**An approach to Risk Based Capital for**

**African Life Insurers**

**A paper to be presented to the International Congress of Actuaries**

**Washington DC.**

**April 2014**

**By Margaret Oyugi & Moses Mutuli**

**December 2013**

Table of Contents

[1: Introduction 2](#_Toc229200559)

2: [Current practices and developments 4](#_Toc229200560)

 [3: A background to capital calculation.................................................................................7](#_Toc229200562)

 [4: Risk capital calculation for a life insurance product. 1](#_Toc229200563)1

 [5: Illustrative example: Non-profit endowment policy 1](#_Toc229200564)8

 [6: Outstanding issues and conclusion 2](#_Toc229200565)3

 [7: References 2](#_Toc229200566)5

1. **Introduction**
	1. **Introduction**
		1. There has been an increased interest by insurance regulators across Africa to introduce risk based capital (‘RBC’). This has been necessitated by the economic turmoil of 2008 and a desire by the regulators to see that insurers review their underlying risks and manage those risks actively.
		2. A lack of proper risk management has seen many insurers in Africa become insolvent. Kenya, for example, has seen at least seven insurers in the last decade being placed under statutory management, and eventually liquidated, due to inadequate capital.
		3. Insurance penetration levels remain very low in Africa and this has largely been due to a lack of trust from the public who find insurance companies unable to pay claims when they arise. This is partly as a result of poor capitalisation of insurance companies and a lack of proper risk management.
		4. RBC provides an opportunity for African insurers to improve on their risk assessment and increase public confidence on how these companies are managed. By implementing RBC African insurers would strategically position themselves to compete with their counterparts in other parts of the world who are currently reviewing their risk management models to tackle the ever complex nature of insurance risks that they face.
		5. This paper provides an introduction to the different techniques used by regulators across the world that implement RBC and suggests a suitably less sophisticated model for a life insurer operating in Africa. The paper is not exhaustive of the methodology and techniques but aims to incentivise regulators in Africa to introduce RBC in their respective regimes and highlight the issues that they should address as they develop a suitable framework. A lot of work is required in developing a suitable model for Africa insurers and this paper aims to encourage further discussion by regulators in Africa on how best to utilise their resources to develop a framework that suits their respective regimes.
	2. **Motivation for RBC for African Insurers**
		1. Implementation of RBC would present an opportunity for African insurers to manage their risks and capital more efficiently. After the economic turmoil of 2008, many financial institutions around the globe began to reassess their risk management techniques. The banking sector, for example, has implemented Basel II, a RBC requirement, and is in the process of implementing Basel III. RBC aims to improve risk management and to align the solvency requirement with international regulatory approaches.
		2. Insurance regulators across Africa have begun to realise the importance of proper risk management and have been studying the possibility of introducing RBC to their respective regimes. This will play an important role for the insurer in early detection of events that may lead to it’s insolvency and identify necessary action to be taken.
		3. There has been a very low life insurance penetration (for example below 2% of Gross Domestic Product in Kenya) in African countries outside South Africa. This is caused mainly by a lack of trust by potential policyholders that their claims will be paid and on insurers’ low capitalisation level and inadequate systems to manage the risks to which they are exposed. A RBC systems aims to encourage low capitalised entities to reduce risk and therefore reduce the probability of insolvency. RBC would instil public confidence in the insurance industry with long term effect being an expected higher consumption of insurance products.
		4. Credit rating agencies, like Moody and Standard & Poor’s, take into account the risks that companies are faced with and the approach adopted by companies to manage these risks. This is in addition to the amount of free capital available to cover for these risks. RBC enhances a company’s risk management capabilities which may in turn enhance the company’s credit rating thereby reducing its cost of capital.
		5. Skilled resources are required for the implementation of RBC. Actuaries are well trained to handle insurance risk and to provide proper guidance on how the risks may be managed. The number of qualified actuaries practising in Africa has been known to be very low and companies have regularly complained of the high fees demanded by actuaries. However, there is a positive trend seen in sub-Saharan Africa, with an increasing number of registered actuarial students undertaking actuarial examinations provided by recognised professional bodies like Institute and Faculty of Actuaries (UK), Society of Actuaries (USA) and Actuarial Society of South Africa. It is expected that with an increased number of qualified actuaries the costs of hiring actuaries will fall.
	3. **Challenges of implementing RBC**
		1. Shortage of skilled resources
		2. Lessons learnt from regimes worldwide that have implemented RBC indicate a shortage of skilled resources to be the biggest hindrance to the development of such a framework. This problem will not be an exception to the African market either where there is an obvious shortage of actuaries and other trained professionals who are well placed to implement RBC. This is mainly caused by the costs involved in training an actuary to qualification and the perceived uncertainty of full qualification to an actuary.
		3. Africa suffers immensely due to brain drain. There are many known actuaries of African origin who prefer to practise in markets outside of Africa, especially in UK and USA. Their desire to return to Africa is hindered by perceived lack of opportunities. There is a perceived lack of incentive, both in terms of professional development and remuneration, by these actuaries to return to Africa.
		4. Lack of consistent valuation methods
		5. The starting point for risk and capital management for an insurer is the realistic balance sheet. Regulators in Africa do not have a consistent method by which the insurance companies operating within their regimes would value their assets and liabilities. For example, regulators may only demand that the values of assets and liabilities be determined on generally accepted actuarial concepts. This leads to inconsistency in valuation as some companies would prefer to follow guidance provided by different established regimes, for example, South Africa’s Guidance Notes or UK’s Prudential Sourcebook for insurers.
		6. Inadequacy of regulatory authorities
		7. In some cases, regulators in Africa have yet to put systems in place that would enhance proper management of insurance companies. This is partly attributed to a lack of adequate funding from respective governments.
		8. In some countries, there is no independent insurance regulator. Instead, insurance regulation lies as a department within Ministry of Finance, hence not given proper attention that it deserves.
		9. The key to monitoring of RBC lies with the regulatory authorities who must communicate and involve local insurers in every step of the process. This however requires that they have more powers to carry out their mandate.
		10. Costs involved
		11. Implementation costs for RBC tend to be prohibitive and this will especially be an issue for a majority of insurance companies operating in Africa. One way to overcome this is by introducing a RBC framework that is simple to implement and requires less human and technological resources.
		12. Lack of data
		13. Calibration of models is an important aspect of RBC but this can only happen if there is adequate, complete and clean data. The collection and analysis of reliable data by insurers in Africa still remains at a very low level and this would render it difficult for insurers to determine credible stress levels for the risks faced. There are only a few notable active stock exchanges in Africa that would provide credible market data, for example that may be used to determine suitable market stress levels.
		14. *Lack of co-operation by insurers in Africa*
		15. Many insurers operating in Africa market are small in size and therefore unable to afford the costs that come with implementing RBC. These costs prove prohibitive to insurers in Africa who are already poorly capitalised. With the knowledge of costs involved and possibility of higher capital requirements, many insurers in Africa are likely to rise against such regulation that may see them wiped out of the industry.
2. **Current practices and developments**
	1. **Introduction**
		1. Many insurance regulatory regimes in Africa do not call for RBC. Only South Africa has a proper system for RBC through its Capital Adequacy Requirement (CAR) regime which came into place in late 1990’s.
		2. However, a few more regulators, like in Kenya and Rwanda, are now either considering or are already implementing RBC. Furthermore, the merging of some markets in Africa, for example the East Africa Community, presents a good opportunity for regulators in Africa to come up with a consistent regulatory method between member states that allows for better risk management within insurance companies.
		3. We take a look at current practices in Europe, Asia and South Africa. This paper aims to motivate a blend of the current practices in these regimes to derive a suitable framework that may be applied to a life insurer operating in Africa.
	2. **Europe – Solvency II**
		1. Solvency II is the European Union project which aims to facilitate the creation of a single market for insurance services in the EU, introducing economic risk-based solvency requirements.
		2. Solvency II is administered in three pillar system, similar to Basel II for banks:

Pillar 1: Quantification of capital requirements

Companies have to meet two capital requirements, a Solvency Capital Requirement (SCR) and a Minimum Capital Requirement (MCR). Both levels of capital represent the different levels of supervisory intervention. MCR is the minimum solvency requirement where a breach would trigger ultimate supervisory intervention. The SCR is a risk based capital requirement that can be determined either through a prescribed European Standard formula or via the company’s internal model.

Pillar 2: Qualitative requirements

This covers the firm’s internal controls and risk management activities as well the supervisory process. The review process itself may occasionally lead a supervisory authority to apply capital guidance in the form of a capital add-on.

Pillar 3: Reporting and disclosure requirements

There will be public disclosures on business overview and performance, governance, and the valuation basis employed for solvency. In addition, there will be non-public disclosures on risk and capital management.

* + 1. Under the Solvency II framework, companies may calculate their capital requirements using a standard formula which is based on the correlation method (See Section 3.4.3 below). Many smaller insurers are expected to use the standard formula to save on costs involved in building internal models.
		2. It is however envisaged that the much bigger companies will opt to use an internal model. This is because the standard formula may not appropriately model the complex nature of their risks.
		3. Some companies may also choose to use a partial internal model and standard formula depending on the nature of their risks and ability to build internal models.
		4. Solvency II framework is scheduled to be implemented across Europe from early 2014. A series of five Quantitative Impact Studies (QIS) have been completed by firms within the EU to assess what impact SII will have on capital requirements for European firms.
	1. **South Africa – Capital Adequacy Requirement (CAR)**
		1. Capital Adequacy Requirement (CAR) is the current practice in South Africa in relation to capital management. The purpose of CAR is to quantify the minimum level of assets above liabilities that will provide a sufficient cushion against random negative fluctuations in experience in any of the variables used in the statutory valuation. In addition, CAR functions as a regulatory warning system.
		2. The size of the cushion in CAR calculations is based on a 95% confidence level (or 1 in 20 chance of insolvency) over 10 years.
		3. The overall cushion allows for diversification benefits by applying correlation between the different variables. The CAR formula is the maximum of Termination CAR (TCAR) and Ordinary CAR (OCAR).
		4. The TCAR ensures that a long-term insurer is in a position to survive a very selective “run-on-the-bank” scenario.
		5. The OCAR formula comprises a factor based approach that isolates each major risk category and establishes what capital needs to be held in respect of that risk. The results are then summed with an adjustment to the sum to recognise independencies and diversification.
		6. There are plans to replace the current CAR regime with Solvency Assessment and Management (SAM). SAM borrows heavily from Solvency II with noticeable similarities between SAM’s QIS1 to Solvency II’s QIS5. Companies in South Africa have already completed their QIS1 submissions and it is anticipated that SAM would come into place in January of 2014.
	2. **UK – Individual Capital Assessment (ICA)**
		1. ICA is a private submission of the firm’s capital requirement to the UK regulator Financial Services Authority (FSA) and is not published as part of the FSA’s return. ICA has a three-pillar approach similar to Solvency II.
		2. There are three model principles underlying the calculation of ICA:
* The firm’s assessment of the adequacy of its capital resources
* A requirement to submit the ICA calculation on a 99.5% survival probability (or 1 in 200 chance of insolvency) over 1 year or a different equivalent basis over a longer term that the value of the firm’s assets will exceed the value of their liabilities
* Documenting the firm’s reasoning and judgment underlying the ICA assessment, its calculation methodology, assessment of firm specific risks and justification for the values used.
	+ 1. A firm must submit their ICA calculations to the FSA who subsequently reviews them to assess whether the capital requirement is adequate and accordingly issues an ICG (Individual Capital Guidance). If the FSA is satisfied with the calculations then the ICG will be set at the same level as the ICA. Although if the FSA believes that the firm has not appropriately assessed all the risks it is exposed to then it will set the ICG at a level higher than the ICA.
		2. ICA will be replaced by Solvency II on implementation but it is worth noting that there is a lot of overlap between the two regulatory regimes.
	1. **Singapore**
		1. Singaporean insurance companies are regulated by the Monetary Authority of Singapore (MAS). The Singapore model of RBC framework was implemented on 1st January 2005. The key objective behind the implementation of the framework was to adopt a common regulatory principle across different sectors (for example banking and insurance).
		2. The RBC framework was designed to provide a clearer indication of financial strength, and sets a series of trigger points for regulatory action. A company has to demonstrate that it has sufficient capital at both a fund level and a company level. The Fund Solvency Requirement (FSR) is applied to each fund while the Capital Adequacy Requirement (CAR) applies to the entire company.
	2. **Malaysia**
		1. The Malaysia model requires each insurer to determine the adequacy of the capital available in its insurance and shareholders’ funds to support the “Total Capital Required” (TCR).This serves as a key indicator of the insurer’s financial resilience, and will be used as an input to determine supervisory interventions by the Bank Negara of Malaysia, the Central Bank of Malaysia, which is the insurance regulator.
		2. The Malaysia model is developed based on a standardised approach.
		3. Currently, the formula based approach includes capital charges for credit, market, insurance and operational risks of an insurer.
	3. **Summary**
		1. The Singapore and Malaysia models don’t come without shortcomings though:
* They do not allow for diversification effect of the risk factors
* The regulations do not motivate larger companies, especially those exposed to more complex risks, to shift to internal models in future
	+ 1. This paper recommends a blend of all the regimes discussed above, looking at situations that suit African insurers better. However, a lot of material is borrowed from the South African, Singapore and Malaysia models which are found suitable for Africa insurers due to their simplicity to apply.
1. **A background to capital calculation**
	1. **Introduction**
		1. Risk Based Capital (‘RBC’) is defined as the amount of capital required by a company to protect itself against adverse movements in its risk profile. This section looks at the theoretical background for calculating RBC requirement for a financial firm.
		2. Capital calculation engine is driven by three processes:
* Risk classification and measurement
* Stress test calibration
* Net asset value function and capital aggregation methodology
	1. **Risk classification and measurement**
		1. The firm must consider all material risks that may have an impact on the firm's ability to meet its liabilities to policyholders. The RBC for a firm would depend on the risks that the company is faced with; it’s risk appetite (measured as the probability of survival within a specified time period) and regulatory requirements. UK’s ICA, Europe’s Solvency II and South Africa’s SAM require a 99.5% probability of survival within a year (otherwise known as a 1 in 200 year event). Currently, South Africa’s CAR is based on a 95% ten year survival probability.
		2. Diagram below shows the classification of risks faced for a life insurer based on Solvency II.
	2. **Stress test calibration**
		1. Stress testing is calibrated in terms of risk driver moves. Setting the severity of the extreme events at the required confidence level involves analysis of historic moves and judgment to formulate a view about what is a 1-in-200 year event. Because of the complexity of stress test calibration this is often determined by the regulator.
		2. For the purpose of deriving the level of stress tests for each risk, companies must determine how they will measure risks in terms of the variability of outcomes. Commonly used risk metrics are Value at Risk and Tail Value at Risk.
		3. Value at Risk (VaR)
		4. A one year value at risk is defined as the potential loss in a portfolio in a year at a specified confidence level, say 99.5%. Under Solvency II and SAM frameworks it is the basic risk measure to calculate capital requirements.
		5. One method that may be used to calculate VaR is the Variance-Covariance method (or delta-normal method). It assumes that all asset returns are normally distributed and the portfolio return is a linear combination of normal variables.
		6. One limitation of VaR is that it is uninformative about the extreme tail. It only tells us what we could lose in normal states, where the tail event does not occur, but nothing about what we could lose in bad states where a tail event occurs. Also, linear form cannot adequately express the risk when options or other non-linear instruments are contained in the portfolio.
		7. Tail value at risk (TVaR)
		8. TVaR may be defined simply as the value at risk of a portfolio plus the expected loss above the VaR. TVaR at a specified confidence level is therefore generally greater than VaR. However, TVaR is more difficult to calculate than VaR since information on the full distribution of outcomes is required, and this is usually not available in practice.
		9. TVaR has been adopted by the Canadian Institute of Actuaries, the American Academy of Actuaries and the Swiss regulators.
		10. In this paper, it is recommended that a VaR method be adopted to decide on level of stresses that may be applied for the African markets. It is recommended that the stresses be calibrated at (a less stringent) 95% confidence level over one year to reduce the impact of capital requirement on balance sheets of African insurers who are less capitalised.
	3. **Capital aggregation techniques**
		1. Capital aggregation refers to the task of incorporating the financial impact of multiple types or sources of risks into a single capital figure.
		2. There are a number of capital aggregation techniques that have been implemented in different regulatory regimes. The most common being:
* Correlation method
* Monte Carlo Simulation
* Risk Geographies
* Copulas
	+ 1. Correlation method
		2. Correlation method is the simplest and most widely used method to calculate diversified capital requirements. It is the approach implemented in South Africa’s CAR, UK’s ICA and has also been adopted for Solvency II and SAM standard formula.
		3. This paper will adopt the correlation method for capital aggregation for the following reasons:
* It is easier to implement
* It requires less computer effort
* Many existing, and proposed, risk based capital frameworks use the method to aggregate capital e.g. Solvency II
	+ 1. Correlation method makes two assumptions:
* Risk drivers have a multivariate elliptically contoured distribution
* A firm's net assets is a linear function of risk drivers
	+ 1. A multivariate Normal distribution is an example of an elliptically contoured distribution and is the most widely used because it is tractable and widely understood.
		2. The correlation method calculates the solvency capital requirement, , based on the formula:



* + 1.  is the impact on net assets after individual stressing of risk and  is the matrix of correlation between risk factors and .
		2. The correlation matrix may be derived using historical data. Quantitative Impact Study 1 (‘QIS1’) for South Africa’s SAM has used the same correlation matrices as those used for QIS 5 for Europe’s Solvency II. Although this may not be appropriate for South Africa market, as some of the risks will behave different in South Africa as they do in Europe, it was agreed that the same correlation matrices be used for the purpose of QIS1 before a thorough study on the correlations is done in preparation for QIS2. The same approach may be adopted by regulatory regimes in Africa before a full study of correlations between the different risks is conducted.
		3. One important aspect of the correlation matrices is that they need to be positive definite. Positive definiteness ensures consistency between the different risk factors. There are several mathematical methods used to test positive definiteness of a matrix, for example checking that all the “eigenvalues” of a matrix are strictly positive or that the matrix may be decomposed using “Cholesky factorisation”.
		4. One major short-coming of correlation method is that it does not allow for non-linearity. Non-linearity arises because the occurrence of one risk changes the exposure to another. The only way to allow for non-linearity is to test combined stress tests where more than one risk appears at once. UK’s ICA attempts to overcome this problem by use of “medium bang” technique but Risk Geographies and Copulas techniques, discussed below, appear to handle it better.
		5. This paper recommends a RBC framework for Africa that ignores any allowance for non-linearity, like in Solvency II’s standard formula, until companies develop internal models to manage their risks.
		6. Monte-Carlo simulation
		7. Monte-Carlo approach is a principles-based approach to calculate capital requirements and involves simulation of an explicit parametric model for risk-factor changes.
		8. This method is less fussy about the assumptions, and it is applicable with virtually any model of changes in risk factors and any mechanism for determining a portfolio’s value in each market scenario.
		9. The major problem with Monte-Carlo is that it is difficult to implement and very costly as many simulations are required to be run to arrive to the desired results. As such, it is not recommended in this paper.
		10. Risk Geographies
		11. Risk Geographies (‘RG’) is a framework for analysis and allocation of economic capital, understanding risk interactions and finding which combination of events is most likely to ruin your firm. The approach has been used mainly in the UK to aggregate risks.
		12. RG is an interactive and graphical approach for understanding capital needs of financial institutions – principally a robust risk aggregation method capable of dealing with non-linear net asset value functions, common in insurance liabilities. It provides an intuitive way to estimate the extreme percentiles required for capital calculations as well as optimal hedges allowing for interactions between different risks.
		13. The assumption of the risk drivers is the same as in correlation method, but RG method is more robust to non-linearity and can calculate the most onerous scenarios at a given confidence level.
		14. This method is however not recommended in this paper because non-linearity effect is ignored in the proposed framework.
		15. Copulas method
		16. Copulas method uses a Monte Carlo approach to aggregate capital. The method combines the marginal distributions of risk factors using copula functions. Fed through an asset-liability model, these simulations are then used to produce a full distribution of capital requirements.
		17. The method allows flexibility in assumed distributions of risk factors (including non-normal) and dependency structure but a key challenge is obtaining reliable data to calibrate each copula.
		18. Allowance can be made for non-linearity between risk factors through the use of an appropriate simplified asset-liability model.
		19. Due to complexity of the method, and the requirement to carry out Monte Carlo simulations, this method is not recommended in this paper.
1. **Risk capital calculation for a life insurance product**
	1. **Introduction**
		1. This section examines how a blend of the different RBC techniques in Chapter 2 may be applied to arrive at a suitable risk capital framework for a life insurer selling simple life policies in Africa.
		2. While assessing the adequacy of its overall capital requirement the firm must consider its assets, liabilities and future plans. This section will therefore begin by looking at how a life insurer’s assets and liabilities should be valued for the purpose of capital calculation.
		3. We shall then suggest on methods for calculating capital risk requirements that should be applied to each risk faced by the insurer and this will be followed by how these individual requirements can be aggregated to derive a suitable economic capital for the insurer.
		4. The ideas in this section are not exhaustive. Instead, the section provides an overview of a conceptual framework for RBC but that more work will be needed by each country to develop suitable frameworks that suit their respective markets.
		5. In this section, we shall dwell on areas that would affect a typical African insurer that sells simple conventional life insurance products and therefore does not have complex hedging structures in place.
	2. **Asset and liability valuations**
		1. RBC emphasizes transparency and a more realistic picture of an insurer’s financial position. This is achieved by using a more market consistent valuation methodology and basis. This will place greater reliance on the professional judgement of actuaries and accountants.
		2. Some of the key features of the valuation rules proposed by this paper are highlighted below.
		3. Valuation of assets
		4. For a realistic valuation, assets are to be valued at their market value.
		5. For unlisted assets, whose market values are not available, a suitable discounted cash flow model that is marked to market may be used.
		6. Valuation of insurance liabilities
		7. Realistic valuation of insurance liabilities will require insurers to determine the best estimates of these liabilities. The best estimate shall be determined by projecting future cash flows using realistic assumptions, and then discounting these cash flows streams at appropriate interest rates.
		8. The assumptions used to arrive to these technical provisions shall include those for expenses, mortality, morbidity and lapses.
		9. An appropriate interest rate to use should be the risk free rate. Many markets in Africa are not liquid enough to define a suitable risk free rate. However, we recommend that the risk free rate be equal to the market yield of the respective regime’s government bonds corresponding to the term of the liabilities.
		10. In cases where such an instrument does not exist for the specified term of the liability, then interpolation may be used to derive the yield for that term.
		11. The level of with-profits business in Africa is rather low, and the above valuation shall therefore largely relate to all other conventional life insurance products.
		12. For unit-linked business, the liabilities shall be equal to the sum of unit and non-unit reserves. Non-unit reserves are set equal to the present value of future net cash flows, excluding those cash flows related to unit-reserves. The cash flows are projected using best estimate assumptions and are discounted at the risk free rate.
		13. In addition to the best estimate liabilities, insurers must adequately allow for risk margins. This is to introduce a degree of prudence to allow for possible adverse deviations in experience. Risk margins may be allowed for as compulsory additions to best estimate assumptions (as in South Africa’s CAR) or by using a cost of capital approach (as for Solvency II).
		14. Reserves need to be established for implicit and explicit costs of guarantees, e.g. investment guarantees, by use of suitable actuarial methods. Closed form formulas, like Black-Scholes, may provide appropriate estimates for the costs of these guarantees.
	3. **Capital requirements**
		1. The capital requirements proposed reflect the risks faced by a life insurance company and will act as an effective buffer to absorb losses.
		2. The framework should serve as an indicator of financial strength or weakness, and facilitate progressive intervention by regulators if need be.
			1. Capital Cover Ratio
				1. The Capital Cover Ratio (‘CCR’) measures the adequacy of the capital available in the insurance fund to support the capital required. This is calculated as follows:

$$CCR= \frac{Capital Available}{Capital Required} ×100\%$$

* + - * 1. Regulators in Africa may then decide on appropriate minimum level of CCR for their respective regimes but this is expected to be at least 100%.
			1. Capital Available
				1. This is composed mainly of the core capital available to an insurer and reflects the shareholders’ funds. The regulators need to ensure that the capital is available to meet any losses arising from the risks that insurers are exposed to.
				2. For example in Solvency II available capital is defined as Tier 1, Tier 2 and Tier 3 depending on the characteristics of the assets.
			2. Capital Required
				1. Capital Required (CR) consists of five components, as per Malaysian model, and is calculated as follows:

$$CR=Max \{C\_{1}, \sum\_{}^{}\left(C\_{2}+C\_{3}+C\_{4}+C\_{5}\right) \}$$

* + - * 1. The five components are each determined in terms of capital requirements as defined below:
1. $C\_{1}$ is the surrender value capital requirement
2. $C\_{2}$ is the credit risk capital requirement
3. $C\_{3}$ is the market risk capital requirement
4. $C\_{4}$ is the insurance risk capital requirement
5. $C\_{5}$ is the operational risk capital requirement
	* + - 1. The diagram below is a schematic representation of the relationship between available assets and capital requirement as per the proposed framework.



* 1. **Determination of capital requirements**
		1. Surrender value capital requirement ($C\_{1}$)
			1. This aims to address lapse risk in excess of the levels assumed in the calculation of reserves for the life insurer.
			2. For conventional insurance products this is defined as:

$$Max \{0, Surrender Value of inforce business-Policy Reserves\}$$

* + - 1. For unit-linked business, $C\_{1}$ shall apply if there are guaranteed surrender values that exceed the sum of the unit fund values and non-unit reserves at the valuation date.
		1. Credit risk capital requirement ($C\_{2}$)
			1. This aims to mitigate risk of losses resulting from asset defaults, related losses of income and the inability or unwillingness of a counterparty to fully meet its contractual obligations.
			2. The formula to compute $C\_{2}$ is as follows:

$$C\_{2}= \sum\_{i}^{}(Exposure\_{i} × Credit risk charge\_{i})$$

 where $i$ refers to the different exposures to counterparties in the fund.

* + - 1. The values of credit risk capital requirements for each exposure are based on South Africa’s CAR and are shown in table below:

|  |  |
| --- | --- |
| **Credit rating (*i*)** | **Risk charges** |
| Government Bond | 0.0% |
| AAA | 1.0% |
| AA | 1.0% |
| A | 4.1% |
| BBB | 5.0% |
| BB | 13.6% |
| B | 22.4% |
| CCC and below | 44.8% |

* + - 1. The above values are based on Standard & Poor’s International scale on South Africa’s Rand. Regulators in other African countries may obtain similar ratings for their respective regimes.
		1. Market risk capital requirement ($C\_{3}$)
			1. This aims to mitigate risks of financial losses arising from the level or volatility of market prices of financial instruments. Market risk will affect both assets and liabilities and consists of the following three risks:
* Equity risk
* Property risk
* Interest rate risk
	+ - 1. The formula to compute individual market risk capital requirement, $C\_{3}$, is defined as follows:

$$C\_{3}=(A\_{3}-A\_{0})-(L\_{3}-L\_{0})$$

* + - 1. $A\_{0}$ and $L\_{0}$ are respectively the base market value of assets and best estimate liabilities
			2. $A\_{3}$ and $L\_{3}$ are the adjusted assets and liabilities computed for each of the three market risks in turn as described below.
			3. For non-linked business, the stresses under equity and property risks will affect only the assets. The formula to compute individual market capital requirements for equity and property risks is as follows:

$$C\_{3}= \sum\_{i}^{}(Market Exposure\_{i} × Market risk charge\_{i})$$

 where $i$ refers to the different asset classes in the respective funds.

* + - 1. The values of market risk requirements for each asset class are based on South Africa’s SAM QIS1 and are shown in table below:

|  |  |
| --- | --- |
| **Asset class** | **Risk charges** |
| Equity | 53% |
| Property | 25% |

* + - 1. For unit-linked business, assuming the assets perfectly match the liabilities, the above risk charges apply to both assets and liabilities.
			2. Assets such as fixed income investments and financing instruments like loans are sensitive to interest rates movements. On the other side, the discounted value of future cash flows, in particular in the valuation of insurance liabilities, will be sensitive to a change in the rate at which those cash flows are discounted.
			3. The formula to compute the risk capital requirement, $C\_{3,int}$, for interest rate risk is defined as follows:

$$C\_{3, int}=(A\_{3,int}-A\_{0})-(L\_{3,int}-L\_{0})$$

* + - 1. $A\_{0}$ and $L\_{0}$ are respectively the base market value of assets and best estimate liabilities
			2. $A\_{3,int}$ and $L\_{3,int}$ are the adjusted assets and liabilities computed for interest rate risk using methodology described below.
			3. The stress factor for interest rates should be applied to the published risk-free rate. The stressed interest rate is derived by multiplying the best estimate interest rate by $(1+s^{up})$ and $(1+s^{down})$ where the stresses are as specified in table below:

|  |  |
| --- | --- |
| $$s^{up}$$ | 50% |
| $$s^{down}$$ | -50% |

* + - 1. These stresses are conservative and will need to be calibrated for each market.
			2. The amount of capital required is the higher of the reduction in surplus under the up and down rate scenarios.
			3. The market risk capital requirement is then derived by combining the three individual risk requirements using a correlation matrix as follows:

$$C\_{3}=\sqrt{\sum\_{}^{}CorrMkt\_{i,j}×C\_{3,i}×C\_{3,j}}$$

* + - 1. The correlation matrix $CorrMkt$ is defined as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Interest rate** | **Equity** | **Property** |
| **Interest rate** | 100% | 50% | 50% |
| **Equity** | 50% | 100% | 75% |
| **Property** | 50% | 75% | 100% |

* + - 1. The above correlations are borrowed from South Africa’s SAM QIS1. However, the correlation matrix will need to be derived for each market.
		1. Insurance risk capital requirement ($C\_{4}$)
			1. This aims to address the risk of under-estimation of the insurance liability, over and above the amount of best estimate liabilities. The life insurance risk requirements consist of the following five risk factors:
* Mortality
* Longevity
* Morbidity
* Lapse
* Expenses
	+ - 1. Insurance risk will only affect the liabilities. The formula to compute the risk capital requirements for each of the five life insurance risks is defined as follows:

$$C\_{4,i}=L\_{4,i}-L\_{0}$$

* + - 1. $C\_{4,i}$ is the individual risk capital requirement corresponding to life insurance risk *i*.
			2. $L\_{0}$ is the base market value of best estimate liabilities while $ L\_{4,i}$ is the adjusted liabilities computed for life insurance risk *i* using the stresses shown in table below:

|  |  |
| --- | --- |
| **Valuation parameter** | **Stress factor** |
| **Mortality** | 15% increase in best estimate rates |
| **Longevity** | 20% decrease in best estimate rates |
| **Morbidity** | 35% increase in best estimate rates |
| **Lapse** | 50% increase/decreases in best estimate rates |
| **Expenses** | 10% increase in best estimate rates, and 1% increase in best estimate inflation rate |

* + - 1. The life insurance risk stresses above have been taken from South Africa’s SAM QIS1.
			2. The adjusted values of liabilities may take into account impact of management action.
			3. The insurance risk capital requirement, $C\_{4}$, is then derived by combining the five individual risk requirements using a correlation matrix as follows:

$$C\_{4}=\sqrt{\sum\_{}^{}CorrLife\_{i,j}×C\_{4,i}×C\_{4,j}}$$

* + - 1. The correlation matrix $CorrLife$ is defined as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Mortality** | **Longevity** | **Morbidity** | **Lapse** | **Expenses** |
| **Mortality** | 100% | -25% | 25% | 0% | 25% |
| **Longevity** | -25% | 100% | 0% | 25% | 25% |
| **Morbidity** | 25% | 0% | 100% | 0% | 50% |
| **Lapse** | 0% | 25% | 0% | 100% | 50% |
| **Expenses** | 25% | 25% | 50% | 50% | 100% |

* + - 1. Similar to market risk, the above correlations are borrowed from South Africa’s SAM QIS1 and these will need to be derived for each market.
		1. Operational risk capital requirement ($C\_{5}$)
			1. This aims to mitigate the risk of loss arising from inadequate or failed internal processes, or from personnel and systems, or from external events.
			2. The formula to compute $C\_{2}$ is borrowed from Solvency II and is as follows:

$$C\_{2}=Min \left\{0.3 ×CR\_{-Op}, BOp\right\}+ 0.25 ×Exp\_{ul}$$

* + - 1. $Exp\_{ul}$ is the amount of annual expenses incurred during the previous 12 month in respect to unit-linked business
			2. $CR\_{-Op}$ is the preliminary capital required before allowing operational risk and, for the risk requirements $C\_{1}$, $C\_{2}$, $C\_{3}$ and $C\_{4}$ defined above, it is defined as:

$$CR\_{-Op}=Max \{C\_{1}, \sum\_{}^{}\left(C\_{2}+C\_{3}+C\_{4}\right) \}$$

* + - 1. $BOp$ is the basic operational risk requirement for all business other than unit-linked and is determined as follows:

$$BOp=Max \{Op\_{premiums}; Op\_{provisions}\}$$

 where

$$Op\_{premiums}=0.04 ×(Earn\_{life}-Earn\_{ul}$$

$$+ Max \{0, 0.04×$$

$$\left[\begin{array}{c}Earn\_{life}-1.1×pEarn\_{life}-\\\left(Earn\_{ul}-1.1×pEarn\_{ul}\right)\end{array}\right]\} $$

 and:

$$Op\_{provisions}=0.0045×Max \left\{0, L\_{life}-L\_{ul}\right\}$$

* + - 1. $Earn\_{life}$ and $Earn\_{ul}$ are the gross premiums earned for life and unit-linked business respectively during the previous 12 months.
			2. $pEarn\_{life}$ and $pEarn\_{ul}$ are the gross premiums earned for life and unit-linked business respectively during the 12 months prior to the previous 12 months.
			3. $L\_{life}$ and $L\_{ul}$ are the statutory best estimate for life and unit-linked businesses respectively.
1. **Illustrative example: Non-profit endowment policy**
	1. **Introduction**
		1. This section summarises the risk capital required to be held for a specific non-profit endowment policy as at 31st December 2010 under the above proposed risk based framework.
		2. Capital calculation has been examined assuming the insurer selling the product adopts three different investment strategies as follows:

|  |  |
| --- | --- |
|   | **Investment strategy** |
| **Asset class** | **1** | **2** | **3** |
| **Equity** | 10% | 30% | 60% |
| **Property** | 4% | 15% | 20% |
| **Government Bonds** | 70% | 40% | 5% |
| **Bond AA** | 15% | 10% | 7% |
| **Bond B** | 1% | 5% | 8% |

* + 1. Strategy 1 adopts a more conservative approach with most of its assets invested in low risk government bonds. Strategy 3 on the other hand adopts a riskier approach with a high proportion invested in equity.
		2. An insurer may use results of its risk based capital to decide on a most optimal investment strategy. This section will show how one may define a strategy that reduces its exposure to the different risks that it is faced with.
	1. **Product details**
		1. Let us consider a simple non-profit endowment policy with a term of 35 years. Consider a sample model point for a policyholder that is aged 30 as at valuation date, 31st December 2010, with a sum assured of 1,000,000 units of a currency. The policy has been in force for duration of exactly 10 years and premiums of 4,702 have been paid annually to the company.
		2. The valuation assumptions, that already include risk margins, are shown in table below:

|  |  |
| --- | --- |
|   | **Valuation basis** |
| **Mortality** | 100% of SA 56-62 |
| **Expenses** |   |
|  *Initial* | 8,000 |
|  *Renewal* | 1,300 |
|  *Expense inflation* | 5% |
| **Surrender rates** |   |
| *Year 1* | 25% |
| *Year 2* | 20% |
| *Year 3* | 15% |
| *Year 4* | 15% |
| *Year 5+* | 10% |
| **Interest rate** | 7.50% |

* + 1. Assume the policy has a surrender value of 15,000 as at valuation date.
		2. The impact of taxes and reinsurance shall be excluded from the analysis.
		3. The liabilities have been valued using a gross premium approach and these have a value of 19,274 as at valuation date.
		4. The insurer has assets that exactly match the liabilities in value, at 19,274. In addition, the insurer has other admissible assets not backing the insurance liabilities and these have market value of 25,000.
	1. **Results of capital calculation**
		1. We analyse the results of capital calculation for the above product based on the framework suggested in Section 4. For each of the five risk components described in the previous section, we look at how they impact the realistic balance sheet for the product for each of the three investment strategies described in Section 5.1.
		2. Component C1 – Surrender capital requirement
			1. The surrender value of the policy, as at valuation date, is 15,000 which is below the value of policy reserves of 19,274.The surrender capital requirement is therefore zero.
		3. Component C2 – Credit risk capital requirement
			1. Capital requirements for this component have been calculated based on table in Section 4.4.2.3. Results of capital requirements for each asset class and each strategy are shown in table below.

|  |  |
| --- | --- |
|  | **Strategy** |
| **Asset class** | **1** | **2** | **3** |
| **Government bond** | 0  | 0  | 0  |
| **Bond AA** | 29  | 19  | 13  |
| **Bond B** | 43  | 216  | 345  |
| **Total** |  72  |  235  |  359  |

* + - 1. As expected, Strategy 3 has the highest total capital requirement due to the high proportion of assets in the riskier Bond B asset.
		1. Component C3 – Market risk capital requirement
			1. For equity and property, the risk requirements are calculated based on table in Section 4.4.3.6.
			2. Interest rate risk capital requirement affected both the assets and liabilities. The fixed interest instruments were re-valued for the up and down interest rate stresses. The same approach was used for the liability re-valuation for each of the two interest rate stresses.
			3. Results of the capital requirements for the market risks are summarised in graph below:
			4. Strategy 1 show a high sensitivity to interest rates movements and this is due to the large proportion of assets in government bonds.
			5. Although Strategy 2 shows a higher sensitivity to equity markets movements, it seems the balance sheet is more stable on this strategy and produces the lowest total capital requirement for market risk.
			6. The total capital requirement for market risk for Strategy 3 is highest due to its risky approach. In this strategy, equity capital requirement is large due to the high proportion of assets in equity. The balance sheet is very sensitive to movements in equity markets.
			7. We note a fall in interest rates capital requirement from Strategy 1 to Strategy 2. Then this rises for Strategy 3. This is not expected because Strategy 3 has very low investments in fixed income instruments. However, there is a reason to this movement and this explained below.
			8. For interest rates risk, both the upside and downward stresses were tested and the most onerous scenario taken. For both Strategy 1 and Strategy 2, the upward interest rates stress was onerous. For Strategy 3, due to the low investment in bonds, the decrease in assets for the upward interest rates stress was very small compared to the corresponding decrease in liabilities. This produced a zero capital requirement. On the other hand, the increase in assets due to the downward interest rates stress was very small compared to the corresponding increase in liabilities. This produced a large positive capital requirement.
		2. Component C4 – Life insurance capital requirement
			1. Insurance capital requirements were calculated using methodology in Section 4.4.4. Results of these calculations are summarised in graph below:
			2. The insurer’s balance sheet is very sensitive to a reduction in surrenders. This is because of the high maturity payments to be made for lives that survive to end of term of policy. This is aggravated by the interaction between surrenders and low mortality rates.
		3. Component C5 – Operational risk capital requirement
			1. Operation risk capital requirement was calculated based on formula in Section 4.4.5. This resulted in a capital requirement of 188 under all the three investment strategies.
		4. Aggregate capital requirement
			1. The graph below summarises the capital requirements under each of the five components and for each of the three investment strategies:
			2. In all the three Strategies, the insurer’s balance sheet seem to be very sensitive to the life insurance capital requirement, C4, which is largely driven by the interaction of low surrenders and low mortality. The insurer may want to hedge this risk by selling more term assurance products.
			3. Component C3 for market risk appears more significant for Strategy 3 which has a high equity proportion. Strategy 2, which calls for low equity investment, appears more stable.
			4. The graph below summarises the results of Capital Cover Ratio for each of the three investment strategies:
			5. Strategy 3 has a CCR of 91% indicating that the insurer’s balance sheet is highly exposed and may require regulatory intervention. A reduction in equity investment is necessary.
			6. Strategy 2 has the highest CCR, of 123%, and seems a suitable strategy for the insurer to adopt so as to protect itself against adverse movements in its risk profile.
1. **Outstanding issues and conclusion**
	1. **Outstanding issues**
		1. As mentioned in earlier sections, the framework suggested for African insurers is not exhaustive but this paper sets out the tone for further discussion on how a suitable framework may be developed. There are number of issues outstanding that need to be addressed by practitioners and regulators and these are discussed below.
		2. Calibration of parameters and stresses
			1. The parameters used in this paper were borrowed from South Africa’s CAR, SAM QIS1 and Solvency II. The stresses used too were taken from the three frameworks. However, each African market will need to calibrate its own parameters and stresses based on data collected from their own regimes. The idea of this paper is only to present a RBC framework that may be used in an African market. Therefore, details of how the calibration may be conducted need to be assessed further.
		3. Treatment of with-profit products and non-life business
			1. The discussion in this paper dwelt on a simple life insurance product, but similar technique may be used for all other insurance products, including with-profits. The level of with-profits business in Africa remains at low but this should not preclude further discussion on how capital calculations may be carried out for this product. The same framework may too be extended for non-life products but due consideration need to be taken considering that the valuation approaches for life and non-life products are very different.
		4. Choice of risk-free rate
			1. A single risk-free rate has been proposed for use in liability valuation. However, a more modern approach is to use a curve based on yields on suitable government bonds. The stresses for interest rates may then vary according to bond terms as provided for in Solvency II and SAM.
		5. Treatment of reinsurance
			1. The proposed framework did not discuss the treatment of reinsurance. Under Solvency II, all liabilities are valued gross of reinsurance, with reinsurance incomes treated as assets in the balance sheet. This seems to be the approach that many other regulators are adopting and African regulators may opt to adopt the same methodology.
		6. Allowance for management actions
			1. Solvency II has allowed for management actions by requiring companies to calculate risk capital on gross and net of loss absorbing capacity of technical provisions. This mainly applies to participating business, which has still very low volumes in Africa markets. This allowance may be ignored for the initial stages of adopting a suitable risk framework.
		7. Consideration for other risks
			1. For African insurers investing, or having interests, in international markets, further currency risk need to be allowed for under the market risk component. This was not discussed in this paper as the aim was facilitate an easier understanding of the framework.
		8. Catastrophe risk was not discussed. Different methodologies have been discussed under Solvency II and SAM and African regulators may refer to these discussions to see if they may follow similar approach as for the two regimes.
	2. **Conclusion**
		1. Introduction of risk-based capital framework will highly benefit insurance industry in Africa. Using a solvency measure that is risk-based will lead to improved measurement and assessment of risk.
		2. Risk-based capital will enhance management of insurance companies thereby improving public confidence. Low uptake of insurance products has been partly blamed on poor management of insurers’ capital and RBC provides an avenue for African insurers to rectify this.
		3. By implementing risk-based capital, African insurers would be applying a framework consistent with global trend. This will enhance their competitiveness in the global insurance industry.

**References**

1. Aggregation techniques for Solvency II: A practical example – Highlights of the 2010life conference seminar - A presentation by Roger Simler and Gabi Baumgartner, Deloitte
2. Consultation Paper November 2003: Risk Based Capital Framework for Insurance Business – Monetary Authority of Singapore
3. Integrated Prudential Sourcebook for insurers (UK)
4. Measurement and Modelling of Risk Dependencies in Economic Capital by A.D. Smith *et al*
5. Modern Actuarial Theory and Practice by Booth *et al*
6. PGN 104: Life Offices – Valuation of Long-Term Insurers (South Africa)
7. Risk-Based Capital Framework – Malaysia model
8. Risk Based Capital versus Solvency II: A Singapore Case Study – 30 June 2009 by Wen Yee Lee and Mark Lim
9. Risk Models in Solvency 2 and Capital Allocation – A Master’s Thesis paper by Xiaodan Zhu, Heriot-Watt University, September 2007
10. Risk Geographies SunGard Newsletter: Joint Threats – Visualising Risk Interactions
11. Solvency Assessment and Management: First South African Quantitative Impact Study (SA QIS1) Technical Specifications
12. Stochastic Modelling: Theory and reality from an actuarial perspective – International Actuarial Association
13. QIS5 Technical Specifications for Solvency II
14. Quantitative Risk Management: Concepts, Techniques and Tools by McNeil *et al*
15. 2009 ASSA Convention – paper by Ashleigh Theophanides of Deloitte