-off of the business. The real world scenarios to be used are prescribed and will be provided by the NAIC. Also, the capital requirements can take into account the benefits of hedging strategies.

4.6.4. Selected other risk-based capital regulatory frameworks

In Asia, risk-based capital frameworks have been or are expected to be implemented by the regulators in Japan, Malaysia, Singapore, South Korea and Taiwan. While the specific methodology for calculating the reserving and capital requirements vary by country, these have generally followed a factor based approach.

In Switzerland, which is not within the Solvency II framework, the regulator has already implemented the Swiss Solvency Test which is based on a market-consistent balance sheet approach and is similar to the ICAS framework in the UK and the proposed Solvency II framework, although the measure of risk is set equal to the one-year 99th percentile tail VAR (i.e. the average loss of worst 1% of the distribution of scenarios).

5. Recommendations and Next Steps:

5.1. Recommendations

The objective of this document was to outline the definitions, pre-requisites, methodologies, pros and cons of these methodologies to enable the user to choose a method based on specific conditions applicable to their business entity and not to recommend any single approach.

However, due to paucity of data and various limitations in implementing it is recommended to choose approaches that are simple to use and easy to communicate. It is also recommended that users understand and communicate the limitations of the selected approach.

There are few practical methods that are provided as part of Appendix to this document which can be used in calculating the Economic Capital.

5.2. Next Steps

The next steps for the Working Group on Economic Capital include:

- Set out practical examples along with all calculations explaining various techniques as outlined in the Appendix.

- Investigate and provide additional guidance on the methodologies, tools and models required for calculating economic capital such as Economic Scenario Generators, Option Pricing Techniques, and the principles to be followed in projecting different types of business e.g. Bonus Policy.

Part B – Market Consistent Embedded Value

6. Introduction to MCEV concepts

6.1.Background and Scope:

Market consistent economic value (MCEV) is an approach developed to address the mounting criticism on divergent interpretations of approach and methodology used for calculating and reporting embedded values. In particular, the CFO Forum published the European Insurance CFO Forum Market Consistent Embedded Value Principles©[4] (CFO Forum MCEV Principles) in June 2008 to address the shortcomings of the European Embedded Value (EEV) Principles. The variety of practices used by companies to determine EEV results has led to analysts calling for more consistency and disclosures regarding management assumptions. We found that these principles are of pioneering work for the measurement and reporting of embedded values and hence it is worth examining the same in India.

The Institute of Actuaries of India intends that this report serves as a basis for consistent disclosure of embedded values in India in accordance with the CFO Forum MCEV Principles. The working committee recommends that the CFO Forum MCEV Principles be used as a reference document for purposes of EV calculations and disclosures. However, it is recognized that given the nascent stage of industry growth and considerable uncertainty in long term demographic and expense assumptions in India, there is a need for further guidance in addition to the CFO Forum MCEV Principles.

6.2.Definition of MCEV

MCEV consists of the following components:

- Free surplus allocated to covered business;
- Required capital; and
- Value of in-force covered business (VIF).

[4] Copyright © Stichting CFO Forum Foundation 2008

VIF consists of the following: Present value of future post taxation shareholder cash flows from the in-force covered business and the assets backing the associated liabilities (PVFP); less: the time value of financial options and guarantees; the frictional costs of required capital; and the cost of residual non hedgeable risks.

6.3.EEV and MCEV

The EEV Principles contained 12 high-level principles accompanied by more detailed guidance. The CFO Forum MCEV Principles are a set of 17 principles of which 12 correspond to the existing EEV Principles and the remaining five cover the following areas:

- Costs of residual non hedgeable risks
- Frictional costs
- Stochastic models
- Investment Returns and Discount rates
- Reference (risk-free) rates

In addition to the new principles, amendments have been made to the wording of most of the 12 original principles.

In implementing the EEV Principles, the approach companies have used for the allowance for risk can be broadly categorized as “top-down” and “bottom-up” approaches.

The top-down approaches have normally allowed for risk through the use of one risk discount rate or risk margin (the risk discount rate less the risk-free rate) and an assessment of the cost of options and guarantees using “real world” asset scenarios which are calibrated to historic data or management’s views of expected returns and the potential volatility in returns by asset class.

The bottom-up approaches involve calibrating the allowance for risk to directly reflect each product and cash-flow’s risk profile enabling a more explicit and granular allowance for risk. The majority of companies implementing a bottom up approach used MCEV techniques to calibrate the allowance for risk. However, even within MCEV reporting under the EEV Principles, there were significant differences in the approaches used by companies.

In the following sections we describe some of the differences between the EEV Principles and CFO Forum MCEV Principles.

6.3.1. Cost of residual non hedgeable risks

In using a top-down approach to implement the EEV Principles, the main factor in allowing for risk is through margins in the risk discount rate. This is to reflect the uncertainty of future cash flows occurring as projected. The EEV Principles lacked specific guidance on how the risk margins should be determined.

The CFO Forum MCEV Principles require companies to use a market-consistent approach for the allowance for hedgeable risks. In addition, companies are required to make an allowance for the cost of residual non hedgeable risks. MCEV Principle 9: *Cost of residual non hedgeable risks* includes guidance that sets out a standard way of allowing for non-hedgeable risk. The guidance recognizes the fact that although some allowance for non hedgeable risks will be made in the calculation of the time value of options and guarantees and the present value of future profits as a direct result of using best estimate assumptions, this will not necessarily make appropriate allowance for the impact of all non hedgeable risks on shareholder value.

It is important to consider and take account of the impact of any asymmetries in non hedgeable risk on shareholder value. One example of an asymmetric risk is a 90:10 with-profits fund, where shareholders are partially rewarded for achieving investment returns, but suffer all the losses when the fund performs so badly that the policyholder benefits fall below guaranteed values. Another example is an insurer's operational risk, where good performance does not immediately add shareholder value.

6.3.2. Frictional costs of required capital

MCEV Principle 8: *Frictional cost of required capital* requires allowance to be made for the frictional costs of the required capital for covered business. Frictional costs reflect the taxation and investment costs of the assets backing the required capital. The required capital should be projected appropriately over the lifetime of the underlying risks. Under a market consistent approach, no allowance is made for the cost of capital, other than for the frictional costs of holding the required capital, but in order to enable comparison

across companies and to an embedded value calculated using a traditional cost of capital approach the CFO Forum MCEV Principles require that the cost of non hedgeable risks should also be presented as an equivalent average cost of capital charge on the required capital for non-hedgeable risks at a 1-year 99.5th confidence level.

6.3.3. Financial options and guarantees

MCEV Principle 7: *Financial options and guarantees* requires that the allowance for the time value of financial options and guarantees must be based on stochastic techniques and all projected cash flows should be valued using economic assumptions such that they are valued in line with the price of similar cash flows that are traded in the capital markets.

The impact of applying a market consistent approach to the value of options and guarantees can be explained by comparing the different approaches under a top-down EEV and the CFO Forum MCEV Principles. Both methodologies involve the use of stochastic techniques for modeling the time value of options and guarantees, but this is where similarities end. Under EEV, the time values would be modeled, broadly speaking, by simulating the market and checking the option value under each scenario. MCEV attempts to base the modeled value on the market prices of traded options that closely replicate the insurer's cash flows, thereby allowing the market to price the risk. Another difference is in the volatility assumptions: for EEV, these are based on historical volatilities whereas, for MCEV, these are based on the implied volatilities

6.3.4. Economic assumptions

The former EEV Principle 10: *Economic Assumptions* has been rearranged into three new CFO Forum MCEV Principles (numbers 12, 13 and 14). As in other areas, less discretion is allowed and the guidance is more prescriptive. For instance, all price inflation assumptions should be based on appropriate market instruments, where available, rather than current observed inflation levels. MCEV Principle 14 requires that wherever possible, reference (risk-free) rates should be derived from the swap yield curve relevant to the currency of the cash flows. Approximations are only permitted when the appropriate swap yields are not available.

6.3.5. Disclosure

The guidance provided under MCEV Principle 17 *Disclosure* is more prescriptive and detailed than the guidance provided under the equivalent EEV principle. Changes to the Disclosure guidance include the following:

The format for the analysis of earnings (reconciliation of opening and closing MCEV) is now prescribed. The analysis should be presented separately between free surplus; required capital; and VIF, whereas under the EEV guidance only movements in adjusted net worth and VIF had to be presented separately.

The expected earnings from the in-force book of business should be analyzed between two components: the expected earnings assuming that assets earn the beginning of period reference rates; and the additional earnings consistent with management's expectation for the business.

The MCEV disclosure guidance includes two new sensitivities showing the impact of 25% increases in equity/property and swaption implied volatilities on the cost of options and guarantees.

Guidance is provided for insurers that elect to provide voluntary disclosure of implied discount rates and internal rates of return for new business.

7. Indian specific issues and recommendations

It is felt that a principles-based approach supported by detailed disclosure and explanation is more appropriate for the current Indian marketplace than a prescription-based approach. That being said, to achieve consistency; the right balance of prescription and freedom with disclosures is required. This is likely to vary for different principles and it is recommended that we look to follow the balance adopted by the CFO Forum regarding CFO Forum MCEV Principles and only deviate where absolutely necessary.

7.1. Inclusion of principles as mandatory/discretionary

It is recommended that for purposes of MCEV reporting in India, all 17 principles adopted by the CFO Forum should be mandatory. It is recognized that some parts of the principles might currently not be relevant for India e.g. concept of a Group MCEV. Thus, we should adopt the CFO Forum MCEV Principles as mandatory along with the level of

detail regarding their applications; but specify their meaning and application in the current Indian context where different or not relevant for India.

It is recognized that the challenge is in defining the application as relevant for the current Indian marketplace and capabilities of insurers. Thus, even though each Principle is proposed to be mandatory, an insurer must clearly disclose the approach taken in the application of each principle or, if not followed, clear disclosure to that effect is required.

It is also recognized that the application of some key Principles is currently under review by the CFO Forum and, as such, we should monitor these developments and ensure that we have enough flexibility to consider and adapt to their findings and conclusions as appropriate for India.

7.2. Classification of principles regarding Indian context

Each principle was considered and classified in two categories depending upon the additional technical advice required in the Indian specific context.

7.2.1. Category 1: Principles that are relatively straightforward and at best require simple articulation and do not require a separate working group.

7.2.2. Category 2: Principles requiring additional objective technical advice and a separate working group to define the application (or more accurately, consider the CFO Forum's adopted application points and adapt in Indian context)

Table: Classification of principles into categories

Category 1	Principle 1	Introduction
	Principle 2	Coverage
	Principle 3	MCEV Definitions
	Principle 4	Free Surplus
	Principle 5	Required Capital
	Principle 6	Value of In force Covered Business
	Principle 8	Frictional Costs of Required Capital
	Principle 10	New Business and Renewals
	Principle 16	Participating Business

Category 2	Principle 7	Financial Option and Guarantees
	Principle 9	Cost of residual non hedgeable risk
	Principle 11	Assessment of Appropriate Non Economic Projection Assumptions
	Principle 12	Economic Assumptions
	Principle 13	Investment Return and Discount Rate
	Principle 14	Reference Rate
	Principle 15	Stochastic Models
	Principle 17	Disclosures

7.3. Scope of Working groups

There is a need for defining the scope of work for each working group in relation to category 2 as defined above. In line with the broader recommendation of following a principles based approach, there is always a danger of being prescriptive to the extent of pre-empting/conflicting with the CFO Forum MCEV Principles.

Thus the working groups should be scoped to provide objective technical advice on challenging areas such as stochastic modeling and setting assumptions as they apply to MCEV concepts in India. The output of these actuarial professional working groups should be tailored to the conditions and level of sophistication in India and can be presented in the form of Guidance Notes. Of course, these Guidance Notes would be valuable in other areas like economic capital, assessment of guarantees etc. other than only MCEV.

7.4. Summary of discussion points and recommendations

The group considered the principles in detail and brought out the points and items that needed further attention and clarifications. The outcome of the discussion on these issues is also summarized in the table below along with the relevant categorization.

Table: MCEV principles and working Group Reactions:

Principles	Description	Issues requiring Attention/Clarification	Outcome of the discussion of working group	Category classification
1. Introduction	**Principle 1: *Market Consistent Embedded Value (MCEV)* is a measure of the consolidated value of shareholders' interests in the *covered business. Group Market Consistent Embedded Value (Group MCEV)* is a measure of the consolidated value of shareholders' interests in covered and non-covered business.**	o Group MCEV o Results subject to external review guided by GN o Covered and Non covered business	o For Indian Companies, it's the IRDA licensed entity and for the business it is licensed for. o Results would be subject to external review that would be guided by a GN to that effect	Category 1
2. Coverage	***Principle 2*: The business covered by the *MCEVM* should be clearly identified and disclosed.**	o Covered Business o Specific Guidance for some class of products	o Covered business should be all classes of business for which the entity has been licensed by the IRDA as per the Insurance Act. o For all classes of group business where the term of the contract is not known, a suitable term subject to a maximum term of five years may be used.	Category 1

3. MCEV Definitions	***Principle 3: MCEV* represents the *present value* of shareholders' interests in the *earnings distributable* from assets allocated to the *covered business* after sufficient allowance for the aggregate risks in the covered business. The allowance for risk should be calibrated to match the market price for risk where reliably observable. The *MCEV* consists of the following components:** ***Free surplus allocated to the covered business*** ***Required capital; and*** ***Value of in-force covered business (VIF).*** **The value of future new business is excluded from the *MCEV*.**	o Market value of liabilities o Financial Reinsurance and Subordinated Debt	o Market value of liabilities would be the value of those assets whose cash flows closely resemble the liabilities cash flows. In this context, a replicating portfolio is created and market a value of liabilities is derived. o It is recognized that the mark-to-market value of insurance liabilities is very different to the statutory liabilities o Financial Reinsurance and Subordinate debt not allowed in India currently, so no need for any comments at this stage.	Category 1

4. Free Surplus	***Principle* 4: The *free surplus* is the market value of any assets allocated to, but not required to support, the in-force *covered business* at the valuation date.**	o Free surplus	o Free surplus is market value of excess assets in the balance sheet not assigned to any liability of any class of business. o The free surplus should only include the market value of assets that could be distributed to shareholders immediately	Category 1

5. Required Capital	***Principle* 5: *Required capital is the market value* of assets, attributed to the *covered business* over and above that required to back liabilities for *covered business*, whose distribution to shareholders is restricted**	o What is required capital? o Shareholder distributions from par fund o Allowing par fund surplus to cover non-participating solvency margin requirements	o If a company calculates economic capital (or uses some other internal measure of required capital) they should use the greater of regulatory measure and the internal measure. However, it is noted that currently most companies in India manage using the regulatory required capital o The value of any shareholder distributions from the par fund which are contingent on declaring bonus should be included in the VIF and not the free surplus o Given the current Indian regulations, participating fund surplus can be allowed to cover solvency margin requirements for non-participating business provided this surplus is not taken into account for any other purpose	Category 1

6. Value of Inforce Covered Business	**Principle 6: The value of in-force *covered business (VIF) consists of the following components:*** ***Present value* of future profits (where profits are post taxation shareholder cash flows from the in-force covered business and the assets backing the associated liabilities)** ***Time value of financial options and guarantees* as defined in *Principle* 7** ***Frictional costs of required capital* as defined in *Principle* 8** **Cost of residual *non hedge able risks* as defined in *Principle* 9.**	o Cost of non-hedgeable risk ▪ Classification of risk ▪ Market risk ▪ Non market risk o Value of option and guarantees	o It is recognized that list of non-hedgeable risk would be longer in India as compared to EU due to non-availability of hedging instruments. o Agreed that there is a need to find out some alternate way to quantify impact of such risk o Need to develop stochastic model to quantify value of option and guarantees.	Category 1

7. Financial Option and Guarantees	***Principle* 7: Allowance must be made in the *MCEV* for the potential impact on future shareholder cash flows of all *financial options and guarantees* within the in-force covered *business*. The allowance for the *time value of financial options and guarantees* must *be* based on *stochastic techniques* using methods and assumptions consistent with the underlying embedded value. All projected cash flows should be valued using economic assumptions such that they are valued in line with the price of similar cash flows that are traded in the capital markets.**	o Modeling o Assumption setting o Management's discretion	o Operating assumptions should be based on companies' own experience. o Financial assumptions might be based on information from some common source for whole industry. o Management discretion assumptions should be based on some written internal policy of the company duly approved by a body whose approval would be otherwise sought in practice o Where appropriate, cost of financial options and guarantees should allow for dynamic policyholder behaviour IOAI may institute a working group and issue a GN for this principle	Category 2

8. Frictional Costs of Required Capital	***Principle* 8: An allowance should be made for the *frictional costs of required capital for covered business*. The allowance is independent of the allowance for *non hedgeable risks*.**	o Required cost of capital o Taxation o Investment Cost	o Recognized that such cost should be allowed for the targeted capital. o Tax treatment assumed for determining the frictional cost should be appropriately disclosed o Investment costs on required capital are presumed to be already allowed for in calculation of VIF. Otherwise, such allowances should be imputed here	Category 1

9. Cost of residual non hedgeable risk	***Principle* 9: An allowance should be made for the cost of *non hedgeable risks* not already allowed for in the *time value of options and guarantees* or the *PVFP*. This allowance should include the impact of *non hedgeable non financial risks* and *non hedgeable financial risks*. An appropriate method of determining the allowance for the cost of residual *non hedgeable risks* should be applied and sufficient disclosures provided to enable a comparison to a *cost of capital methodology*.**	o Non hedgeable risk considerably complex but an important subject o Lack of depth of market and liquidity in 'mark to model' situations	o Determine the impact of non hedgeable risk, may need uniform modeling technique across the industry o For illiquid assets some reference yield for valuation should be prescribed o Recognizing the complexity in this area, an approximate method such as increase in risk discount rate with adequate disclosures might be a practical alternative Recognizing that it's quite a complex area and hence needs a separate group to look into it.	Category 2

10. New Business and Renewals	***Principle* 10: New business is defined as that arising from the sale of new contracts and in some cases increases to existing contracts during the reporting period. The value of *new business* includes the value of expected *renewals* on those new contracts and expected future contractual alterations to those new contracts. The *MCEV* should only reflect in-force business, which excludes future new business. The *value of new business* should reflect the additional value to shareholders created through the activity of writing new business.**	o New Business definition o Group business o Profit margin or New business achieved profitability (NBAP) disclosures	o NB is all new contracts and increase in existing contracts and for VNB calculation all renewals & expected alteration under these new contracts should be considered o For group business, maximum contract term should be restricted up to 5 years for projection purposes unless contractually defined o In addition to profit margin, NBAP might be disclosed with denominator being the first year premium. Definition of first year premium must be clearly disclosed especially w.r.t. treatment of single premium/Limited premium/Regular premium products	Category 1

11. Assessment of Appropriate Non Economic Projection Assumptions	***Principle* 11: The assessment of appropriate assumptions for future experience should have regard to past, current and expected future experience and to any other relevant data. The assumptions should be *best estimate* and *entity specific* rather than being based on the assumptions a market participant would use. Changes in future experience should be allowed for in the *VIF* when sufficient evidence exists. The assumptions should be *actively reviewed*.**	o Uncertainty in non-economic assumptions	o Operating assumptions to be based on own experience where relevant o Assumptions should be best estimate as defined as the mean of the underlying distribution o Proper disclosure of assumption setting process and variations o Recognized that maintenance expenses (overruns) and lapse rates are a significant area of uncertainty Working group required, given considerable uncertainty and judgment involved in setting some of the assumptions	Category 2

12. Economic Assumptions	***Principle* 12: Economic assumptions must be internally consistent and should be determined such that projected cash flows are valued in line with the prices of similar cash flows that are traded on the capital market. No smoothing of market or account balance values or unrealised gains is permitted.**		o Assumptions should be based on some common source of information to ensure consistency across companies Working group required (Principle 12,13,14,15)	Category 2
13. Investment Return and Discount Rate	***Principle* 13: *VIF* should be discounted using discount rates consistent with those that would be used to value such cash flows in the capital markets.**	o Investment Return o Discount Rate	o For the VIF, the discount rate should be forward rates. o However, companies may wish to calculate the allowance for Non-hedgeable risk as an increase in the RDR but this amount should be separately identified Working group required (Principle 12,13,14,15)	Category 2

14. Reference Rate	***Principle* 14: The reference rates used should, wherever possible, be the swap yield curve appropriate to the currency of the cash flows.**	o Swap Yield curve	o A uniform reference rate from same yield curve across the industry and appropriate extrapolation of the yield curve to estimate return at extreme durations where liquidity is thin Working group required (Principle 12,13,14,15)	Category 2
15. Stochastic Models	***Principle* 15: Stochastic models and the associated parameters should be appropriate for the *covered business* being valued, internally consistent and, where appropriate, based on the most recent market data. Volatility assumptions should, wherever possible, be based on those implied from derivative prices rather than the historical observed volatilities of the underlying instruments.**	o Stochastic Modeling o Absence of volatility surfaces	o May be left for companies to develop o GN can be issued by IOAI regarding volatility and correlations to make the results more comparable. Working group required (Principle 12,13,14,15)	Category 2

16. Participating Business	***Principle* 16: For *participating business* the method must make assumptions about future bonus rates and the determination of profit allocation between policyholders and shareholders. These assumptions should be made on a basis consistent with the projection assumptions, established company practice and local market practice.**	o Tax rate on shareholder's profit in par fund o Distribution of profit to shareholders o Management discretion	o Shareholder's profit in par fund should allow for tax at an appropriate rate and disclosures need to be made to this effect o Future profits to shareholders shall be taken as $1/9^{th}$ of the cost of bonus subject to any taxes applicable o Management discretion assumptions should be based on some written internal policy of the company duly approved by a body whose approval would be otherwise sought in practice	Category 1

17. Disclosure	***Principle* 17: *MCEV* results should be disclosed at consolidated group level using a business classification consistent with the primary statements, with clear description of what business is covered by *MCEVM* and what is not. Except where they are not considered material, compliance with the *MCEV Principles* is compulsory and should be explicitly disclosed.**	o Frequency of reporting o Financial options and guarantees o Cost of non hedgeable risk o Additional disclosures required to 'educate' the investors/analysts towards valuation of insurance companies o Sensitivities to be more variable given the uncertainty in Indian context o Additional disclosures regarding areas of uncertainty e.g. Tax,, expenses o Disclosures by product type/distribution channel	o It is accepted that there might be phasing in of the application of Principle 7. However, an insurer must clearly disclose the approach they have taken, and views on the impact of taking such an approach rather than a more sophisticated one based on stochastic techniques. o It is recognized that application of Principle 9 on Cost of Non Hedgeable Risk is particularly challenging. Consequently, each insurer must clearly disclose the approach they have taken and quantify it in such a way to enable analysts and other readers to make their own adjustments and comparisons. As for the CFO Forum, sufficient disclosures are to be provided to enable a comparison to a cost of capital methodology and thus results from simplified approximate (generic) approaches can be compared against those who have applied more sophisticated approaches.	Category 2

			o The analysis of movement from one valuation date to the next is particularly powerful in helping understand the drivers of economic value. There is a need to define disclosures in the analysis of movement to address the special considerations for the current Indian marketplace such as expenses, lapses and tax o This Analysis of Movement will then potentially provide more insights than the MCEV result itself. For example, whatever approach a company takes for Expense Assumptions, provided they disclose full detail of the basis of their underlying assumptions and the calculation of Expense Overrun, if any, then the Analysis of Movement will provide strong insight to the true expense position and expense management of the company. o Similarly, disclosure of the lapse assumptions together with a stress test will provide insights into lapse related value creation/destruction. A working group is required to define what should be disclosed as analysis of movement and the relevant stress tests in addition to the ones suggested by CFO form principles.	Category 2

Appendix 1

Practical Methods to calculate Economic Capital for Non-Market Risks

This section looks at one – year approach to calculate the Economic Capital for a typical Life Insurance Company. Under this approach EC represents the current market value of assets required to ensure that the market consistent value of liabilities can be covered in one-year's time at the chosen security level (typically expressed on a VaR basis) less the current market-consistent value of the liabilities. The one-year mark-to-market approach of calculating EC is based on the following main steps:

- An economic balance sheet is developed as at the valuation date on a mark-to-market basis, i.e., with assets at market values and liabilities on a market-consistent basis. The difference between the value of assets and value of liabilities gives the economic value of net assets, i.e., the available capital at the valuation date measured on an economic basis.
- For a number of scenarios, say, 99.95% shock scenarios (AA rating), assets and liabilities are projected forward for one year, at which point a projected economic balance sheet (on a mark-to-market basis) is developed. The resulting projected economic value of net assets (positive or negative) is then discounted to the valuation date using the projected earned investment return over the year.
- A negative discounted value quantifies the additional initial asset value the insurer needs to hold to ensure it remains solvent on a mark-to-market basis at the end of the year under that scenario.
- The worst negative value of all the scenarios gives Economic Capital for that risk factor
- The Economic Capital is thus calculated for each of the risk under consideration in the above manner and is then aggregated using a diversification approach described later in this section

The Group looks at ways in which the Economic Capital can be calculated for each of the risk types in detail below.

1. **Mortality Risk:**

   As discussed under section—the mortality risk can further be divided in to three sub-risks as **Uncertainty**, **Volatility** and **Extreme events**. The Uncertainty is further divided in to L**evel uncertainty** and **Trend uncertainty**. Thus in order to calculate the EC for mortality risk the EC has to be calculated for each of these sub-risks and aggregate them to give the mortality EC.

   a. **Level Uncertainty Risk EC:** The following describes an approach that could be used to determine the portion of economic capital attributable to the uncertainty determined with respect to the level of mortality.

   The method is based on the normal power (3) approximation (NP(3)). In this approach, the compound Poisson distribution is expressed in terms of a normal distribution using its first 3 moments. An issue in using this method for the level uncertainty is that the risk capital can sometimes be determined only in the last year of the period. Assuming that the portfolio is relatively stable over time in terms of average age, gender distribution and spread of the sum assured, a reasonable approximation of the NP(3) approach can be made. For relatively new portfolios care is needed.

   The method used is as follows:
   Define the ratio between the expected mortality rate for insured persons and the whole population by dividing the observed deaths over a certain period by

$$f_{be} = \frac{\mu_{obs}}{\mu_{ref}}$$

   the expected deaths over the same period, based on the population mortality or an industry (reference) table:

In the level uncertainty we reproduce the uncertainty in the observations μ_{obs} in an adjusted factor:

$$f_{ec} = \frac{\mu_{obs} + (-)unc_{ci}}{\mu_{ref}}$$

The uncertainty part in the numerator can be calculated with the same kind of model as used in volatility.

$$unc_{ci} = \sigma(s_{ci} + t_{ci}\gamma)$$

The standard deviation follows:

$$\sigma = \sqrt{\sum_{p} q_p(x) X_{p_i}^2}$$

And the skewness:

$$\gamma = \frac{1}{\sigma^3} \sum_{p} q_i(x) X_{p_i}^3$$

This calculation should be done over the same observations used in calculating the f_{be}, so possible over same period. Problem can be that this kind of dataset is not available over the past. In that case only the most recent dataset can be used. With a weighting factor h a correction needs to be made:

$$h = \frac{\sum_{j} N_j}{N}$$

With N: numbers of policies in the available dataset and $\sum_{j} N_j$ is the total number of policies used over the whole observation period.

In that case the formulas for standard deviation and skewness follow:

$$\sigma = \sqrt{h\sum_{p} q_p(x) X_{p_i}^2}$$

$$\gamma = \frac{h}{\sigma^3}\sum_{p} q_i(x) X_{p_i}^3$$

The s and t depend on the confidence level CI:

		Mortality	
Time horizon	Confidence level	s	t
1	99.95%	3.3	1.6
12	98%	2.1	0.5
12	94%	1.6	0.2
Quantile	90%	1.3	0.1
Quantile	75%	0.7	0.0

The EC is calculated by first calculating the liabilities ($liab_{ec}$), based on the qx's:

$$q_{ec}(x;t) = f_{EC} \times q_{POP}(x;t)$$

Than the economic capital follows: $EC = liab_{EC} - liab_{BE}$

b. **Trend Uncertainty Risk EC:**

The trend uncertainty risk EC can be calculated using the methodology as given below:

Assuming that there are nine sets of mortality improvement factors: $f_i(x)$ (i=1 to 9). With each set $f_i(x)$ a generation mortality table can be calculated:

$$q_i(x;t+a) = f_i(x)^a \times q_{be}(x;t)$$

(In case of positive risk, for example in life insurance, it is advisable to limit a in the exponent, say, to 10 years)

And with each generation mortality table i, a corresponding liability can be calculated. This results in 9 different liabilities: $liab_i$

With these 9 liabilities a standard deviation can be calculated:

$$s_{trend} = \sqrt{\tfrac{9}{8}\{(\tfrac{1}{9}\sum_i liab_i^2) - (\tfrac{1}{9}\sum_i liab_i)^2\}}$$

The trend uncertainty calculated in this way is a Student (t) distribution with 8 degrees of freedom. In the Student (t) distribution with dof=8 the 98% confidence interval is based on 2.5 standard deviations. This gives:

$$EC_{trend} = 2.5 \times s_{trend}(dof = 8).$$

Calculating economic capital using a student distribution

In Table below, the factors that can be used to estimate economic capital are shown that depend on the degrees of freedom reflecting the number of trends available.

The factors then are multiplied by the observed standard deviation. The economic capital factor (EC) is based on a 99.95% (1 year time horizon) or 98% (12 year time horizon for a AA rated entity) or 94% (12 year time horizon, equivalent to the yearly 99.5%), and for the quantile method at 90% and 75% confidence intervals.

Number of standard deviations needed in a student distribution					
Degrees of freedom	EC 99.95%	EC 98%	Solvency II 94%	Quantile 90%	Quantile 75%
5	6.9	2.8	1.9	1.5	0.7
6	6.0	2.6	1.8	1.4	0.7
7	5.4	2.5	1.8	1.4	0.7
8	5.1	2.5	1.7	1.4	0.7
9	4.8	2.4	1.7	1.4	0.7
10	4.6	2.4	1.7	1.4	0.7

The challenge in calculating Mortality Trend Uncertainty EC lies in arriving at the historical trends. Sometimes insufficient data will be available to determine certain historic trends for a given population. For example, when new mortality tables are developed only once every 10 years, an insufficient period of experience may be available to determine a trend.

In the case where there is a lack of trend experience, a standard set of trend factors may be able to be applied. This standard set might be based on an adequate set of historical mortality observations of groups of lives for whom data are available. The reason that this is possible is that we are trying to measure the possible changes of an historical trend over a given period. In general, these changes would not differ very much between different categories of lives. Nevertheless, these standard sets might differ by region, continent or stage of development that may be particular to the observed category or the category to which they will be applied.

c. **Volatility Risk EC:**

An analytical approach is used to calculate the Volatility Risk EC which is described below:

We assume that the number of deaths is Poisson distributed. Including the distribution of the sums assured at risk results in a Compound Poisson distribution of total claims over a fixed time period. There are good reasons (theoretical and practical) for this assumption. Based on the collective risk

model, we can estimate the shape of the mortality distribution using the normal power approach (as in Example 10). In this approach we use the first three moments to compare the distribution with the standard normal distribution. The steps are as follows:

1. Determine for each life
   - The sum assured at risk for each life i (Xi), (i.e. the capital to be paid out because of death).
   - The mortality rate of life I based on Best Estimate Level qi(x)

2. Calculate the standard deviation and skewness using the respective

$$\sigma = \sqrt{\sum qi(x) \times (Xi+)^2} \qquad \gamma = \frac{\sum qi(x) \times (Xi+)^3}{\sigma^3}$$

   formulae given below:

3. The x% confidence interval can than be calculated as follows using the normal power approach as

$$P\{[S - E(S)]/\sigma_s \le s + \tfrac{1}{6}\gamma(s^2 - 1)\} \approx \Phi(s) = \frac{x}{100}$$

For example, to find the 99.95% (one sided) confidence point the calculation is as follows: s=3.29 (99.95% point in a normal distribution) So the 99.95% interval of S follows:

$$\sigma_s \times (3.29 + \tfrac{1}{6} \times \gamma \times (3.29^2 - 1)) = \sigma_s \times (3.29 + \gamma \times 1.64)$$

Substituting for σ and γ as derived in step 2 above in $\sigma_s \times (3.29 + \gamma \times 1.64)$ the EC at 99.95% confidence for volatility risk can be calculated.

d. Extreme Event Risk EC:

An example of extreme event id Spanish flu and other risks of this nature include nature catastrophes like an earthquake, tsunami or the impact on earth of a meteorite and also terrorist attacks. The EC for this type of risk

may be based on simplified approaches such as equaling it to the expected amount of risk in the year of valuation.

2. **Lapse Risk:**

As in mortality risk this risk is also classified in to Uncertainty Risk, Volatility Risk and Extreme Event Risk and Economic Capital has to be calculated to each of these sub-risks separately.

Typically a stress test approach is applied for calculating Lapse Risk EC. This approach determines the EC by calculating the financial impact of selected stress events. While the inherent lapse risks can be modeled independently, the lapse stresses typically consist of one high lapse scenario and/or one low lapse scenario, modeled simply as a multiple of the base lapses.

The calculation for lapse risk is to calculate the liability using

a. Base lapse assumption; and

b. Stressed lapse assumption

The difference between base liability and liability based on stress scenario gives the required capital. The stress scenario is to be chosen to reflect the level of confidence required e.g. 99.5% confidence.

To arrive at the required level of stress requires adequate data so that statistical analysis can be used to calculate the required stress scenarios. In absence of data expert opinions can be used to define the stress.

a. Lapse Uncertainty Risk EC:

The lapse assumption in projecting the cash flows and calculating the liability is modified to stress factor * base lapse assumption. Then the Lapse Uncertainty Risk EC is calculated using the approach explained above.

b. Lapse Volatility Risk EC:

With a finite sample, random fluctuation will affect experience. For large blocks of business, this is not expected to be a significant contributor to EC.

The same approach as above can be used to calculate this EC. However, the difference here is to stress the assumption for one –year period following the date of valuation and revert back to the base assumption there on.

c. Lapse Extreme Event Risk:

A same approach as for Lapse Volatility Risk EC can be used with a different stress assumption reflecting the extreme events or can be taken as equal to the Lapse Volatility Risk EC.

3. Expense Risk:

As given in "MEASUREMENT OF LIABILITIES FOR INSURANCE CONTRACTS: CURRENT ESTIMATES AND RISK MARGINS – MARCH 2008 RE-EXPOSURE DRAFT **IAA ad hoc Risk Margin Working Group" t**he approaches for expense risk are still required to be investigated and a crude approach to estimate this risk EC is to take 0.75% of liability as Expense Risk EC.

4. Operational Risk:

There are many techniques that may be suitable for modeling Operational Risk such as the following:

- Simple add-on models
- The frequency Severity Model;
- Risk event scenarios

These models for losses are based on company and /or industry data. Since data is scarce approaches used are based on expert opinions are normally used.

The comment above related to expense risk is also true for operational risk and needs to developed by taking in to account the country related, entity related and possibly product related factors.

However, a crude approach may be to set this EC at 1% of liabilities.

Members of the Working Group : **Annexure - I**

1	**R Kannan**	**Chairperson**
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3	K S Gopalakrishnan	Member
4	G L N Sarma	Member
5	N Kalpana	Member
6	B N Rangarajan	Member
7	Heerak Basu	Member
8	Avijit Chatterjee	Member
9	Andrew Cartwright	Member
10	Anil Kumar Singh	Member
11	Mark Saunders	Member
12	James Creedon	Member
13	Sanjeeb Kumar	Member
14	Sanchit Maini	Member
15	**Varun Gupta**	**Secretary**

Appendix 2 – Diversification

Marginal diversification

For allowing diversification there are various technical methods such as using Copulas. In this section we an alternate method given in the Paper "MEASUREMENT OF LIABILITIES FOR INSURANCE CONTRACTS: CURRENT ESTIMATES AND RISK MARGINS – MARCH 2008 RE-EXPOSURE DRAFT **IAA ad hoc Risk Margin Working Group"** is reproduced for ready reference.

In the technical methods the diversification effect can be estimated for a given portfolio. In the quantile approach, the diversification effect is calculated over the portfolio we want to know the 75% quantile around the liabilities.
If an exit value is being estimated using the cost of capital approach, we need to know the marginal impact of the portfolio on the (economic) capital of the entity that takes over the obligations. Because of diversification effects within the transferred portfolio and between the transferred portfolio and the already existing portfolio, the increase of the capital will be less than the sum of the risks of the transferred portfolio and also less than the diversified capital of the transferred portfolio.

A simple example is included here to illustrate how this might work:
Suppose there is a portfolio with a capital of 1000. We want to add another portfolio with a separately calculated capital of 100. Suppose this added portfolio is independent from the original one, so that the risks in the two portfolios are

$$\sqrt{1000^2 + 100^2} = 1005$$

independent. This means that the total capital will be:

Adding the new portfolio only increases the capital by 5 (or 5% of the original 100). In case the two portfolios are not independent, but there is a correlation

$$\sqrt{1000^2 + 100^2 + 2 * 0.25 * 1000 * 100} = 1030$$

factor of 0.25 between them, the total capital would have been an increase of 30 (or 30% of the original 100).

These estimated impacts for each of the risk types discussed in this note. The question is whether these factors should be combined according to a more proportional rule. A complication is that some risk types diversify better than others. Therefore a compromise approach is chosen: the use of risk “Buckets." We categorize the risk types into groups, based in each of their levels of diversification.

Risk types with marginal diversification effects between 1% and 25% are allocated to the 25% bucket, between 25% and 50% to bucket 50%, etc. This process includes rounding in which some additional margin is created. In case the transferred portfolio creates more diversification for a certain entity, the Bucket system leads to some conservatism in the margins, and the other way around.

The reason for using the Bucket system is that it is difficult to define a unique, well diversified insurer. In the Bucket system, the diversification effects of most insurers will satisfied. In the Bucket system it is less important to define the reference entity.

Diversification credits Level of diversification	**Capital after diversification**
Full	0%
High	25%
Medium	50%
Low	75%
None	100%

Transfers will not change the reference entity, because that will be based on the “market” and the market itself will not change because of the transfer. However, they will change the risk profile of the real company that actually takes over the portfolio.

Based on experience and testing, the types of risks can be ordered according to the buckets shown in Table below (note that this table includes life, health and property & casualty risks).

Ordering Risk Types	
Risk Type	**Bucket – Life**
Mortality level uncertainty	25%
trend uncertainty	25%
volatility	0%
calamity	50%
catastrophe credit risk reinsurance	50%
Expense	50%
Persistency volatility & calamity	0%
uncertainty	50%
Operational risk capital	-
Interest rate risk	-
Currency risk	-
Real estate risk	-
Equity risk	-
P&C current non-catastrophe uncertainty	25%
Current non-catastrophe volatility	0%
current catastrophe risk	75%
catastrophe credit risk reinsurance	75%
claims development risk - volatility & uncertainty	25%
Morbidity uncertainty	25%
volatility	0%
claims development risk	0%
calamity	50%

The percentages listed below are not recommendations from the IAA but are included for illustrative purposes.

In the above table all volatility risks are set at 0 (full diversification). Alternatively they could also be assigned a relatively small, e.g., 25% value.

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