The Revolution in Risk Management

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Over the last decade, the field of risk management has experienced a revolution. This revolution has affected the conduct of insurance business as well as the broader wealth management and financial services industries on a global basis.

This revolution has been characterised by the changes shown in the table in Figure 1.

FIGURE 1: CHANGES IN RISK MANAGEMENT

AREA	TRADITIONAL OLD WORLD	MODERN NEW WORLD
LIABILITY VALUATION		
FREQUENCY	*MONTHLY*	*DAILY*
METHODS	*DETERMINISTIC, MODEL POINTS*	*STOCHASTIC, PER-POLICY SERIATIM*
ASSUMPTIONS	*PRUDENT, SUBJECTIVE*	*BEST ESTIMATE, MARKET-CONSISTENT*
RESOURCES	*LABOUR-INTENSIVE*	*HIGHLY AUTOMATED*
ASSET VALUATION	**BOOK VALUE**	**MARKET VALUE**
PRODUCT LANDSCAPE	**OPAQUE PRICING AND BENEFITS**	**TRANSPARENT PRICING AND BENEFITS**
GUARANTEE FEATURES	**NOT VALUED NOR TYPICALLY EXPLICITLY CHARGED FOR**	**EXPLICITLY VALUED AND CHARGED FOR WITH MARGINS ABOVE ECONOMIC COST**
RISK MANAGEMENT		
METHODS	*ASSETS SEPARATE FROM LIABILITIES*	*REAL-WORLD REPLICATION VIA HEDGING*
RISK ASSESSMENT	*NONE TO LIMITED AND INFREQUENT*	*REAL-TIME, 24/7, HOLISTIC, AND DETAILED*
MITIGATION	*NONE TO LIMITED STATIC HEDGING*	*REAL-TIME, 24/7, DYNAMIC HEDGING*
REPORTING	*INFREQUENT, ACCOUNTING-FOCUSED*	*VERY FREQUENT AND DETAILED, ECONOMIC*
CAPITAL		
METHOD	*(MOSTLY) RISK INSENSITIVE*	*ECONOMIC CAPITAL; RISK SENSITIVE*
ASSESSMENT	*ONCE-OFF, ANNUAL*	*DAILY, CONTINUOUS MONITORING*
PLAYING FIELD	**MOUNTAINOUS**	**BECOMING LEVEL**

These changes have taken place incrementally over time, but, viewed collectively, they represent a seismic shift in the way financial services businesses operate from a risk and capital perspective. Some markets have clearly transitioned from the traditional to the modern world faster than others, whilst other markets such as Australia are still in the process of this transition.

The key drivers and catalysts of these changes have been:

- The acceptance of financial economic theory and the adoption of market-consistent techniques to value liabilities.
- The increased awareness of economic risks and returns, even if these are not being captured by regulatory or accounting measures, brought on by market events such as the recent global financial crisis (GFC).
- A scarcity of capital and increasing focus on maximising the returns on the economic capital.
- An acceptance by regulators of the need to level the playing field between countries, sectors, and product categories to minimise the occurrence of regulatory arbitrage and to improve the operational efficiency of the overall industry.
- The development of sophisticated modelling techniques and an associated improvement in technology, which has enabled the rapid valuation of large blocks of business.
- The development of products with guarantees, which have become an important part of the landscape in meeting the wealth accumulation and income generation needs of the retirement sector. This has forced the industry to price, value, and risk-manage these liabilities in a modern way.

In addition to the areas above, regulators across a number of markets have introduced risk-sensitive frameworks. These regulations, such as Solvency II and Basel III in Europe, AG43 in the United States, and potential changes to capital standards in Australia, have facilitated recognition of economic valuations within a number of industries, resulting in various opportunities.

RISK-SENSITIVE CAPITAL STANDARDS

One of the most important global developments for the insurance industry over recent years has been the adoption of risk-sensitive capital regulations. Examples of such standards include:

- Individual Capital Assessment in the UK
- Solvency II in the EU
- Swiss Solvency Test in Switzerland
- AG43 in the United States

Australia is following the lead of these countries and regions with the introduction by the Australian Prudential Regulation Authority (APRA) of similar risk-sensitive draft capital standards. The new standards will require capital to be held against asset, insurance, and operational risk categories, net of an aggregation (diversification) benefit. This capital amount will be a function of specific risk factor stresses prescribed by APRA, and may be subject to a supervisory adjustment by APRA if required. The diagram in Figure 2 outlines the overall structure of the proposed APRA capital requirements.

Under the APRA proposal risk capital for asset and insurance risks will be based upon instantaneous stress tests calibrated over a one-year horizon at the 99.5th percentile level. The asset risk factors will include stresses to the risk factors shown in Figure 3.

Compared to the existing capital framework, new risk factors will be added into the assessment of capital such as volatility risk, to ensure that all asset risk factors are included.

All of the new standards require market-consistent valuations of liabilities and capital that is a function of the risks the entity is exposed to. These risks cover a range of factors including market, insurance, health, counterparty, and operational risks.

FIGURE 2: PROPOSED APRA CAPITAL REQUIREMENTS

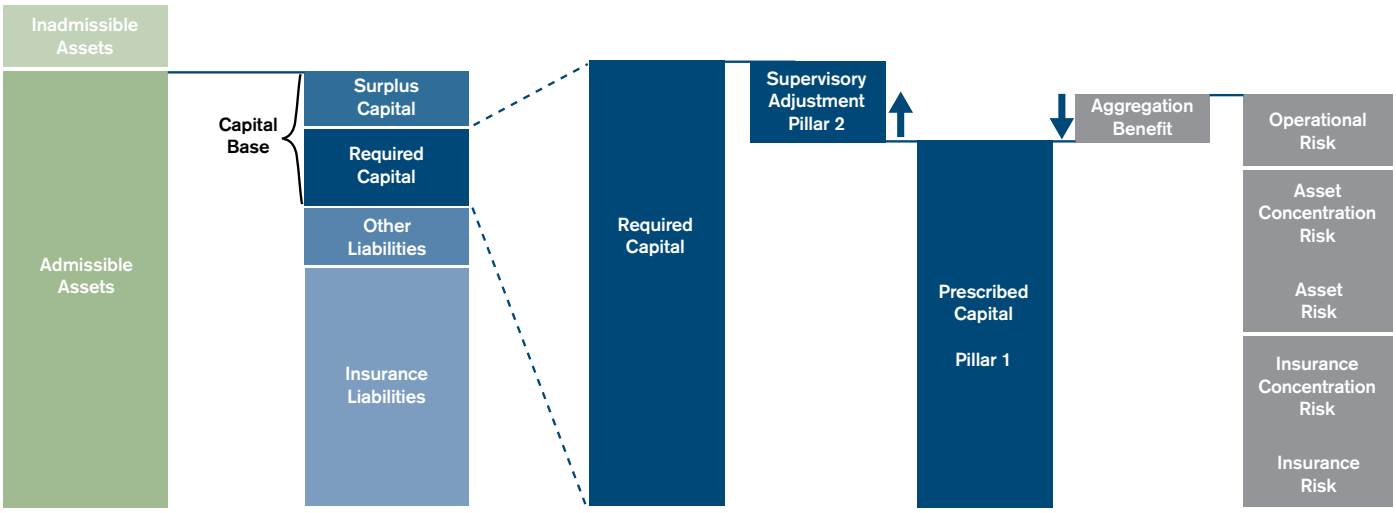


FIGURE 3: ASSET RISK FACTORS

RISK FACTOR	DIRECTION	RISK VARIABLE	NEW RISK FACTOR?
REAL INTEREST RATES	UP, DOWN	REAL YIELDS	NO
EXPECTED INFLATION	UP, DOWN	CPI INFLATION EXPECTATIONS	NO
CURRENCY	UP, DOWN	EXCHANGE RATES	YES
VOLATILITY	UP, DOWN	VOLATILITY ASSUMPTIONS (EQUITIES, CURRENCY, INTEREST RATES)	YES
EQUITY	UP	ASX200 DIVIDEND YIELD	NO
PROPERTY	UP	RENTAL YIELDS	NO
CREDIT	UP	CREDIT SPREAD YIELDS	YES
DEFAULT RISK	DOWN	VALUE	YES

The introduction of risk-sensitive capital requirements has resulted in a number of challenges and opportunities, including:

1. **Capital Assessment and Utilisation**
   - There is and will continue to be a drive towards capital efficiency to achieve acceptable returns on risk-based capital.
   - New systems and processes are required to calculate and monitor risks and capital.
   - There are incentives by regulators and rating agencies, such as lower capital or higher credit ratings, to adopt more sophisticated approaches aligned to the actual risk management of the business.

2. **Risk Management**
   - In order to justify the capital benefit of risk mitigation strategies, they must be deeply embedded in business and risk management decision-making processes (for example as required under Pillar II of Solvency II).
   - The application of hedging techniques and practices to enable the real-world replication of complex liabilities using capital market instruments. This is becoming a key core competency of insurance companies.
   - Risk management frameworks, systems, and processes are being reorganised to meet these challenges.
   - Existing in force business is being more effectively monitored and managed for risk.

3. **Product Development**
   - Risky products that are not appropriately risk managed will be penalised through high capital requirements.
   - New products are being designed with hedging in mind to be capital efficient, such as the development of attractive products with guarantees to meet retirement wealth accumulation and income generation needs.

CAPITAL ASSESSMENT AND UTILISATION

Utilising capital efficiently is central to the goal of generating attractive risk adjusted returns for shareholders. Competitive pressure exists on many fronts in order to achieve this. Regulators require capital to be held according to the amount of risk involved, whilst rating agencies penalise companies with insufficient capital relative to the business risks they run through lower credit ratings. Shareholders are careful in handing out scarce capital for management to execute business opportunities and demand high hurdle rates of return dependent upon the level of risk associated with each opportunity. Management can be faced with a large business opportunity set, and an assessment of the potential returns available based upon the amount of risk capital required is one of the main ways of determining which subset to invest in. In short, high demand for scarce capital means that deploying capital efficiently at the enterprise level is critical.

In order to utilise capital more efficiently, companies are turning to a number of techniques that manage the risks associated with each business activity. These include risk avoidance, risk reduction, hedging, or risk transfer.

Risk Avoidance

The simplest strategy is to avoid the risk by not selling new products with risk. Unfortunately, in many cases this means missing out on potentially significant opportunities. For many companies, risk mitigation starts with product design. Designing products with features that share some elements of risk with the customer is a central feature of modern risk management activities.

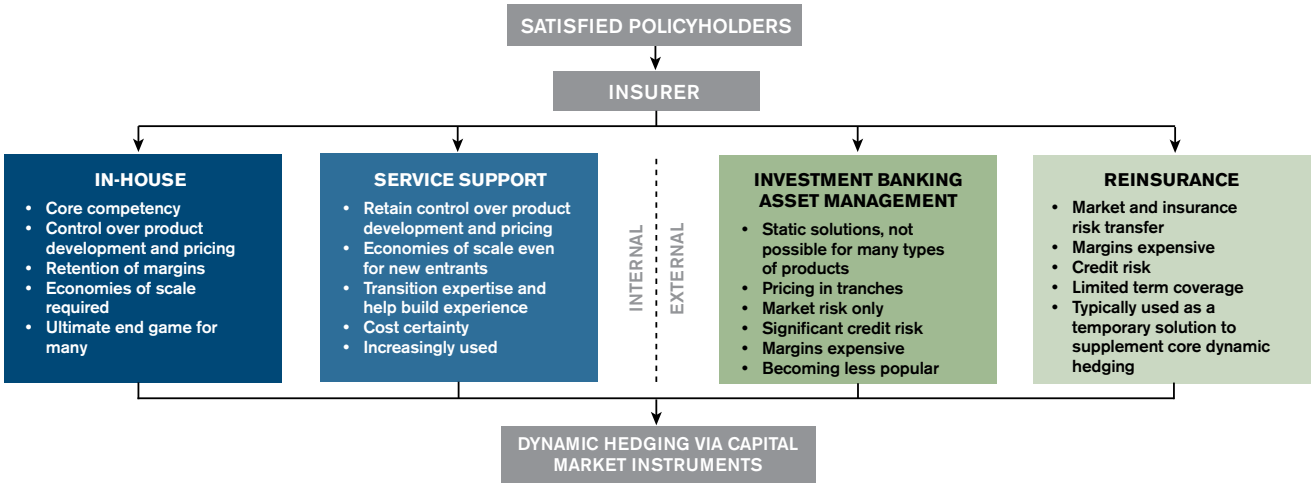
Risk Mitigation and Hedging

Risk mitigation through hedging is increasingly becoming a key core competency and source of competitive advantage of companies. Hedging involves the use of capital market instruments such as derivatives to replicate otherwise risky and capital-heavy liabilities. This can be achieved through either dynamic hedging, which continuously rebalances a portfolio of derivatives to replicate liability sensitivities, or, where possible, with (semi)-static approaches that use assets more on a hold-to-maturity basis.

Risk Transfer

The final alternative is to transfer the risks off the balance to a third party such as a reinsurer or investment bank. This has the benefit of removing the main risk source, although it does introduce a large counterparty risk. Importantly, no matter what risk mitigation path companies ultimately use, all risks end up being dynamically hedged in the capital markets. Hence dynamic hedging can be considered as the core driver of the cost of all higher-order risk management options. These concepts are illustrated in the diagram in Figure 4.

FIGURE 4: RISK MANAGEMENT OPTIONS AND CONSIDERATIONS



As regulatory capital (and liabilities) is now sensitive to market conditions, there are substantial benefits available from making improvements to methodologies, systems, and processes to monitor risks and capital frequently.

RISK MANAGEMENT

Operating within a risk-sensitive capital framework implies that risk management needs to transcend traditional asset-liability management (ALM) constructs. Instead, risk management becomes tightly integrated into the day-to-day operations of the business. Functional expertise is needed that integrates both sides of the balance sheet. Methodologies such as dynamic hedging, replicating portfolios, and liability driven investment (LDI) need to be used that manage assets and liabilities together on a consistent basis. An example of this is in the calibration of economic scenario generators used to stochastically value liabilities, whereby the asset calibration set is directly dependent upon the hedge instruments used to replicate the liability. Systems, processes, and governance structures similarly need to be restructured to accomplish this. Regulators are increasingly demanding that risk management become an integral part of the operations of the business.

Risk and Capital Management Frameworks for the New World

An important part of the new capital standards is the possibility of adopting internal models for regulatory capital assessment, as opposed to using the standard formula method. Where regulators are allowing the use of internal models, a key prerequisite in doing so is that the models must be used actively in the decision making process. Under Solvency II, this is known as the "Use Test." It is no longer sufficient for internal models to be solely used for capital assessment and removed from the ongoing risk management of the business. Instead, pressure must exist in the company for the models to be improved, with the intention being that this will be the case where the capital models are actively being used to make decisions in the ongoing risk management of the business. In this way, regulators are providing companies an opportunity to be in greater control of the financial circumstances of their businesses through the use of internal models, as long as they are aligned to ongoing risk management processes.

In addition to the move towards risk-sensitive economic capital measures under the new regulatory capital management frameworks (Pillar I), it is also a requirement for companies to ensure that risks are appropriately and continuously monitored and managed (Pillar II). An integrated risk and capital management framework is therefore a primary requirement of companies in the eyes of regulators and other third parties such as rating agencies.

Financial Risk and Capital Management

Emerging best practice in the risk management of financial risks is real-time risk and capital assessment and real-time risk mitigation via active hedging to replicate liabilities using capital market instruments. Whilst Milliman has helped companies to achieve this gold standard, there are many others who are at various stages of an evolutionary development. The diagram in Figure 5 characterises these stages. A key question for companies to ask is, "What stage are we at and where do we need or aspire to be?"

Real-World Prudent and Asset Liability Segregation

Traditionally liabilities were valued on a prudent basis using real-world assumptions around the expected return on backing assets, which incorporated risk premiums. Assets were then managed simply with the goal of maximising return, mainly in the context of risk being solely defined in terms of asset return volatility. The problem with this approach nowadays is that in many cases this leads to significant asset-liability risk and high capital requirements.

FIGURE 5: STAGES OF RISK MANAGEMENT

Risk neutral and Traditional ALM

This previous approach has been abandoned by a large number of countries in favour of a risk-neutral approach to the valuation of liabilities. This involves using risk-free rates to value all liabilities, thus removing the incentive to invest in risky assets simply to notionally reduce liability values. Liability valuation now becomes more comparable across various product classes. Accompanying this approach was a move to traditional ALM. ALM involves setting the investment strategy and benchmark with respect to the liabilities. This could be a simple index of the risk-neutral value of the liabilities, or it could use risk budgets to control the range of allowable asset allocations. The limitation of this approach is that asset-liability risks still persist, and that liability valuations can still be distorted because of the use of simple deterministic methods.

Market consistent and Matching

The solution to this problem has been the adoption of market-consistent valuation techniques. Liabilities are valued with respect to the price of market instruments, and stochastic techniques are used to value embedded options. The choice and calibration of economic scenario generators to capital market variables such as volatility surfaces becomes a central part of the valuation process. As the liabilities become extremely market or risk sensitive, the use of matching techniques to guide the investment process is typical in order to neutralise any potential asset-liability mismatch risks that give rise to capital charges. Matching is undertaken typically via physical rather than derivative instruments. Although this solves the most severe problems with the previous approaches, it is still significantly limited in dealing with any embedded options in liability portfolios.

Replicating Portfolios and Static Hedging

In order to deal with the embedded options in liabilities, replicating portfolio techniques are often used. Replicating

portfolio techniques can be used to find a set of physical and/or derivative assets that replicate the liability across a wide range of possible scenarios. The value of the liability is then the value of the replicating portfolio. The main benefit of this is that it may save significant computational time if assets can be found that can be valued using closed-form formulae, as opposed to computationally lengthy Monte Carlo methods. In an ideal world, tradable assets could be found and invested in to provide a static hedge, which eliminate most or all residual risk and thus minimises capital. However, in practice, there are significant challenges in finding a portfolio of theoretical assets that can be valued on a closed-form basis, and it is even more difficult to find such an asset portfolio that can be invested in directly. Nonetheless, the use of replicating portfolio techniques can provide valuable insight and understanding into the nature of the business, and clear guidance as to what risk mitigation strategies are likely to be effective. Numerous replicating portfolio techniques can be used, including direct option identification, optimisation methods, and Milliman's light and rapid stochastic MG-Hedge® valuation model.

Real world Replication and Dynamic Hedging

In order to overcome the difficulties and limitations with replicating portfolios and static hedging, it is necessary to replicate the liabilities in the real world using dynamic hedging techniques. This represents the ultimate end game and best practice in global risk management. Instead of trying to identify and invest in illiquid and potentially expensive complex derivatives via third parties, the liability is decomposed into its constituent risks, each of which is replicated directly by using simple and liquid capital market instruments such as futures and swaps. Any and all complex liabilities can be replicated this way, as the liability risk sensitivities can be determined analytically using stochastic techniques, and a portfolio of derivative assets can be dynamically managed to replicate them at all times over the life of the contract. Expertise, experience, systems, processes, and governance are critical in the ability to do this effectively. For those who are able to master or access it as a core competency, significant competitive advantages and capital efficiencies are able to be sustainably derived.

Achieving Global Best Practice

Different countries are at different development stages in the above development process. The US, UK, and European markets have generally led the way in establishing best practice, whilst emerging economies are generally at the bottom end. For Australia, although there are some Australian companies at each development stage, overall the level of development is moving towards the central part of the spectrum (from ALM to matching). Multinational companies tend to be significantly more developed compared to domestic companies, which is due mainly to their ability to leverage existing expertise and experience in other parts of the group in more advanced markets.

In most cases development towards global best practice mainly occurs because of catalysts such as changes to regulatory standards, M&A activity resulting in wholesale movements of business units from one company with expertise to another without it, crises that expose economic risks such as the GFC, and competitive pressures such as keeping pace with product innovation. For a specific company wishing to develop towards global best practice based upon a strategic plan, two main alternative approaches can be employed:

- **Direct**
  Directly developing a capability to replicate liabilities dynamically using dynamic hedging can be a significant undertaking. Milliman consultants are working with a number of companies to achieve this, which involves restructuring existing governance frameworks, systems, processes, and people. This typically involves a significant up-front capital expenditure.

- **Incremental**
  Gradually developing a capability by leveraging outsourcing services and transitioning these services internally as the expertise, experience, and systems are gradually developed. In this regard, it is typical to start out with a new block of business or small in-force block, and then gradually expand the scope of the operation once management is comfortable with the results and once the internal resources are in place. Again Milliman consultants are working with a number of companies in this regard. Capital expenditure under this model is spread over a number of years.

As a company climbs the development ladder, the system requirements, governance structures, processes, and, critically, the expertise and experience of key personnel increases. However, the reward for achieving best practice is a sustainable competitive advantage.

In order to achieve global best practice, it is necessary to adopt an integrated asset, liability, risk, and capital framework, along with the systems, people, and processes necessary to efficiently produce it. The goal of the framework is to:

- Produce ex-ante liability, asset, and residual risk exposures on a real-time basis
- Produce economic/solvency capital measures on a real-time basis
- Enable real-time risk mitigation strategies such as dynamic hedging to be executed
- Produce ex-post financial and performance attribution reports to explain movements in the balance sheet and the P&L
- Produce reports to enable the monitoring of risk mitigation strategies in detail

In order to produce this management information, the key operational activities that need to be undertaken include:

- **Nightly liability valuations**
  Use of either replicating portfolios or stochastic cash flow models on a per-policy seriatim basis in order to derive the full range of risk sensitivities on a nightly basis.

- **Real-time asset valuations and liability estimation**
  Live links into capital market databases such as Bloomberg enable assets to be valued and liabilities to be estimated on a real-time basis. Asset and liability risk positions can also be generated on a real-time basis enabling comparison to risk thresholds.

- **Real-time capital assessment**
  Various methodologies can be used to calculate or estimate

capital on a real-time basis and feed into dashboards for management to monitor. This includes capital on a post-stress basis, which can also be broken down by business class/block level.

- **Real-time risk mitigation and hedging**
  Translation of net risk measures into actionable hedge positions in tangible derivative assets is the key to effective risk mitigation. Operational trade management, execution, and back-office processes need to be well established.

- **Frequent and regular production of actionable management information**
  The production of both ex-ante and ex-post management information such as risk measures, capital measures, trade recommendations, financial reports, performance attribution reports, or experience analysis is critical to ensure the effectiveness of the risk management strategy.

In order to be able to operationally undertake these activities, systems, infrastructure, and people are required. Whilst these can be significant hurdles for some companies to acquire, it is possible to leverage Milliman's capabilities in this field through service support. The combination of MG-Hedge and the expertise and experience of our circa 90 specialist financial risk management (FRM) consultants make us the ideal partner in this regard.

In addition to greater capital efficiency, the other main benefit arising from the development of a capability to replicate liabilities via dynamic hedging is that it enables significant freedom and flexibility to develop new products and thus to stay ahead of the competition. Products can be designed with new features that can be directly risk-managed via hedging. This significantly speeds up the development process compared to the alternatives of having to use third-party risk management solutions.

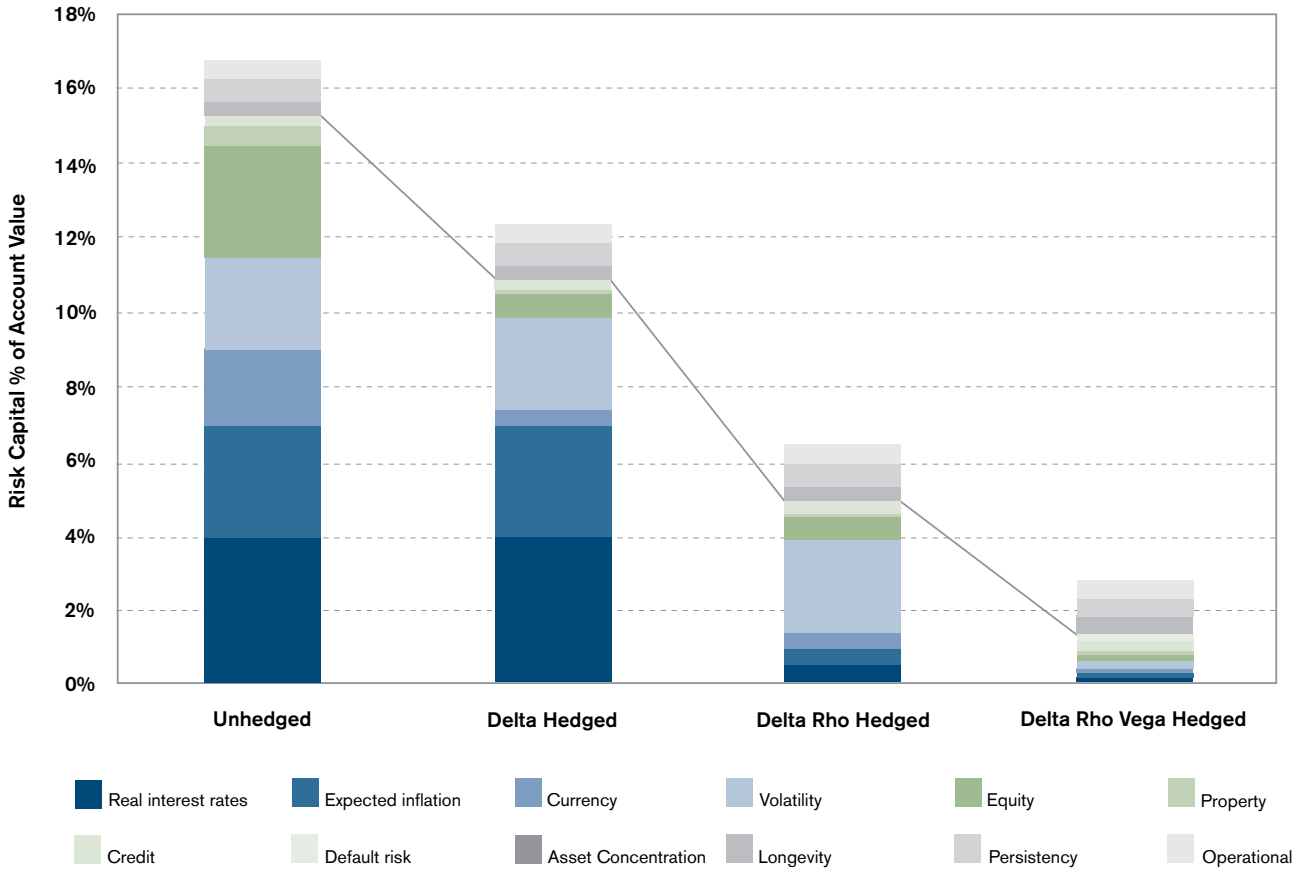
In order to demonstrate the effectiveness of alternative risk mitigation and hedging strategies, the graph in Figure 6 illustrates some indicative capital results for a lifetime unit-linked guaranteed product supported by alternative dynamic hedging strategies.

As can be seen, the choice of dynamic hedging strategy will clearly impact the residual risk that the company is exposed to and thus its economic capital. As such, the use of risk mitigation strategies such as dynamic hedging in order to replicate the liability is likely to become a central requirement of managing in-force insurance blocks as well as to developing new products on capital efficient budgets.

Governance and Enterprise Risk Management

Whilst the production of regular risk and capital analysis is central to the risk management framework, it alone is not enough. It is not sufficient to simply produce the analysis if it can't or isn't being used in management's decision making process.

FIGURE 6: IMPACT OF ALTERNATIVE HEDGING STRATEGIES ON ECONOMIC CAPITAL



Governance structures need to be in place in order for the right information to be made available at the appropriate time for management to make actionable decisions from it.

An effective governance committee such as a financial risk management committee or asset-liability committee (ALCO), comprising senior executives who can actively make risk management decisions, set risk and capital management policies and operational procedures, and communicate on risk management issues to both internal and external stakeholders is a key first step. Specialist line managers and their teams are responsible for the operational activities, processes, and systems needed to produce the management information (MI) required by the governance committee as well as to execute the risk management strategy.

Over recent years, Milliman consultants have been working with a number of financial services companies to put in place appropriate governance frameworks, and the processes and systems required to produce the MI to support it. Our GRC online platform and CRisALIS™ tools are ideally suited to meet the evolving governance and enterprise risk management (ERM) needs of organisations in this area. The GRC online platform is an advanced ERM information platform that can be used to actively monitor, track, validate, and report on all types of risks faced by an organisation at all levels of detail in an efficient, distributable, controlled, and flexible way.

Benefits and the Way Forward

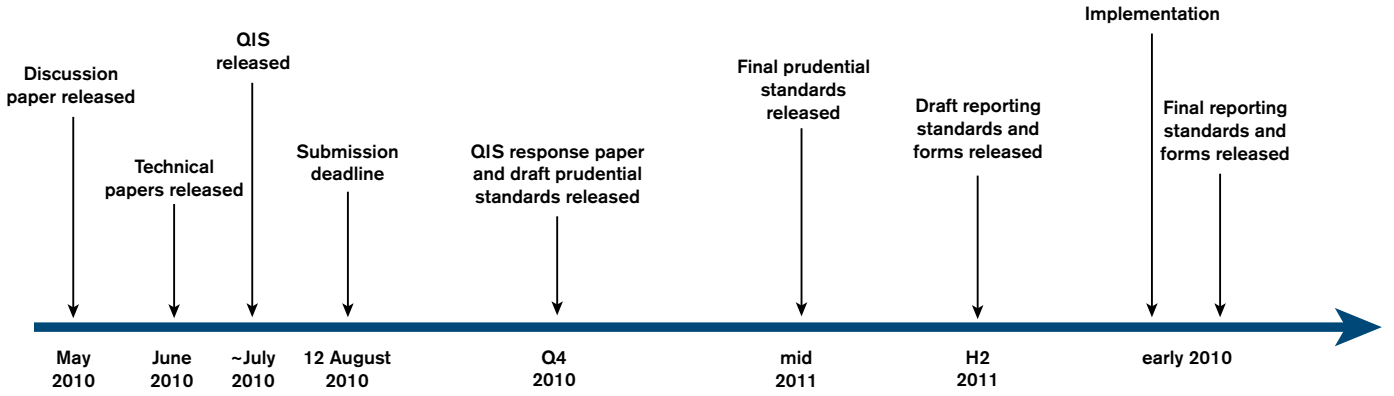
With the draft APRA capital standards released in mid-2010, there are only about 18 months before insurance companies are required to implement the standards in early 2012. The timetable for implementation is shown in Figure 7.

In the immediate term, companies will need to be responding to APRA on the draft standards, and planning for completion of the Quantitative Impact Study (QIS) in the second half of 2010. Planning and implementation of the necessary changes to risk management frameworks, systems, and processes will then occur in late 2010 and over the course of 2011. Given the experience of Solvency II, we would encourage companies not to underestimate the time, budget, and resource commitment it will take to achieve this within these tight timescales.

Establishing a plan of action to implement the APRA requirements in a way that also works towards bridging the gap to global best practice is the immediate challenge faced by companies. The benefits to the various stakeholders in doing so include:

- Benefits to management
  - More appropriate, detailed, and frequent information is available to manage the business
  - An economic perspective and framework is a better framework for understanding the value and risks of the business
  - The ability to manufacture attractive and rich guarantees, appropriately priced and risk-managed on capital-efficient budgets
- Benefits to the shareholder
  - Increased utility of and risk adjusted returns on s hareholder capital
  - Facilitates a stronger credit rating thereby reducing the cost of finance
  - Greater transparency of how risks are being managed
- Benefits to the policyholder
  - Access to a wide range of attractive products that are appropriately priced and risk-managed
  - Greater protection against the risk of the insurance company becoming insolvent

FIGURE 7: IMPLEMENTATION TIMETABLE FOR APRA CAPITAL STANDARDS



HOW MILLIMAN CAN HELP

Milliman consultants have the expertise and experience necessary to help companies navigate their way through the new APRA capital standards. Our consultants have firsthand experience in advising some of the largest multinational companies on new capital standards such as Solvency II, and in implementing the framework, systems, and processes that are necessary for it. Ways in which we are able to help companies in this regard and to upscale their capabilities include:

Advisory

Our risk and capital management advisory services include:

- Quantitative Impact Study (QIS) assessments for the new Australian insurance standards
- Advice and support on designing, building, and implementing:
  - Methodologies for internal models for capital assessment
  - Replicating portfolios for in-force and new business
  - Risk and capital management frameworks, systems, and processes
  - Enterprise risk management frameworks, systems, and processes

- Strategic and business planning for optimal capital utilisation
- Development of new wealth management products that are attractive, capital-efficient, and profitable, particularly around meeting retirement needs

Operational Process Support

One of our unique service offerings is support services for ongoing risk management operational processes. Our depth of experience and significant scale enable us to provide these services on a long-term partnership basis, at attractive costs relative to the cost of building the capabilities directly. These services include:

- Liability valuations and replicating portfolios
- Economic scenario calibration, generation, and validation
- Asset valuation
- Risk and capital monitoring
- Hedge management and trade execution, including 24-hour global capital market coverage
- Financial reporting, performance attribution, and experience analysis
- Enterprise risk assessment

We tailor the scope of these services directly to each company's unique needs, and offer flexible business model alternatives including expense risk sharing through asset-based fee structures. More than 30 companies globally utilise our services in the above areas.

Systems and Tools

Milliman offers a suite of systems and tools for the benefit of both our own internal use on client engagements, as well as to our clients through licensing arrangements. Our philosophy is to design, develop, use, support, and extend all of our systems to ensure that they and Milliman are the ideal solution to meet the long-term needs of our clients. Milliman's systems and tools used for risk management purposes include:

- MG-Hedge® is the leading platform for financial risk management.
- MG-ALFA® is one of the leading ALM actuarial platforms for valuations, projections, and reporting
- Technology solutions including grid computing and customised applications
- ERM systems including:
  - GRC online work platform–facilitates the management of enterprise-wide risks and fulfills regulatory and rating agency requirements
  - CRisALIS–assessing, understanding, and monitoring the interrelationships among all risks

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