DEVELOPING THE RISK APPETITE FRAMEWORK OF A GENERAL INSURANCE BUSINESS

Prepared by the Risk Appetite for General Insurance Working Party
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1 INTRODUCTION

1.1 Purpose of paper

It is important for businesses to have a well-articulated risk appetite framework to ensure they have considered the risks associated with their business plans, and have the resources to mitigate these risks should they arise.

The General Insurance Risk Appetite Working Party has written this paper to give practical assistance to a general insurance business operating in Australia in developing or reviewing its risk appetite framework. It is a guide to possible approaches and is not meant to be prescriptive.

There are few papers on this topic which specifically cover the general insurance industry. This paper gives both a general background to setting a Risk Appetite Framework within an institution’s Risk Management Framework, as well as specific general insurance examples for Risk Tolerances and Risk Limits.

The paper is set within the context of APRA’s regulatory framework in Australia.

We acknowledge the wide range of general insurance businesses operating in Australia which vary by size and complexity. No one approach will fit all and we recognise this where possible in the paper. We also recognise that best practice in relation to risk management and risk appetite is an area that is constantly developing and evolving and it is our hope that this paper is an aid to that development.

The writers recognise the substantial body of work carried out in relation to risk appetite. We have selected from that material, and have added some suggestions based on our experience and ideas.

We would like to thank the Life Insurance Risk Appetite Working Party, with whom we worked concurrently on this project, for their contribution and enthusiasm.

1.2 Historical Context

It is worthwhile to consider the context of risk appetite (and the risk reward trade-off) more generally before applying it directly to general insurance.

Humankind has always been familiar with the linked concepts of risk aversion, risk tolerance and risk appetite.

Utility theory – an economic concept codified in 1947 proposes that humans are rational agents, and hence:

- They are utility maximising – in that they seek to behave in a way that will maximise their expected utility. This introduces the concept of choice and uncertain outcomes (which will eventually morph into business strategies and risk),
- They are risk averse – they prefer a certain outcome with equivalent payoff to an uncertain outcome with the same expected payoff.

Within the realm of finance the work of Harry Markowitz in 1952 established a framework to consider the risk / reward trade-off in the context of investment portfolio construction. He advocated that rational beings should invest where the benefit of more risky investments (increased expected return from bearing risk) was consistent with the investor’s tolerance for bearing that additional risk.
Since the 1970s, research (under the general topic of Prospect Theory) has shown that this is not the case – most people fail the tests that defined a ‘rational agent’ with risk preferences that vary depending on the way the risk / reward options are presented. People are not always risk averse and are not particularly good at assessing the probabilities associated with uncertain outcomes – they have certain persistent biases that distort decision-making.

For example, underwriters may underestimate expected loss costs based on recent benign experience (an “availability bias”). This problem may be further exacerbated by agency risk whereby the underwriter’s remuneration does not align to the expected outcome (eg a bonus scheme that is asymmetric with respect to performance).

From this historical context we conclude that:

- Establishing a risk appetite is hard – Boards should aim to be rational in establishing a risk appetite but the people who comprise Boards may not be,
- Establishing a risk appetite is important – appetite must be set at the top and then cascaded down via effective tolerances and limits, and
- Risk appetite should be set in the context of the expected reward for risk taking – in a company context the profits arising from the business plans and strategies.

1.3 Risk Appetite in Enterprise Risk Management

Risk Appetite has been part of the Enterprise Risk Management (ERM) movement since its emergence in the 1990s – though as more of a bit player than a star performer. In 1996 Jerry Miccolis and Tim Quinn wrote a paper ‘What is your appetite for risk?’ which appeared in the magazine ‘Risk Management’. However, a 2003 paper by the US Casualty Actuarial Society on ERM failed to mention the topic at all. Text books on ERM published in 2003 also gave the area little attention.

In public finance, risk appetite gained greater credibility earlier. In the United Kingdom, the ‘Orange Book’ – published by the British Treasury in 2001 and titled ‘Management of Risk, a strategic Overview’ – included a reference to risk appetite in the modern context. It recognised that an institution’s willingness to accept risk should drive risk mitigation strategies.

By 2006 the concept of risk appetite (or risk tolerance - the two were used interchangeably) was beginning to find its way into insurance and risk vernacular. In October 2007 the International Association of Insurance supervisors (IAIS) issued its “Guidance Paper on Enterprise Risk Management for Capital Adequacy and Solvency Purposes” which first introduced the concept in a regulatory setting.

The Global Financial Crisis was the catalyst for an additional focus on risk appetite. In 2011 the FSB commented that effective risk appetite frameworks were not prevalent in financial institutions1. The IAIS meanwhile had adapted a Key Feature of its guidance note into a part of its Insurance Core Principle 8 on Risk Management and Internal Controls.

In November 2013 the FSB finalised its “Principles for An Effective Risk Appetite Framework” on which this paper leans for guidance and definitions.

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1 http://www.financialstabilityboard.org/publications/r_131118.htm
In December 2013, the North American CRO Council and the (generally European based) CRO Forum issued, in a paper “Establishing and Embedding Risk Appetite: Practitioners’ View”, ‘a variety of sound practices that can enable an institution to create an effective risk appetite framework’ for the insurance industry.

1.4 APRA’s expectations in CPS 220

APRA have responded to emerging requirements in banking and insurance through CPS 220, which was fully operational from January 2015.

APRA’s requirements in respect of risk appetite as set out in CPS 220 are:

- Paragraph 13 (a) requires the Board to define an institution’s risk appetite as a part of its Risk Management Framework. This is reinforced in paragraph 25(a);
- Paragraphs 13 (c), (e) and (h) require senior management to develop policies and controls, and to monitor all material risks consistent with, inter alia, the Risk Appetite Statement;
- Paragraphs 29 and 30 deal directly with risk appetite. Paragraph 29 requires the institution to maintain an ‘appropriate, clear and concise risk appetite statement that addresses its material risks’.
- Paragraph 30 sets out the minimum requirements of a risk appetite statement. It is reproduced verbatim below (additional bold text has been added by the authors of the Paper);
- Paragraph 47 (a) requires that a formal review consider whether the Risk Management Framework is consistent with the Board’s risk appetite;
- Paragraph 52(a) requires that the Risk Appetite Statement be provided to APRA on first adoption and after material revisions.

APRA set out the key requirements involved in the documentation and governance of the Risk Appetite Statement in paragraph 30 set out below.
Figure 1: Key APRA requirements in the documentation and governance of the Risk Appetite Statement

CPS 220: Paragraph 30

“30. An APRA-regulated institution’s risk appetite statement must, at a minimum, convey:

a) the degree of risk that the institution is prepared to accept in pursuit of its strategic objectives and business plan, giving consideration to the interests of depositors and/or policyholders (risk appetite);

b) for each material risk, the maximum level of risk that the institution is willing to operate within, expressed as a risk limit and based on its risk appetite, risk profile and capital strength (risk tolerance);

c) the process for ensuring that risk tolerances are set at an appropriate level, based on an estimate of the impact in the event that a risk tolerance is breached, and the likelihood that each material risk is realised;

d) the process for monitoring compliance with each risk tolerance and for taking appropriate action in the event that it is breached; and

e) the timing and process for review of the risk appetite and risk tolerances.”

APRA requires the Risk Appetite Statement to document the institution’s broad risk appetite (as defined by the Board), the risk tolerances to specific material risks, and the governance for setting monitoring and reviewing risk tolerance.

1.5 Structure of the paper

The paper has two parts to it. The first part (Sections 2 to 4) discusses the anatomy of a Risk Appetite Framework and sets out some criteria that can be used to assess the various components of a framework. The second part (Sections 6 and 7) discusses the steps required to set and implement the framework. Breaking down these parts into further detail:

Section 2 introduces the various components of the Risk Appetite Framework and defines the terms used in this paper.

Section 3 considers the risks facing a general insurance company.

Section 4 sets out considerations for establishing and maintaining an effective Risk Appetite Statement.

Section 5 discusses Risk Tolerances and Risk Limits and how these two key concepts relate to each other.

Section 6 considers the setting of a Risk Appetite Framework, and

Section 7 discusses how to embed risk appetite within the broader risk framework.
2 THE RISK APPETITE FRAMEWORK

One of the requirements of APRA’s Prudential Standard CPS220 is that an APRA-regulated institution must maintain a Board-approved risk appetite. In addition, the institution must maintain an appropriate, clear and concise Risk Appetite Statement that addresses its material risks.

In this paper the definitions for key risk appetite terms quoted in sections 2 and 3 were chosen after considering the definitions used by APRA and key international institutions.

We have tended to opt for the definitions advocated by the Financial Standards Board (FSB)2 where they have been considered to be appropriate. The FSB published a paper on the ‘Principles for an Effective Risk Appetite Framework’ in November 2013.

We also considered definitions recently proposed by the CRO Forum and the North American CRO Council3.

Further information regarding the approach adopted in determining the following definitions, along with information regarding the key international bodies mentioned above, can be found in Appendix A.

2.1 Principles

As a general insurer progresses through the process to develop, establish and use its Risk Appetite Framework, it needs to be conscious of certain guiding principles to ensure the framework is appropriate and effective. These principles are informed by the FSB’s publication “Principles for An Effective Risk Appetite Framework”.

These guiding principles are:

- Risk appetite should be built on an understanding of the institution’s Risk Capacity and strategic direction.
- Risk appetite should be integrated with the development of the institution’s strategy and business plans.
- Risk appetite should be clear enough for Board and management to use in the development of business planning.
- Risk appetite should be able to be communicated easily and effectively to all layers of the institution and externally.
- Risk appetite should be integrated with the risk culture of the institution.
- Risk appetite should explicitly define the boundaries for risk taking in pursuit of strategy at institutional, individual business and risk type levels.
- Risk appetite should be consistent both top down and bottom up and within a legal entity and a wider corporate group.
- The Risk Appetite Framework should be an integral part of the Risk Management Framework.
- Risk appetite should consider all material risks both in normal and stressed conditions.

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2 “Principles for An Effective Risk Appetite Framework”, FSB 18 November 2013
3 “Establishing and Embedding Risk appetite: Practitioners’ View”, CRO Forum December 2013
• Risk appetite should be monitored with sufficient frequency and efficiency to enable timely decision making in response to changes in the institution’s risk profile.

2.2 Risk Appetite Framework

The Risk Appetite Framework (RAF) describes the overall approach, including policies, processes, controls, and systems through which risk appetite is established, communicated, and monitored. The RAF should consider material risks to the financial institution, as well as to the institution’s reputation vis-à-vis policyholders, depositors, investors and customers. The RAF and the institution’s strategy should be aligned. An appropriate RAF should also enable Risk Appetite, Risk Tolerances, Risk Limits and risk profile to be considered at the legal entity level as well as within the group context.

Definition 1: Risk Appetite Framework

"The framework describes the overall approach (including policies and processes) through which risk appetite is established, communicated and adherence to the institution’s risk appetite is monitored."

The Risk Appetite Framework should incorporate the following elements:

• A Risk Appetite Statement,
• Tolerances and/or limits on the activities of the insurer designed to ensure that it operates within the Board-approved Risk Appetite,
• A process for ensuring that the tolerances and limits are set at an appropriate level given the appetite for risk set out in the Risk Appetite Statement,
• A reporting structure against the limits and tolerances,
• An outline of the roles and responsibilities of those overseeing the implementation and monitoring of the RAF,
• A method of cascading the limits and tolerances, where appropriate, down to business units while ensuring that they remain appropriate in aggregate, and
• A governance framework to ensure the ongoing integrity of the framework.

2.3 Risk Appetite

Definition 2: Risk Appetite

“The aggregate level and types of risk an institution is willing to assume, or avoid, within its Risk Capacity to achieve its strategic objectives and business plan.”

2.4 Risk Appetite Statement

The Risk Appetite Statement should, at the very least, articulate in writing the Board’s willingness to accept risk in the pursuit of its corporate goals and objectives.
Definition 3: Risk Appetite Statement

“The articulation in written form of the aggregate level and types of risk that an institution is willing to accept, or to avoid, in order to achieve its business objectives. It includes qualitative statements as well as quantitative measures expressed relative to earnings, capital, risk measures, liquidity and other relevant measures as appropriate. It should also address more difficult to quantify risks such as reputation and money laundering, as well as business ethics and conduct.”

Risk Appetite Statements are considered in more detail in Section 4 of the paper.

2.5 Risk Capacity

If we consider Risk Appetite as the institution’s willingness to accept risk (in the context of achieving its business objectives), then Risk Capacity can be viewed as an absolute maximum on risk taking imposed from outside the institution i.e. it is an exogenous constraint determined by such factors as minimum regulatory capital.

Definition 4: Risk Capacity

“Risk Capacity is the maximum level of and type of risk an institution is able to support before breaching constraints determined by regulatory capital and liquidity needs and its obligations to customers, shareholders and other stakeholders.”

2.6 Tolerances and Limits

Risk Tolerances define the boundaries for the maximum amount of each type of risk that an institution is prepared to accept. A tolerance sets out the overall quantitative and/or qualitative boundaries for a material category of risk. It is often expressed in the form of key metrics and targets, and is established after considering how much variability and risk-taking is acceptable in the pursuit of achieving strategic objectives. It is often described as the ‘line in the sand’ beyond which an institution will not move without prior Board approval. Another way to view tolerances is that they can be viewed as a constraint on business outputs.

Definition 5: Risk Tolerances

“Risk Tolerances are the quantitative measures and qualitative assertions for the maximum risk allowed by the appetite. Risk Tolerances are typically set at the enterprise level.”

Risk Limits are operational in nature and serve to translate the Risk Tolerances (contained in the Risk Appetite Statement) into practical constraints on business activities. In this sense they could be viewed as being constraints on business inputs. They are threshold controls designed to ensure that variation from expected outcomes will not exceed an institution’s Risk Appetite. Effectively applied, Risk Limits are the manner in which Management gives effect to the Board’s Risk Appetite, by curtailing activities that would contravene the overall Risk Appetite.
Risk Limits often relate to a subsection of the enterprise – such as business division or ‘material risk’. They are ‘no go zones’ – in effect, the way that a Board can progress from ‘we don’t want this to happen (Risk Appetite) to ‘you can’t do that’. Conversely, the enterprise should have a Risk Appetite that takes enough risk to meet the objectives of its shareholders.

In order to facilitate effective monitoring and reporting Risk Limits should at the very least be specific, testable and reportable. Risk Limits should also be tested to ensure they are effective in controlling Risk Tolerances.

2.7 **Risk Profile**

Risk Profile can be seen as a snap-shot of where an institution sits at a given time on the risk spectrum.

**Definition 7: Risk Profile**

“A point in time assessment of risk exposures, expressed in relation to Risk Limits, Risk Tolerances and Risk Capacity.”

Risk Profile relates to the risk exposures and the potential future outcomes. Two useful related concepts are:

- **Target Risk Profile** – The Board and management’s strategic exposure to each material risk, measured in an appropriate manner; and
- **Actual Risk Profile** – The actual exposure at any point in time

Actual and target risk profile may differ because (as an example) a material risk owner sees that the cost of laying off a risk is highly beneficial or the returns to bearing a specific risk are not there.

2.8 **A Reporting Structure for Risk Limits and Risk Tolerances**

Monitoring performance and risk exposures against Board-approved Risk Tolerances and Limits presents its own challenges.

Chief amongst them is the issue of sovereignty – should the risk owner report on a material risk or should it be centralised by the CRO? Most would argue that a risk profile goes across multiple risk types and needs to be presented holistically. If risks are not managed holistically, then interactions between risks may not be properly assessed. However, if this is the approach adopted, it is important that ownership of the risk remains with the appropriate person.

Another challenge deals with diversification (or aggregation) benefits. Even with so-called tail events (e.g. Black Swan events) there are some aggregation effects and
Risk Limits should be set considering these. How should diversification benefits be reflected in reporting? Either:

- The aggregation benefit is ‘allocated’ to each risk measure (a near arbitrary and always opaque exercise), or
- It is identified separately – leaving a potentially significant contributor to risk without a natural ‘owner’).

Each board will deal with this in its own manner.

2.9 Integrating Risk Appetite into the Broader Risk Management Framework

One would expect that a Risk Appetite would be a rather central part of any Risk Management Framework. After all, what use is it to identify a risk if we have no framework to determine if it is acceptable or not?

Risk Appetite is an early part of any risk management process. After identification, assessment is against a question around ‘how much of this risk are we willing to bear’.

A formal Risk Appetite Statement allows this question to be addressed in a consistent manner, and facilitates cascading the appetite throughout the institution.

2.10 A governance framework to ensure the ongoing integrity of the framework

The FSB wants the Board to approve the Risk Appetite Statement – and we agree. However we would argue that this is one area where Board involvement in the development of the Framework is essential. We don’t believe a paper drafted in isolation then sent to the Board for approval will be meaningful. By their nature the Risk Tolerances should lie on the boundary of what is acceptable to the Board – and the Board must be consulted early on in the piece to ensure they approve a document that reflects their combined appetite for risk.

Other key stakeholders are the risk owners – the officers within the company responsible for managing each material risk. Risk Limits are imposed on risk owners in the pursuit of profit, for example the Chief Investment Officer often has responsibility for implementing any market risk positioning. Risk owners should be engaged early to ensure that any Risk Limits:

- Are easily understood (i.e. use the language the manager uses everyday in communicating with their staff),
- Make sense (that is, they are meaningful, relevant and consistent), and
- Are measurable. Arguments about how to calculate a specific Risk Limit should not be conducted in front of the Board!

One approach to this is for the relevant risk owner and CRO to jointly propose Risk Limits to the Board in a paper that addresses strategy, performance targets and limits for that particular risk.

2.11 How should the Risk Appetite cascade down?

This paper deals primarily with the task of establishing a Board-approved Risk Appetite and giving force to that appetite via carefully constructed tolerances and limits for key material risks. It deals with the obligations of the Board in relation to this. Once established, the appetite must cascade throughout the institution to influence the risks actually taken within the organisation.
A call centre operator with the authority (and training) to exercise discretion to spend money to deal with customer complaints can generate much goodwill and return custom for an institution. The risk / return trade-off that call centre operators choose is a microcosm of the decisions made by the Board.

We see two separate but related areas:

- The requirement that the risk exposures actually borne by the institution remain within the appetite, by limiting the exposure and activities via Risk Limits, and
- Promoting a culture that encourages a consistent understanding and assessment of risk taking throughout the institution. This should drive an alignment of the individual propensity of managers and others to bear risk with the collective institution’s willingness and capacity to bear risk.

The further down the institution appropriate risk taking can be cascaded, the greater the potential gain – think about the call centre operator. However risk taking implies the exercise of discretion and there must be limits (consistent with the Board approved appetite) on this discretion. In practice, these limits will be articulated as limits in delegated authorities, specific policies and procedures.
3 RISKS FACING GENERAL INSURERS

3.1 Sources of risk for financial institutions

In order for a Risk Appetite Framework to be executable and effective, consideration must be given to specific sources of risk. Underpinning any Risk Appetite Statement and framework is the recognition that adverse outcomes are possible. Without proper identification of the sources of these outcomes, the risk framework may be ambiguous and of little practical value to the institution.

Categorisation of risk into discrete types allows practical procedures to be developed for the risks to be assessed, monitored and reported.

The spectrum of risk facing financial institutions may generally be categorised into the following risk types (Paragraph 28 of CPS 220):

- **Credit Risk**: The risk of loss arising from failure to collect funds from creditors, including reinsurers and intermediaries.
- **Market and Investment Risk**: The risk arising from all aspects of the value of investments and currencies, including interest rate changes, market price changes, counterparty default, and exchange rates.
- **Liquidity Risk**: The risk that a company may be unable to meet short term financial demands. This usually occurs due to the inability to convert a security or hard asset to cash without a loss of capital and/or income in the process.
- **Insurance Risk**: The risk of loss due to actual experience being different than that assumed when an insurance product was designed and priced.
- **Operational Risk**: The risk of loss resulting from inadequate or failed internal processes, people and systems.
- **Strategic Risk**: The risk arising from an institution’s inability to implement appropriate business plans and strategies, or adapt to changes in its business environment.
- **Other risks**: Risks that, singly or in combination with different risks, may have a material impact on the institution.

In some cases, certain risks may be classified under several categories. For example, aspects of Market Risk related to counterparty default may be considered as part of Credit Risk instead.

In relation to Operational Risk, it is important to recognise that the above definition is very broad and as a result may overlap with other risks unless defined more clearly. For example, any failures which may occur in the claims processes could be defined as part of Insurance Risk rather than Operational Risk. Operational risk may also include Regulatory, Compliance and Reputation Risks.

It can be difficult, or practically impossible, to differentiate poor decisions (which may be considered to be operational risk) from appropriate decisions combined with poor luck. Typically in the absence of evidence of inappropriate decision making (in light of data that was, or should have been, available) these outcomes are normally allocated to insurance, market or credit risk.
3.2 Materiality of Risks for General Insurers

The range and materiality of risks for general insurers will vary by institution and depend on their asset and the liability profile.

- **Insurance Risk**
  - Usually the most material risk for general insurers. It consists of:
    - Underwriting Risk – Non Catastrophe: the possibility that future insurance exposures (both from business in force and future business) will be loss making.
    - Underwriting Risk – Catastrophe Risk: natural or man-made events that produce insurance losses from many insureds at the same time. Although Catastrophe Risk is considered part of Underwriting Risk, it is modelled separately due to its highly uncertain nature and potential to cause extreme losses.
    - Reserving Risk: the possibility that the provisions for outstanding claims will be inadequate to meet the ultimate costs as the business runs off.

- **Market and Investment Risk**
  - Includes movements in the market value of assets, duration and/or currency mismatch risk and typically includes credit risk on investment assets.
  - Less material than insurance risk for most Australian general insurers which tend to have relatively modest exposures to volatile assets and typically hold highly rated credit.
  - Risks relating to inflation will typically be picked up within Insurance Risk to the extent that they impact insurance liabilities and Market Risk to the extent that they impact assets.

- **Credit Risk**
  - Consists primarily of risk related to non-receipt of reinsurance recoveries (for example due to reinsurer impairment) and exposures to other counterparties (for example premium debtors).
  - Also relates to investment risk (over-the-counter derivatives counterparties) and in commercial contracts (payment in advance for provision of software development services, for example).
  - Materiality depends strongly on the reinsurance arrangements (both past and current) and the creditworthiness and spread of reinsurance counterparts. Typically a low probability but high severity risk.

- **Liquidity Risk**
  - Generally not material for general insurers, although post Global Financial Crisis the liquidity of debt market has reduced considerably; General insurers are not subject to rapid uncontrolled outflows of cash due to the risk of lapses (life insurers) and withdrawals (banks). Liquidity concerns could arise, if not managed, from the difference between paying claims and recovery under reinsurance contracts.
  - The main cashflow stress for an insurer would relate to catastrophe risk and corporate actions initiatives (share buybacks, dividend payments and acquisitions).
  - Liquidity risk can arise in multi-national companies where the capital to meet variations in claims experience reside in a different regulatory regime to the that in which the claims are payable.

- **Operational Risk**
All financial institutions by definition are subject to operational risk. Many operational risks in insurers are to an extent boundary risks, i.e., they could also be classified as other risk types. External claims fraud and claims handling errors, for example, may be considered insurance risk and captured there rather than operational risk. Boundary risks are best allocated to the risk type that facilitates appropriate risk management.

- **Strategic Risk**
  - All financial institutions by definition are subject to strategic risk.

### 3.3 Measurement/Modelling Approaches

The maturity of modelling techniques available to measure the risks set out above varies greatly between well-established and emerging ones. There are relatively well-established and generally accepted modelling techniques to measure Market, Insurance, and Credit risks. The measurement of Operational Risk is still an emerging area with a variety of approaches, some of which are largely qualitative. The potential impact of Insurance Risk can be modelled with stress and scenario testing based on the general insurer’s portfolio and best estimate assumptions.

Even where well-established modelling techniques exist to measure a particular risk, levels of sophistication adopted by individual insurers can vary greatly due to factors such as availability of data, access to proprietary modelling software and technical knowhow and the setting of best estimate experience assumptions and stress scenarios.

### 3.4 Risk Dependence

Once individual risks have been measured, they must be aggregated in order to produce a view of the institution’s overall risk profile. This poses significant challenges.

Adverse outcomes in one risk do not always coincide with adverse outcomes in other risks. This results in a degree of diversification between risks. In establishing the level of diversification between risks, it is more common to focus on dependence, which is the opposite of diversification, and consider the particular drivers of dependence between individual risk pairs. Dependence between risks may vary significantly between institutions, depending on their individual circumstances. Dependence assumptions used in modelling are difficult to base, to any reasonable extent, on observable data. Therefore, qualitative methods are most commonly used to identify drivers of dependence and assign levels of statistical correlation.

One of the key challenges in making assumptions on dependence between risks is identifying a combination of risks that may experience “tail dependence”, where there is a relatively high likelihood for extremely adverse outcomes to coincide. An example of this may be the default of a reinsurer as a consequence of a natural catastrophe which should also generate a large reinsurance recovery.

Another may be a severe global economic downturn which may:

- Impact the market value of the insurers investments;
- Impact the credit worthiness of reinsurers, and some commercial clients;
• Impact claims costs (potentially both financial lines and workers compensation claims could increase);
• Impact volumes of business (less economic activity means, for example, lower payroll which means less workers compensation insurance premium).

3.5 Model limitations

All models used to inform the Risk Appetite Framework must be understood to have limitations. A model is only an approximation of reality and the nature of probabilistic models used to inform risk decisions is that the estimated probabilities of adverse events, especially those in the tail scenarios, can be highly uncertain.

3.6 Key Modelling Considerations by Risk

• Insurance Risks
  o Reserve and Underwriting (non-cat) Risks:
    ▪ Relatively advanced statistical techniques like bootstrapping and statistical loss fitting are available. But how reliable are they with a limited number of years of data, changing market conditions and policy conditions, changing claims processes etc?
    ▪ The approach for making allowance for systemic risk is reasonably consistent in the Australian actuarial profession, but is highly subjective. It is borrowed from the risk margins framework which focusses on 1:4 year adverse outcomes not ones which can cause large capital deterioration / regulatory breaches.
    ▪ Dependence between classes of business is very important to allow for but it is difficult to set assumptions.
  o Catastrophe Risk
    ▪ Sophisticated models are used, using a combination of first principles science and historical experience. There is often wide variation in outputs between different vendor models.
    ▪ Vendor models in Australia are primarily focused on ‘peak’ natural perils most likely to cause very large losses, and smaller natural perils do not receive as much focus and investment.
    ▪ Non-natural peril accumulations are currently at a far less developed stage than the modelling of natural perils.
    ▪ Effort is needed to ensure the outputs from these complex models are presented in a suitable way so as to be clearly understandable to senior management and the Board.

• Credit Risk
  o There are well established modelling techniques but these still rely on highly uncertain estimates of default and credit transition probabilities and the potential for loss given default. Historical data is of limited reliability due to the infrequent nature of defaults of highly rated reinsurers, as well as variability over time of the economic and insurance market environment.
• Market Risk
  o There are many well established modelling techniques, but the extent to which these are employed can vary greatly across the industry, with some insurers using basic approaches.
  o For internal modelling purposes it is common practice to license an external vendor Economic Scenario Generator.
  o It is important to match the sophistication of the market risk modelling tools to the sophistication of the underlying exposures.

• Operational Risk
  o Measurement is less certain, mainly due to the complexity in modelling the risk drivers and the difficulty in compiling representative, historical event sets.
  o The lack of robust data means that modelling of operational risk is usually dependent on expert judgement such as scenario analysis.
  o Approaches range from completely qualitative through moderately sophisticated statistical loss models, to sophisticated Bayesian techniques.

• Strategic Risk
  o Reputational risk is a significant risk but is difficult to quantify.
  o The implementation of major systems or other projects may present a strategic risk to the business.
  o Disruption is of increasing concern within the strategic risk category, for example digital disruption in insurance distribution.
4 THE RISK APPETITE STATEMENT

4.1 Introduction

The Risk Appetite Statement (RAS) is the key document that articulates the Board’s appetite for risk and which influences the whole institution’s approach to taking on and managing risk.

This paper only considers the Risk Appetite Statement for single entity institutions. There are various ways to integrate a RAS created at a group level to a legal entity or business level.

The role of the Risk Appetite Statement in an institution’s Risk Management Framework is also discussed later in this Paper.

4.2 Risk Appetite Statement Definition

The Risk Appetite Statement has been defined earlier in this paper, and is repeated here for convenience:

**Definition 3: Risk Appetite Statement**

The articulation in written form of the aggregate level and types of risk that an institution is willing to accept, or to avoid, in order to achieve its business objectives. It includes qualitative statements as well as quantitative measures expressed relative to earnings, capital, risk measures, liquidity and other relevant measures as appropriate. It should also address more difficult to quantify risks such as reputation and money laundering as well as business ethics and conduct.

The Risk Appetite Statement should, at the very least, articulate in writing the Board’s willingness to accept risk in the pursuit of its strategic objectives.

CPS 220 (specifically paragraphs 29 and 30) sets out APRA’s expectations for the minimum content of the Risk Appetite Statement.

Paragraph 30 states that the Risk Appetite Statement should convey:

- “the degree of risk that the institution is prepared to accept in pursuit of its strategic objectives and business plan, giving consideration to the interests of depositors and/or policyholders (risk appetite)”; and
- “for each material risk, the maximum level of risk that the institution is willing to operate within, expressed as a risk limit and based on its risk appetite, risk profile and capital strength (risk tolerance).”

We note that shareholder interests are not considered in APRA’s paragraph 30. It seems obvious that the Risk Appetite Statement must also consider the interests of shareholders (or other owners) of the business.

APRA’s intention is for the Risk Appetite Statement to be a truly “Board-owned” document. It is the Board’s responsibility to define, establish and approve an institution’s risk appetite (CPS220 paragraphs 13a and 29).
The Board’s strategic and business decisions need to be consistent with the Risk Appetite it has framed. Therefore the Risk Appetite Statement should be directly linked to the institution’s strategy. It is also therefore important that the level of risk taken on by an institution is consistent with and sufficient to meet the strategic goals as per the business plan. A Risk Appetite Statement might therefore also include commentary regarding what actions should be taken if insufficient risk is accepted to meet the strategic objectives.

4.3 Stakeholders

In setting the Risk Appetite Statement, the Board should consider the institution’s stakeholders and their expectations. The Risk Appetite Statement needs to be understood by all stakeholders and it must be readily cascaded down to all levels of the institution.

The key stakeholders other than the Board and their interests in the Risk Appetite Statement are shown below:

**Figure 2: Key stakeholders in the Risk Appetite Statement**

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shareholders</td>
<td>Solvency, earnings volatility, franchise value, reputation and liquidity</td>
</tr>
<tr>
<td>Policyholders</td>
<td>Solvency, liquidity, quality of service, reputation</td>
</tr>
<tr>
<td>Debt holders</td>
<td>Solvency, debt rating, leverage, liquidity</td>
</tr>
<tr>
<td>Regulators</td>
<td>Solvency, compliance, security of policyholder obligations</td>
</tr>
<tr>
<td>Employees</td>
<td>Solvency, earnings volatility, growth, reputation</td>
</tr>
</tbody>
</table>

4.4 Characteristics of a good Risk Appetite Statement

The characteristics of a good Risk Appetite Statement include:

- A holistic statement that sets out an entity’s willingness to take on risk;
- Owned by the Board;
- Forward-looking – a view of risk that reflects and informs strategy;
- Consistent with the entity’s risk framework and strategy, and internally consistent in itself;
- “Tight” wording – allows for effective and proactive monitoring;
- Contains quantitative statements where possible;
- Cascadable – can be made relevant to all staff and ties to risk culture; and
- Usable and consistent with day-to-day business decision-making.

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4 CRO Forum
The Risk Appetite Statement should be reviewed annually, however, to ensure it remains appropriate, but it should also be reviewed:

- If Risk Tolerances are breached,
- If there are material shifts in the institution’s business, or
- If there are material shifts in strategic opportunities, or material shifts in market conditions.

The Risk Appetite Statement should be reviewed in conjunction with any strategic review that is undertaken by an institution.

4.5 Overall Design of the Risk Appetite Statement

There is no a “one size fits all” design and structure for a Risk Appetite Statement. Institutions of different sizes and degrees of complexity will have different requirements. There will be material differences between the Risk Appetite Statements of a small mono-line insurer writing risks only in Australia, a multiline insurer with branches and subsidiaries in many countries, and an Australian branch of a large global insurer.

There are a number of ways of structuring the Risk Appetite Statement. These include:

1. A document which includes both the high level Risk Appetite Statement and associated Risk Tolerances and Risk Limits.

The Risk Appetite Statement is a Board-approved document. Therefore, it should be written so that it facilitates discussion with the Board and enables the Board to agree whether it appropriately reflects the institution’s appetite for risk. In addition a good Risk Appetite Statement would enable a new director to quickly and correctly grasp an institution’s Risk Appetite after reading the Risk Appetite Statement.

The Risk Appetite Statement should include the following key elements:

1. It should be clearly linked to the institution’s short and long term strategic plans and the associated capital and financial plans.
2. It should establish the amount of risk the institution is prepared to accept in pursuit of its strategic objectives and business plan while considering any relevant constraints.
3. It should clearly articulate the types of risk that the institution is willing to accept as well as the risks it is not willing to accept.
4. It should determine for each material risk (where appropriate) the maximum level of risk (the Risk Tolerance) that the institution is willing to operate within based on its Risk Appetite.
5. It should include both quantitative measures and qualitative statements. The quantitative measures will likely include Risk Tolerances for the enterprise level
risks and/or material risks. Qualitative statements will likely cover risks that are not as easily measured such as reputational risks.

6. It should include an overview of the main risk classes faced by the institution. An institution may choose to have individual Risk Appetite Statements for each of these risk classes.

As mentioned above, there are a number of ways the Risk Appetite of an institution can be articulated in a Risk Appetite Statement. A popular approach is to have an over-arching Risk Appetite Statement approved by the Board which contains details of the Risk Appetite, along with relevant Risk Tolerances and Risk Limits, for the key enterprise risks as determined by that institution.

Flowing down from this over-arching RAS, there might also exist an individual RAS for each of the material risks for that institution such as Asset Risk, Operational Risk etc. It is likely that these statements would also include relevant Risk Limits which have also been approved by the Board. Risk Tolerances may also exist at this level but in some cases it may not be practical to determine Risk Tolerances for all risks at this level.

Another level of Risk Appetite Statement might also exist where a Risk Appetite Statement for each business unit has been drafted. This may or may not be a Board-approved document; however, the business unit Risk Appetite Statement should be consistent with the higher level Board approved Risk Appetite Statement.

Many existing policies are logically part of the Risk Appetite Framework.

4.6 Format of the Risk Appetite Statement

There are a number of ways of setting out the elements that should be considered when defining an institution’s Risk Appetite. Boards have considerable flexibility in how they define their Risk Appetite and the type of and amounts of risk they choose to have exposure to. However, they are limited to operating within their Risk Capacity.

The Risk Appetite Statement should cover a small number of what the Board considers to be its key risks. These risks can take various forms:

- Whole company risks – profit, insurance margin, regulatory capital,
- Industry specific risk categories – insurance risk, investment risk, operational risk etc. and
- Specification of business operations e.g. only one industry, not outside core business etc.

4.6.1 CRO Forum Suggestion

The CRO Forum suggests using the four broad categories of risk listed below5.

1. Achievement of target performance,
2. Preservation of capital,
3. Maintenance of liquidity, and
4. Protection of franchise value.

An example of a Risk Appetite Statement set out in this format as provided by the CRO Forum is set out in Appendix B.

These types of risks are ‘Enterprise Risks’, Board level risks, which are not confined to one source. They reflect an aggregation of an underlying (and different) set of “source risks” such as insurance risk, asset risk, credit risk, operational risk etc.

In so far as is practical, for each of these four risks, there should be a clearly articulated qualitative or quantitative bound, or Risk Tolerance. This is essential for the interpretation and the monitoring of the Board-approved Risk Appetite and the cascading of Risk Tolerances to Risk Limits.

In CPS 220, paragraph 30(b) states that the RAS should convey “for each material risk, the maximum level of risk that the institution is willing to operate within, expressed as a risk limit and based on its risk appetite, risk profile and capital strength (risk tolerance)”.

4.6.2 Alternative Format

Another common format is for the Risk Appetite Statement to cover some or all of the following:

1. Strategy,
2. Financial management,
3. Operational risk,
4. Industry specific risk categories, and
5. Reputational risk.

4.7 Additional CPS220 Requirements

In addition to the above considerations, CPS220 also requires that an APRA regulated institution’s Risk Appetite Statement must convey:

“(c) the process for ensuring that risk tolerances are set at an appropriate level, based on an estimate of the impact in the event that a risk tolerance is breached, and the likelihood that each material risk is realised;

(d) the process for monitoring compliance with each risk tolerance and for taking appropriate action in the event that it is breached; and

(e) the timing and process for review of the risk appetite and risk tolerances.”
5 RISK APPETITE TOLERANCES AND LIMITS

5.1 Business Outcomes from a Risk Management Perspective

Before we consider Risk Tolerances and Risk Limits in detail, it is useful to consider first how to frame business outcomes from a risk management perspective.

Virtually nothing in the business world, and indeed the wider world, can be guaranteed. Almost all decisions involve weighing up the likelihood of that decision leading to a particular outcome. The wisdom of a particular decision is often viewed after the fact (and with the benefit of hindsight), and a decision that led to a detrimental outcome being considered a ‘wrong’ decision.

As a simple example if an evens bet was offered on rolling between one and five inclusive on a fair six-sided die, clearly there is a strong likelihood the party taking this bet will win and the decision to take it would be a good one (as long as the potential impact of a loss is acceptable). If the die is rolled and comes up as a six, was the decision to accept the bet incorrect, or a ‘bad’ decision? In this simple example it is fairly clear that the person taking on the bet made a sensible decision, and was simply unlucky as to the outcome.

Monitoring risk appetites should ideally be done in a forward-looking sense. This would consider what the exposure to future outcomes is rather than looking backwards at what the outcomes were, which includes natural variability (or luck).

In the business world we are rarely dealing with known likelihoods and have to estimate these. It is therefore much harder to determine whether a decision was a ‘good’ one beyond considering the outcome. Many a senior executive has been fired for making decisions that in advance appeared to be appropriate but, because of either misunderstanding of the probabilities involved or due to bad luck, the outcome was detrimental. For this reason, whilst exposure-based, forward-looking tolerances are preferable it is still common practice to supplement these by including outcome-based expressions to define risk tolerances.

5.2 Risk Tolerances

5.2.1 Definition

Definition 4: Risk Tolerances

“Risk Tolerances are the quantitative measures and qualitative assertions for the maximum risk allowed by the appetite. Risk Tolerances are typically set at the enterprise level.”

Risk Tolerances are, at a minimum, defined on enterprise outcome variables such as profit, value, solvency, liquidity and reputation. However it is also typical to define Risk Tolerances at least to the next layer down, relating to business units, product lines or material risks. As noted above, risk appetite should be framed in terms of exposure to risk rather than to deterministic outputs, although the latter is often used when exposures cannot be accurately measured. They are commonly set from a top down perspective, by the Board, and form the keystone upon which all risk based activities of the institution are based.
5.2.2 Components

A quantitative expression of Risk Tolerance requires the following components shown below:

Figure 3: Key components of a Risk Tolerance

<table>
<thead>
<tr>
<th>Components of a Risk Tolerance</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification and definition of the set of strategic outcomes or exposure variables upon which risk will be expressed</td>
<td>Profit, solvency, value, liquidity, reputation, individual risks</td>
</tr>
<tr>
<td>What the planned outcome is</td>
<td>EBITDA growth of 8%, Solvency ratio of 200%</td>
</tr>
<tr>
<td>What the tolerated outcome is</td>
<td>EBITDA growth of 0%, Solvency ratio of 150%</td>
</tr>
<tr>
<td>An expression of the frequency of the tolerated outcome</td>
<td>5% or 1 in 20</td>
</tr>
</tbody>
</table>

The first component requires the institution to clearly articulate what it is trying to achieve. The goals are:

- Financial goals: profitability, solvency, valuation, growth, liquidity, etc.
- Non-financial goals: reputation, market position, environmental sustainability etc.

These are the elements which frame strategy. The next step is then to define what the planned strategic outcome is for each of these goals. This sets a benchmark for assessing performance relative to the agreed strategy. The next step is to consider the uncertainty around each of these outcomes, and in particular, define the undesirable outcomes for each of these elements. Within this set of possible outcomes, an expression of a bad yet tolerable outcome may be defined, along with an expression regarding its frequency. This Risk Tolerance expression defines the risk constraints for the entire risk management framework.

The expression of frequency is important as it explicitly recognises that outcomes are uncertain, and that it is typically impossible to guarantee a 0% chance of outcomes outside of this level. For example, the tolerance might be an underwriting loss 1 in every 10 years, but it is almost impossible to manage this to a zero percent likelihood. However in some cases – such as for an immature risk framework – it is not possible, meaningful or desirable to define an expression of frequency. Risk managers should consider whether such frequency statements are being made implicitly and, if so, make them explicit.

The Risk Appetite Statement may also contain expressions of preferences for being (or not being) exposed to certain types of risk. For example, it may say that we will not accept any form of internal fraud. The combination of these means that the Risk Appetite Statement is defining a set of preferences for where the institution would like to take risk in order to achieve its strategic objectives.
### 5.2.3 Expression of Risk Tolerance

There are a number of ways of expressing risk tolerances. There are pros and cons of each type of expression, and in reality a Risk Appetite Statement will contain a range of these.

**Figure 4: Examples of Risk Tolerance expressions**

<table>
<thead>
<tr>
<th>Expression</th>
<th>Example</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
</table>
| **Probabilistic** | Probability of failing to pay all policyholders and bondholders in full to be no more than 1-in-300 | • Forward looking and can reflect exposure to risk  
  • Can be monitored | • Subject to model risk  
  • Frequency of update depends on frequency of model refresh |
| **Outcome** | Bad debt write offs not to exceed Y% | • Avoids model risk  
  • Easy to understand | • Retrospective  
  • Statement likely to be mathematically incorrect  
  • May not reflect exposure |
| **Exposure** | Should not lose more than 5% of FUM under the following scenarios … | • Proxy for risk profile  
  • Supplements models  
  • Easy to apply and understand | • Unlikely to properly reflect risk in all situations |
| **Behavioural/cultural** | Internal fraudulent behaviour will not be accepted and result in mandatory termination | • Guide risk taking  
  • Set behavioural expectations | • May be open to interpretation |
| **Risk level** | Low appetite for market risk | • Guide risk taking  
  • Broad enough not to be loop-holed | • Requires interpretation  
  • May be difficult to use to steer the business |
| **Strategic** | No appetite for non-core products | • Link to strategy | • Difficult to word tightly |
| **Delegated** | S&P rating to be at least … | • Reflects an independent view of risk | • May not reflect internal view |
5.2.4 Unit of Measurement

It is also important to clearly define the unit of measurement that is being used. The unit of measurement itself could be either quantitative or qualitative. There is often a preference for quantitative measures, simply because these are objectively defined, and can be measured unambiguously. However not all risks can be defined quantitatively, and thus qualitative measures are often a necessity. These will use descriptive language such as low / medium / high, red / amber / green, or strong / weak. In using qualitative measures, it is critical to be aware of the degree of ambiguity and thus additional uncertainty that these create, as different people will interpret these states differently. This uncertainty should be taken into account when calibrating the Risk Appetite Framework.

5.2.5 Setting Risk Tolerances

Risk Tolerances are ultimately determined by the Board using judgment after considering analysis and input from executive management. The additional concepts of planned outcomes, Risk Capacity and actual risk levels can be very useful in providing context in this process.

It may be useful to work through the following questions as part of the process:

- What are the products and services offered by this business?
- How is this impacted by the business environment?
- What are its key targets or KPIs?
- What are the main areas of risk to which it is exposed?
- What are the key factors which could cause issues in meeting its targets?

This will indicate the areas for which risk metrics are required.

Some further questioning will help to hone in around metrics:

- Are there existing decisions or processes which give a view around the acceptability of this risk? What level of variance has typically resulted in investigations or action? Past decisions give a view of the implicit attitude to this kind of risk.
- At a high level, how is this risk viewed relative to others? For example, based on its internal capability and experience, a company may feel more comfortable in accepting market risk than insurance risk. As a result, it would want to set tighter tolerances around insurance risk as compared to market risk.
- What kind of a scenario would be viewed as acceptable? What kind of scenario would be viewed as catastrophic? Are there examples from within the business itself or in the wider market that the board would want to ensure it could withstand or avoid?
- What metrics are currently used for business management? Are these appropriate for risk reporting? Close alignment between business and risk reporting will help in the vital step of embedding risk concepts within business areas.
Risk Capacity in particular can be a useful concept to help the setting of Risk Tolerance, as Risk Tolerance levels are constrained by Risk Capacity. Whilst Risk Capacity should ideally be determined prior to setting Risk Tolerance, in practice it is more common for Risk Tolerances to be drafted and then Risk Capacity to be considered. However it is done, it is the comparison that is ultimately important. Note that the difference between Risk Capacity and Risk Tolerance levels provides one indication of the level of planned resilience of the institution. Large systemically important institutions are more likely to have bigger buffers between capacity and tolerance, whilst small new entrants are more likely to be operating with minimal buffers and thus be more fragile.

Some examples of Risk Tolerance statements include:

**Figure 5: An example of a Risk Tolerance statement**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Target capital is set such that the probability of meeting regulatory requirements (in the absence of management actions) over one year is at least 97.5%.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome / Exposure Variable</td>
<td>Probability of meeting regulatory requirements (outcome variable with units of %)</td>
</tr>
<tr>
<td>Planned Outcome</td>
<td>100%</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>97.5%</td>
</tr>
<tr>
<td>Frequency</td>
<td>2.5 in 100 years (or 1 in 40 years)</td>
</tr>
</tbody>
</table>

Note that in this example, target capital is the input risk driver upon which a Risk Limit (of say $x million) would be set to give the required probability level.

**Figure 6: An example of a Risk Tolerance statement**

<table>
<thead>
<tr>
<th>Statement</th>
<th>The Board expects underlying insurance margin to deviate by no more than 2% from the Financial Plan under normal business conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome / Exposure Variable</td>
<td>Insurance margin conditional on normal business conditions. An outcome variable with units of % change.</td>
</tr>
<tr>
<td>Planned Outcome</td>
<td>100% of Plan</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>- 2% of Plan</td>
</tr>
<tr>
<td>Frequency</td>
<td>0% implied. Any breach will trigger risk response actions. Note that this may not always be the case, particularly for business lines with high uncertainty / volatility</td>
</tr>
</tbody>
</table>

This example is qualitative rather than quantitative and doesn’t not lend itself to robust modelling. Since some of the larger listed insurers quote an insurance margin after adjusting for exogenous events (eg natural perils differ from forecast, credit
spreads, reserve releases) this risk appetite statement could inform business decisions (expense management, underwriting rigour).

**Figure 7: An example of a Risk Tolerance statement**

<table>
<thead>
<tr>
<th>Statement</th>
<th>The company targets an S&amp;P AA range credit rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome / Exposure Variable</td>
<td>S&amp;P credit rating (an outcome variable with defined states)</td>
</tr>
<tr>
<td>Planned Outcome</td>
<td>AA</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>AA-</td>
</tr>
<tr>
<td>Frequency</td>
<td>0% implied. Any breach will trigger risk response actions</td>
</tr>
</tbody>
</table>

This is a ‘delegated’ risk tolerance statement – related to franchise value of the firm and relying on an external party’s view of the company’s ability to meet its financial commitments. For commercial underwriters it also controls the chance that an insurer will remain on certain brokers’ panels.

**Figure 8: An example of a Risk Tolerance statement**

<table>
<thead>
<tr>
<th>Statement</th>
<th>There is no appetite for a particular market segment, product line or risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome / Exposure Variable</td>
<td>Certain long tail lines (e.g. product liability), geographical segments (NSW or QLD) or type of risk (insuring oil tankers).</td>
</tr>
<tr>
<td>Planned Outcome</td>
<td>Zero exposure</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>Zero exposure</td>
</tr>
<tr>
<td>Frequency</td>
<td>0% implied. Any breach will trigger risk response actions</td>
</tr>
</tbody>
</table>

This risk tolerance statement ties in closely to strategy. A decision may be made not to enter a market because of lack of scale etc, lack of synergies with other market segments (underwriting a single product via intermediated lines). Alternatively it could be because the operational, political and other risks associated with it are considered too great to be managed.

**Figure 9: An example of a Risk Tolerance statement**

<table>
<thead>
<tr>
<th>Statement</th>
<th>No appetite for undertakings from the ACCC arising from market misconduct.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome / Exposure Variable</td>
<td>Successful prosecution by the ACCC.</td>
</tr>
<tr>
<td>Planned Outcome</td>
<td>None</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>None</td>
</tr>
</tbody>
</table>
This statement is designed to influence behaviour and define the firm’s culture. It relates to franchise value / brand value.

**Figure 10: An example of a Risk Tolerance statement**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Sufficient liquidity must be held to meet three months of forecast gross cash flow.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome / Exposure Variable</td>
<td>Fund liquidity - in this case defined as cash and securities maturing within three months as a proportion of gross cash flow.</td>
</tr>
<tr>
<td>Planned Outcome</td>
<td>Liquidity ratio of 100% under normal circumstances</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>Liquidity ratio of 100% under a stress scenarios</td>
</tr>
<tr>
<td>Frequency</td>
<td>0% implied. Any breach will trigger risk response actions</td>
</tr>
</tbody>
</table>

This shows a risk tolerance statement related to a stressed environment (one in which the insurer has no source of funding or premium income for three months). This one would be more suited to a lending institution, or a reinsurer with very variable premium revenue.

**Figure 11: An example of a Risk Tolerance statement**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reduction in insurance margin arising from changes in credit rating and duration management should be less than 1%, with 95% probability measured over twelve months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome / Exposure Variable</td>
<td>Contribution to insurance margin arising from investment risk making (measured as a percentage of Net Earned Premium) assessed over twelve months.</td>
</tr>
<tr>
<td>Planned Outcome</td>
<td>0.5%</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>-1%</td>
</tr>
<tr>
<td>Frequency</td>
<td>5% measured over a 12 month period. Any breach will trigger a review.</td>
</tr>
</tbody>
</table>

This applies a VaR type risk measure to investment risk, and expresses the result as a percentage of a common insurance profitability measure. Measurement of the numerator (dollar loss at 5% confidence level) would require a model whereas the denominator (NEP) would be based on accounting measures.

**Figure 12: An example of a Risk Tolerance statement**
Statement

Fall in market value of assets under designated stress should be no more than 50% of target capital (regulatory capital above statutory minimum).

<table>
<thead>
<tr>
<th>Outcome / Exposure Variable</th>
<th>Asset volatility annualised (outcome variable measured in units of $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned Outcome</td>
<td>25%</td>
</tr>
<tr>
<td>Tolerated Outcome</td>
<td>50%</td>
</tr>
<tr>
<td>Frequency</td>
<td>Depends on scenario</td>
</tr>
</tbody>
</table>

Breaches of Risk Tolerance for outcome variables can occur in two forms, depending upon the frequency statement. Where there is an explicit and non-zero frequency statement, then a specific breach may not imply a breach of the frequency statement. Consider for example earnings results being more than 10% below plan (the Risk Tolerance). If the frequency statement says that this result is OK if it occurs less than 1 in every 10 years (10% likelihood), then more evidence is needed in order to assess whether the result warrants a remedial risk response, although a review will typically be undertaken.

5.3 Risk Limits

5.3.1 Definition

Definition 5: Risk Limits

“The restrictions prescribed by an institution on its business activities, designed to constrain overall risk taking within the Risk Tolerances established in the Risk Appetite Statement. Risk Limits are operational in nature and serve to cascade the Risk Tolerances (contained in the Risk Appetite Statement) into practical constraints on business activities.”

For many companies, Risk Limits provide operational controls at the level of the institution that manages the risk on a day-to-day basis. They are expressed in metrics that are locally relevant and convenient to monitor, and are often thought to “act as a brake against excessive risk-taking”.

5.3.2 Attributes of Effective Risk Limits

Before discussing implementation we set out five useful criteria to assess whether Risk Limits are effective.

- **Limits must be measurable.** If a risk owner can’t tell if they are within a limit they can’t take remediation action.
- **Quantitative limits are preferable, where feasible.** We recognise that some Limits may not be amenable to quantification. However, where Limits can be expressed quantitatively they should be.
- **Limits should be sufficiently binding so as to potentially restrict the business.** A limit that cannot be reached doesn’t help a risk owner in
conducting business but may impose a reporting burden. They also lead to a blasé attitude to the risk function.

- **Limits should be unambiguous.** Discussion should be about what the limits should be, not whether they were breached or not.
- **Limits should be expressed in the language of the business.** The limits will be discussed and agreed with the risk owners. It is important that they be expressed in terms risk owners and the business can understand, measure and act on.

### 5.3.3 Examples of Risk Limits

Some examples of Risk Limits are shown in the table below.

#### Figure 13: Examples of Risk Limits

<table>
<thead>
<tr>
<th>Ease of Quantifying</th>
<th>Category (Risk or Other)</th>
<th>Risk Type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy</td>
<td>Market</td>
<td>Equity, property</td>
<td>$5,000 net delta against the S&amp;P/ASX 200 index and S&amp;P/ASX Property Index</td>
</tr>
<tr>
<td></td>
<td>Market</td>
<td>Interest rate</td>
<td>$10,000 net dollar duration for 1% parallel shifts</td>
</tr>
<tr>
<td></td>
<td>Business line</td>
<td>Various</td>
<td>Max GWP for Motor of $100m</td>
</tr>
<tr>
<td></td>
<td>Credit</td>
<td>Counterparty</td>
<td>Max 10% exposure per counterparty</td>
</tr>
<tr>
<td></td>
<td>Liquidity</td>
<td>Short term cash flow mismatch</td>
<td>Min $100m held in liquid assets</td>
</tr>
<tr>
<td>Moderate</td>
<td>Insurance</td>
<td>Underwriting</td>
<td>$10m retained exposure per commercial building</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>Catastrophe</td>
<td>Maximum event retention of $100m</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>Reserving</td>
<td>Minimum probability of sufficiency 85%</td>
</tr>
<tr>
<td></td>
<td>Market</td>
<td>Combined</td>
<td>95% Value at Risk less than $X over twelve months</td>
</tr>
<tr>
<td>Difficult</td>
<td>Operational</td>
<td>OH&amp;S</td>
<td>Zero tolerance for fraudulent behaviour of staff</td>
</tr>
<tr>
<td></td>
<td>Reputation</td>
<td>Brand</td>
<td>Minimum brand awareness scores</td>
</tr>
</tbody>
</table>

### 5.4 Monitoring and Breaches of Risk Appetite

Monitoring of risk levels against Risk Tolerance and Risk Limits is a key risk management function. Risk dashboards are generally used to facilitate this. These are commonly based on traffic light indicators, which present visual information of where the various risks are sitting in relation to the Risk Appetite.

- **Green:** the risk is within tolerance / limits that the business is comfortable with
- **Amber:** the risk has exceeded a comfortable level, warranting close monitoring and consideration of remedial action to return the rating to Green.
- **Red**: the risk has exceeded the allowable tolerances / limits, and is going outside Risk Appetite. Remedial action must be put in place, with clear accountabilities, metrics and timeframes. It may also be appropriate to revisit the tolerance to determine if it is still appropriate.

Outcomes that have breached Risk Tolerance levels do not necessarily breach Risk Tolerance, as the frequency statement may not have been breached. Technically it is necessary to build up enough evidence in order to decide whether a breach has actually occurred or not. This is particularly important for relatively low Risk Tolerance levels on high frequency risks, such as market risks, where a daily VaR limit may be exceeded multiple times within a given period. This would be entirely expected and consistent with the Risk Appetite framework. However all breaches of Risk Tolerances and Risk Limits will typically result in a review.
6 PROCESS FOR SETTING A RISK APPETITE

6.1 Introduction
Effective risk management should include a formal process for setting the Risk Appetite Framework.

The purpose of this section is not to prescribe the formal process, but rather to encourage consideration around how current processes may be improved or revised for a more robust framework. Many of the elements that make up the process are discussed in more detail in other sections of the paper.

At a minimum, a Board will approve the company-wide Risk Appetite Framework and Risk Appetite Statement, which is highly likely to be developed in collaboration with the Chief Executive Officer (CEO), Chief Risk Officer (CRO) and Chief Financial Officer (CFO). The CEO, CRO and CFO will likely play leading roles in translating those expectations into targets and constraints for a company (and subsequent cascading to business units or product lines) to follow.

An effective Risk Appetite framework should aim to be transparent and integrated within the business. Whatever process is implemented the guiding principles set out in Section 3 should be kept in mind.

6.2 Generic Process
The following figure outlines a generic process for setting the Risk Appetite framework. Most implemented approaches will broadly align with this structure. However, there is not a one size fits all solution, particularly given the diversity across general insurance entities. Importantly, managing a Risk Appetite Framework-setting process iteratively is superior to not incorporating learnings into the framework.

There are a number of quantitative and qualitative tools that can assist across the entire process, such as internal workshops, risk attribution analysis, SWOT analysis, risk registers, discussions with external stakeholders, scenario testing and internal capital models.

Ideally there should be also be regular communication across the breadth of the institution to ensure that there is the best possible opportunity to capture the interaction of risk events across the institution and also any emerging risks.
A description of each phase is given below:

1. **Recognise strategic objectives** – This initial phase helps the Board to frame business objectives in Risk Appetite terms; the ability and willingness to take risks in pursuit of the strategic plan is defined here.

2. **Define principles** – This step aims to define and communicate at Board level the principles of the Risk Appetite Framework (as referred to in Section 3) including establishing consistent definitions, identifying stakeholders and process owners and setting the main scope of the Risk Appetite Framework. This phase will include an evaluation of the risk management activities being undertaken so far.

3. **Understand risk drivers** – This step ensures all significant risks are identified and considered by the Board. The process should include, at a minimum, the APRA prescribed risk categories discussed in Section 4. These minimum risk categories can be further articulated into underlying risk drivers as the complexity of the business dictates. Understanding can only be gained through an analysis of the external and internal environment in which the insurer operates. The Risk Appetite Framework process needs to consider the structural differences in the risk and return characteristics between different business lines.

4. **Choose and measure risk metrics** – The choice of risk metrics (such as the probability of meeting capital requirements over a given time horizon) will determine what managers learn about the current risk position of the
institution. Therefore, appropriate risk metrics should align with the business objectives of the institution and expectations of stakeholders. This stage will involve a quantification process to determine which risks are the material ones, but one should also be aware of the limitations of such a process. If an important risk is not measured correctly then the risk may be ignored or misinterpreted by executive management. For some risks, stochastic modelling, or other techniques, can be used to calculate probability of impairment below a capital threshold.

5. **Set appetite, tolerances, and limits** – To align risk with return and business strategy, selected risk targets should encourage those risks that are rewarded and discourage those that offer little return for stakeholders. In setting limits, the institution must consider Risk Tolerance as an upper bound to Risk Appetite. Again, quantification methods can be used to select appropriate limits and tolerances. This stage will also include qualitative statements from management that determine the tone of the risk management approach within an institution. In considering these levels, the Board should consider its appetite for significant outcomes – examples of these, as suggested by APRA, could include:

- How often is an underwriting loss for the company acceptable?
- What is the worst over-run in project costs that would be acceptable?
- What is the worst net loss that would be acceptable from a catastrophe event?
- How often would it be acceptable to produce an annual loss?
- How often would it be acceptable to pay no dividend?
- How does the board regard the possibility of an adverse front page story in the AFR?

6. **Embed** – Establishing an effective risk management culture and cascading the Risk Appetite through the business is crucial to the effectiveness of the regime. This phase should ensure processes are in place for the day-to-day management of risks articulated within the framework.

7. **Monitor and action** – Once the Risk Appetite is defined and embedded, continual monitoring and subsequent actioning, including escalation, is required. Employees should know the extent of the freedom they have to act independently and when and how to escalate. More broadly, appropriate communication channels should be maintained across the institution. This improves the likelihood of successfully managing, appropriately, the effects of live and emerging risk events on the institution. This stage should also include the documentation and recording of historical experience for use in the review phase.

8. **Review and revise** – Regular review of the process will ensure it remains relevant. Further, the drivers and impacts of risk, and indeed the risks themselves, will change over time. A general insurance entity should consider their ability to monitor and revise the framework in response to changing circumstances, such as changes in pricing sophistication, developments in technology, evolving regulation or the emergence of new risks.
6.3 **Implemented Approaches**

A review of the published literature reveals a range of suggested processes broadly classified as either top-down (commencing the construction of a Risk Appetite Framework from a company-wide level) or bottom-up (where construction commences at a lower level and builds up, such as from product line or business unit levels). Each approach has its advantages and disadvantages as outlined in Figure 15 below.

The implemented approach should be guided by an individual company’s assessment of its own core competencies and adherence to key performance measures – there is no prescriptive ‘right’ or ‘wrong’ approach to adopt for companies of a certain profile. Outside assessments of Risk Appetite may also favour either approach – external management consultants may be capable of instigating a bottom-up approach, although sufficient practical knowledge of the business will be a pre-requisite for this.

**Figure 15: Comparison of bottom-up or top-down**

<table>
<thead>
<tr>
<th></th>
<th>Top-Down</th>
<th>Bottom-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>• Stimulates discussion on risk management at executive and board level</td>
<td>• Granular intricacies of business may only be understood at this level</td>
</tr>
<tr>
<td></td>
<td>• Likely to align with the corporate objectives and future desires</td>
<td>• Very practical and implementable for a particular business unit</td>
</tr>
<tr>
<td></td>
<td>• Likely to be clear and articulate</td>
<td>• Promotes buy-in and an effective risk management culture</td>
</tr>
<tr>
<td></td>
<td>• Has support of executive management to proactively embed within the institution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ensures group wide view of risk and horizontal consistency in implementation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Mediates views of external stakeholders</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pragmatic and cost efficient</td>
<td></td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>• May be too generic / arbitrary and therefore fail to capture the intricacies of an individual business unit</td>
<td>• May favour the status quo and therefore is less effective at fulfilling strategic objectives</td>
</tr>
<tr>
<td></td>
<td>• May not be linked to the day-to-day operations or the risk management system</td>
<td>• Difficult to quantify risks may not be considered properly (e.g. off balance sheet risks)</td>
</tr>
<tr>
<td></td>
<td>• May restrict decision making at operational level</td>
<td>• Different views across business units may be difficult to aggregate</td>
</tr>
<tr>
<td></td>
<td>• Requires careful cascading to ensure the resulting risk tolerances are coherent</td>
<td>• May be resource intensive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• May result in inconsistent appetites across different risks / business units</td>
</tr>
</tbody>
</table>
6.4 A Combined Iterative Approach

Top-down and bottom-up approaches each have their merits. However, a combined approach, where both top-down and bottom-up approaches to setting the Risk Appetite Framework are utilised, ensures that emerging risks are captured and enables the governance and decision making framework to consider the different views of all stakeholders.

Development of any robust process is driven by experience and the most relevant experience should be consulted for the process to be effective. Relevant experience will occur at all levels. This noted, obviously the Board should be satisfied with the ultimate top-down view of Risk Appetite that it opts to adopt for the institution.

In practice, linking top-down / bottom-up views of Risk Appetite may be difficult. However, if successfully achieved, it will ensure both horizontal and vertical consistency in the framework. The approach will be most successful when there are multiple iterations between the top and bottom until a balance is reached.

Multiple iterations can improve the process. Starting with a simple, less granular scope more aligned to a top-down approach, and subsequently revising over a number of iterations from both perspectives, is likely to achieve more success than trying to implement an all-encompassing framework immediately.

In terms of day-to-day operations, the top-down view from the Board of the level of risk with which it is comfortable should be cascaded down through the institution. In this way, management’s individual activities will be (or at least they should be) consistent with the Risk Appetite defined by the Board. Therefore, once the firm-wide Risk Appetite has been determined, the aggregate Risk Appetite has to be allocated to the firm’s business lines, legal entities, and down to all relevant levels. This needs to align with the firm’s strategic and business plans. These allocations of Risk Appetite can be assessed against the institution’s actual Risk Profile assessed at de-aggregated levels, as well as at the aggregated level, to provide further insight into actual and desired risk-taking levels within the institution.
7 EMBEDDING RISK MANAGEMENT

7.1 Risk Management

Risk Appetite is a foundational feature of enterprise risk management. A clearly articulated Risk Appetite enables management to determine the types and limits of risk it can take and consequently the levels of risk governance, process and control it should invest in to manage the assumed risks.

There are many definitions of risk and risk management and their relevance to an institution’s broader purpose. For this section, let’s consider the ISO 31000 description, being that risk management is the ‘coordinated activities to direct and control an institution with regard to risk’.

If risk is the effect of uncertainty of achieving objectives, then Risk Appetite is an expression of the level of that uncertainty a Board is prepared to accept in pursuing their objectives.

This section explains the relevance of Risk Appetite within the broader context of an institution’s enterprise risk management environment and provides guidance into how to effectively ‘embed’ the Risk Appetite Statement (RAS) within a business.

7.2 Risk Appetite within the broader risk management framework

APRA CPS 220.30 states that an institution’s Risk Appetite must convey the degree of risk that it is prepared to take in pursuit of its strategic objectives and business plan, in particular defining the maximum level of risk it will operate within for each material risk. CPS 220.32 goes on to state that the institution’s Risk Management Strategy (RMS) should describe material risks and its approach to managing these, including governance, risk roles and procedures for dealing with risk matters.

Figure 16 below provides a contextual overview of the role of Risk Appetite within the broader risk management framework.

Figure 16: Risk Management Framework
Risk Appetite should direct and inform the development of risk policies, frameworks, standards and operating licences. These risk measures and processes should, in turn, support the embedding of the Risk Appetite of the general insurer.

7.3 Embedding and cascading throughout the business

Many general insurance employees may have very little interaction with their Risk Appetite Statement and instead use policy and framework documents to understand their operating constraints. This relationship highlights the importance of alignment between the general insurer’s Risk Appetite and other risk measures as a way of embedding Risk Appetite within a general insurer.

The approach taken by general insurers to cascade Risk Appetite into their institutions can vary widely dependent on many factors, including the corporate culture and the skills-profile of its employees. The figure below provides a high-level example of some of the mechanisms that insurers can employ to cascade their Risk Appetite.

Figure 17: Risk Appetite Cascading Approach

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Embedding mechanism</th>
<th>Risk monitoring and reporting</th>
</tr>
</thead>
</table>
| Market and investment risk     | • ICAAP and capital management plans
• Market risk policies or investment policies and decision criteria
• Investment guidelines and mandates
• Investment governance committees (Asset Liability Committees) | • VaR measures
• Stress testing and reverse stress testing
• Custodial reviews and reporting
• Compliance testing of investment mandates |
| Credit risk                    | • ICAAP and capital management plans
• Credit risk policy
• Wider investment policies with relation to creditworthiness of counterparties,
Reinsurance purchasing guidelines and approved reinsurer lists. | • Average credit quality and other credit measures
• Custodial reviews and reporting
• Compliance testing of credit mandates |
| Liquidity risk                 | • Hedging programs
• Liquidity Risk Policy
• Asset Liability Committees (ALCO) | • Hedge effectiveness tests
• Liquidity stress tests |
A general insurer will need to continually ensure an alignment between the RAS and all related controls and processes to ensure gaps don’t appear over time between approved Risk Appetite and operational practices. For example, if there were changes to an insurer’s strategy, the insurer could be accepting risk outside its Risk Appetite if the RAS is not re-aligned.

While there is debate over the level of detail to be held within a RAS versus the tools used to embed Risk Appetite within a business, a useful guide may be to consider which of these cascading documents is also Board approved. An approach which reduces repetition is generally preferred.

An advantage of considering the Risk Appetite at a more granular level is that the assessment of associated risks and the development of controls can be undertaken by specialists in those disciplines. This goes to address the CPS 220.12 requirement that ‘appropriate controls are established that are consistent with the institution’s Risk Appetite, Risk Profile and capital strength, and are understood by, and regularly communicated to, relevant staff’.

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Embedding mechanism</th>
<th>Risk monitoring and reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insurance risk</strong></td>
<td>• Underwriting delegations</td>
<td>• Underwriting peer reviews and reports (Quality assessments)</td>
</tr>
<tr>
<td></td>
<td>• Underwriting governance committees</td>
<td>• Product and pricing reviews</td>
</tr>
<tr>
<td></td>
<td>• Risk selection and pricing manuals</td>
<td>• Accumulation exposures (e.g. cat OEP)</td>
</tr>
<tr>
<td></td>
<td>• Reinsurers audits</td>
<td>• Renewal and retention rates</td>
</tr>
<tr>
<td></td>
<td>• Product management policies</td>
<td>• Exposures to high risk segments</td>
</tr>
<tr>
<td></td>
<td>• Underwriting committees including monitoring of key risk indicators</td>
<td>• 2nd line oversight and challenge of decisions</td>
</tr>
<tr>
<td></td>
<td>• Claims committee</td>
<td></td>
</tr>
<tr>
<td><strong>Operational risk</strong></td>
<td>• Delegations of authority</td>
<td>• Balanced scorecards</td>
</tr>
<tr>
<td></td>
<td>• Human capital systems (include performance scorecards and assessment</td>
<td>• 1st line of defence QA processes</td>
</tr>
<tr>
<td></td>
<td>• Operational risk policies and frameworks (e.g. fraud, BCM and outsourcing)</td>
<td>• 2nd line of defence oversight and reporting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Operational incidents and operational losses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Breach reporting</td>
</tr>
<tr>
<td><strong>Strategic risk</strong></td>
<td>• Strategic initiatives</td>
<td>• Portfolio review processes</td>
</tr>
<tr>
<td></td>
<td>• Strategic reset</td>
<td>• Regular risk reporting</td>
</tr>
<tr>
<td></td>
<td>• Major projects</td>
<td>• Emerging risks analysis</td>
</tr>
<tr>
<td></td>
<td>• Business planning process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Corporate values</td>
<td></td>
</tr>
</tbody>
</table>
7.4 **Key risk management process of which Risk Appetite is a key driver**

As outlined above, an institution’s Risk Appetite is one of the principal factors in decision-making. These decision points may exist at a strategic (often executive and/or Board level) or operational level. Examples of these are:

- **Strategic Level**
  - Strategy development and business planning
  - M&A and new business ventures
  - ICAAP and capital management
  - Risk based capital modelling

- **Operational Level**
  - Operational risk assessments and acceptance of residual risk (i.e. within or outside Risk Appetite).
  - Product pricing
  - People management and performance management

When making strategic-level decisions, such as developing and updating the strategy or undertaking M&A activity, management should ensure that the entity’s Risk Appetite is taken into account and certain areas adapted, where necessary, such that the entity can operate within its Risk Appetite on an ongoing basis.

The entity’s Risk Appetite should be incorporated into its ICAAP. The capital modelling, including stress testing and capital management processes, should highlight situations where the entity might be outside of its Risk Appetite.

The entity’s Risk Appetite should also be reflected at an operational level in areas such as product pricing. This may require the enterprise’s Risk Appetite to be defined at a lower level such as for a line of business within the enterprise to which the product pricing relates.

7.5 **Monitoring and reporting**

Risk management infrastructure, in particular risk systems, provide an important means of ensuring that an institution operates within its stated Risk Appetite. This infrastructure is an important means of demonstrating that the Board and senior management have taken steps necessary to monitor and manage all material risks consistent with strategic objectives, the Risk Appetite Statement and policies (per CPS 220.12).

Risk reporting should be concise and timely enough to enable management to identify any significant risk management issues that may be emerging in the enterprise and take appropriate actions in order to mitigate these risks.

The figure below provides an indicative overview of the role of risk systems in monitoring operational performance within Risk Appetite. The outputs of the risk management processes undertaken (e.g. risk assessments, breach management, and controls assurance) are captured and utilised for a variety of risk oversight and monitoring governance purposes.
7.6 Risk Culture

Embedding Risk Appetite in the culture of a general insurer is not a simple exercise and needs to be part of a company wide effort to ensure that the business makes considering risk an integral part of their decision making process.

The Risk Maturity Framework can be thought of in 3 stages:

1. **Early stages** – Controlling Risk
2. **More advanced stages** – Supporting decision making
3. **Advanced stages** – Optimising the risk profile

The early stages of embedding a Risk Appetite Framework may be led by the Risk Management Function in collaboration with the teams responsible for the strategic and business plans. Risk may be a constraint to the company’s plans. The use of stress testing would help to set expectations and monitor against them.

As the business model matures the Risk Appetite Framework becomes more embedded in the general insurer. Risk Appetite becomes a more important input to the strategy informing management of the decisions that may optimise the likelihood of delivering the business objectives.

The main way Risk Appetite influences business decisions is through establishing Risk Tolerances and Risk Limits providing key metrics against which to monitor the risk profile of ongoing operations and assuring adherence to the general company’s strategy.
7.7 Implementing a Risk Management Framework

As general insurers implement their risk management frameworks a number of processes need to be implemented with various degrees of difficulty. The table below sets out some examples that are known to have been successful and unsuccessful for insurers in embedding risk management in their institutions.

---

**Figure 19: Risk Maturity Frameworks**

<table>
<thead>
<tr>
<th>Early Stage</th>
<th>More Advanced</th>
<th>Advanced Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Risk</td>
<td>Support decisions</td>
<td>Optimise risk profile</td>
</tr>
</tbody>
</table>

- **Early Stage**: Control Risk
  - Set controls around risk taking and ensuring adequate solvency
  - **Limits**: Set risk targets based on cascade from the Group position
  - **Solvency**: capital held and managed to local requirements plus operational buffer

- **Business and Control Context**
  - Cascade would allow risk taking to be controlled at local entity level as well as the Group level
  - Sets risk targets that provide the basis for risk management activities and monitoring
  - Limits business risk taking to within the overall Group Risk Appetite

- **More Advanced Support decisions**
  - Covers aspects of "early stages" RAF
  - Supports business planning and other decision making
  - Facilitates allocation of capital to the most desirable opportunities during the business planning process
  - Consciously takes account of fungibility constraints/trapped capital
  - Allows capital to be allocated efficiently throughout the Group
  - Facilitates allocation of physical capital from less attractive activities to more attractive activities
  - Identifies key constraints and opportunities to improve capital efficiency

- **Advanced Stage Optimise risk profile**
  - Covers aspects of "more advanced" RAF
  - Active optimised allocation of Group capital
  - Constraints to be addressed as required by e.g. restructuring, internal risk transfer, asset/liability management, product management etc.
  - Drives economic optimisation through risk selection and structural change
  - All Group capital benefits from diversification should be captured
  - Drives all possible capital benefits resulting from internal risk transfers, internal or external leverage and other structural considerations

---

6 Based on Graph 5.1.1 Maturity Model of Risk Appetite Implementation of the paper “Establishing and Embedding Risk Appetite: Practitioners’ View”, CRO Forum and North American CRO Council, December 2013
Figure 20: What works?

<table>
<thead>
<tr>
<th>Ease of implementation</th>
<th>Example of successful Risk Framework implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Easy</strong></td>
<td>Expectations set by the Board</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Recognising different stakeholders have different tolerances; some are more focused on value protection, while others are focused on value creation</td>
</tr>
<tr>
<td></td>
<td>Developing training materials for all levels in the institution</td>
</tr>
<tr>
<td></td>
<td>• Taking message from Board to employee</td>
</tr>
<tr>
<td></td>
<td>• Templates for the businesses to follow</td>
</tr>
<tr>
<td></td>
<td>Aligning reporting from the Board, through to a governance committee and then into the performance objectives of the company and its management.</td>
</tr>
<tr>
<td></td>
<td>Improving risk reporting</td>
</tr>
<tr>
<td></td>
<td>• Data tailored to the audience and level of granularity</td>
</tr>
<tr>
<td></td>
<td>• Focusing on material risks</td>
</tr>
<tr>
<td></td>
<td>• Useful visuals that prompt decision making</td>
</tr>
<tr>
<td></td>
<td>• Timeliness of the report</td>
</tr>
<tr>
<td><strong>More difficult</strong></td>
<td>Separating the discussion of fundamental concepts - Risk Profile, Risk Capacity, Risk Appetite, Risk Appetite Statement</td>
</tr>
<tr>
<td></td>
<td>Incorporating capital allocation within the Risk Appetite Statement</td>
</tr>
<tr>
<td></td>
<td>Integrating the Risk Appetite Statement with the strategic and financial plan through linking key drivers with appetite</td>
</tr>
</tbody>
</table>

Even though a number of measures are difficult, time consuming and complex to implement they may be beneficial in the risk management practices of institutions.
**Figure 21: What doesn't work?**

<table>
<thead>
<tr>
<th>Ease of implementation</th>
<th>Example of unsuccessful Risk Framework implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Easy</strong></td>
<td>Focus on risk governance (box -ticking exercise) rather than risk management</td>
</tr>
<tr>
<td></td>
<td>Completely quantitative or qualitative focus</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Not incorporating the risk management measures into the performance objectives of the company and the management</td>
</tr>
<tr>
<td></td>
<td>Not engaging with the 1st line of the business</td>
</tr>
<tr>
<td><strong>More difficult</strong></td>
<td>A very theoretical approach with a focus solely on Economic Capital</td>
</tr>
<tr>
<td></td>
<td>Trying to fit too many risk settings into the Risk Appetite Statement – the RAS cannot possibly capture all meaningful risk settings and controls</td>
</tr>
<tr>
<td></td>
<td>Not incorporating the risk management measures into the performance objectives of the company and the management</td>
</tr>
</tbody>
</table>
APPENDIX A: DEFINITION OF RISK APPETITE TERMS

In the paper, the definitions for key risk appetite terms quoted in Sections 2 and 3 were selected after considering the definitions used by APRA and key international institutions. In this Appendix, these definitions are listed and the background to the selections is documented.

We have tended to opt for the definitions advocated by the Financial Standards Board (FSB), if they are considered to be appropriate. The FSB coordinates, at the international level, the work of national financial authorities and international standard setting bodies, and develops and promotes the implementation of effective regulatory, supervisory and other financial sector policies in the interest of financial stability. The FSB’s paper is relatively recent (November 2013).

We have also considered definitions recently proposed by the CRO Forum and the North American CRO Council. The CRO Forum member companies are large multinational insurance companies headquartered across the world with a concentration in Europe. The CRO Council is a professional association of Chief Risk Officers of leading insurers based in the United States, Bermuda and Canada.

While APRA does not propose definitions for all risk appetite terms in CPS 220, or elsewhere, where terms are defined they are generally similar to those of the FSB. Ernst & Young’s definitions quoted by Ian Laughlin, a Member of APRA, in his address to the ANZIIF Reinsurance Rendezvous in September 2012, are also listed below.

The Institute of Risk Management provided definitions of risk appetite terms in September 2011.

As mentioned in Section 2, we have used “institution” to refer to the firm/ company/ institution.

Figure 22: Risk Appetite definitions

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS 220</td>
<td>The degree of risk that the institution is prepared to accept in pursuit of its strategic objectives and business plan, giving consideration to the interests of depositors and/or policyholders (paragraph 30(a))</td>
</tr>
<tr>
<td>Institute of Risk Management</td>
<td>The amount of risk that an organisation is willing to seek or accept in the pursuit of its long term objectives.</td>
</tr>
<tr>
<td>Financial Stability Board</td>
<td>The aggregate level and types of risk a firm is willing to assume within its risk capacity to achieve its strategic objectives and business plan.</td>
</tr>
</tbody>
</table>

7 “Principles for An Effective Risk Appetite Framework”, FSB 18 November 2013
8 “Establishing and Embedding Risk Appetite: Practitioners’ View”, CRO Forum December 2013
9 “Risk Appetite - The strategic balancing act”, Ernst & Young 2010
A company’s risk appetite establishes boundaries for the aggregate level or types of risk a company is willing to assume in order to achieve its business objectives.

The aggregate level and types of risk an institution is willing to assume within its risk capacity to achieve its strategic objectives and business plan. (FSB)

**Figure 23: Risk Capacity definitions**

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS 220</td>
<td>Not defined</td>
</tr>
<tr>
<td>Institute of Risk Management</td>
<td>Not defined</td>
</tr>
<tr>
<td>Financial Stability Board</td>
<td>The maximum level of risk the financial institution can assume given its current level of resources before breaching constraints determined by regulatory capital and liquidity needs, the operational environment (e.g. technical infrastructure, risk management capabilities, expertise) and obligations, also from a conduct perspective, to depositors, policyholders, shareholders, fixed income investors, as well as other customers and stakeholders.</td>
</tr>
<tr>
<td>CRO Forum</td>
<td>The maximum level of risk a company can assume before it breaches regulatory constraints (e.g. breach of solvency or liquidity ratios) or other stakeholders’ constraints (e.g. inability to fulfil pension scheme obligations).</td>
</tr>
<tr>
<td>Selected for paper</td>
<td>The maximum level of and type of risk an institution is able to support before breaching constraints determined by regulatory capital and liquidity needs and its obligations to customers, shareholders and other stakeholders.</td>
</tr>
</tbody>
</table>

**Figure 24: Risk Appetite Framework (RAF) definitions**

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS 220</td>
<td>Not defined</td>
</tr>
<tr>
<td>GPS 220</td>
<td>“includes systems (including the structures, processes, policies and roles supporting them) for identifying, assessing, mitigating and monitoring the risks that may affect a regulated institution’s ability to meet its obligations to policyholders” (paragraph 7(a), applicable until 31 December 2014)</td>
</tr>
<tr>
<td>Source</td>
<td>Definition</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Institute of Risk Management</td>
<td>Not defined</td>
</tr>
<tr>
<td>Financial Stability Board</td>
<td>The overall approach, including policies, processes, controls, and systems through which risk appetite is established, communicated, and monitored. It includes a risk appetite statement, risk limits, and an outline of the roles and responsibilities of those overseeing the implementation and monitoring of the RAF. The RAF should consider material risks to the financial institution, as well as to the institution’s reputation vis-à-vis policyholders, depositors, investors and customers. The RAF aligns with the institution’s strategy.</td>
</tr>
<tr>
<td>CRO Forum</td>
<td>The framework of policies and processes that establish and monitor adherence to the company’s risk appetite.</td>
</tr>
<tr>
<td>Selected for paper</td>
<td>FSB definition above</td>
</tr>
</tbody>
</table>

**Figure 25: Risk Appetite Statement definitions**

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS 220</td>
<td>Not defined</td>
</tr>
<tr>
<td>Institute of Risk Management</td>
<td>Not defined</td>
</tr>
<tr>
<td>Financial Stability Board</td>
<td>The articulation in written form of the aggregate level and types of risk that a financial institution is willing to accept, or to avoid, in order to achieve its business objectives. It includes qualitative statements as well as quantitative measures expressed relative to earnings, capital, risk measures, liquidity and other relevant measures as appropriate. It should also address more difficult to quantify risks such as reputation and conduct risks as well as money laundering and unethical practices.</td>
</tr>
<tr>
<td>CRO Forum</td>
<td>Establishes boundaries for the aggregate level or types of risk a company is willing to assume in order to achieve its business objectives. Risk appetite may have multiple qualitative and quantitative dimensions, resulting in multiple ways of expressing risk appetite. Risk appetite statements reflect the combination of risk acknowledgment, including preferences to and unacceptability of specific risks, and company-wide</td>
</tr>
</tbody>
</table>
tolerances for those risks. In its most general form, a risk appetite would describe the pertinent risks to which the company is exposed and the amount of exposure it is willing to assume from those sources of risk.

**Selected for paper**
The articulation of the aggregate level and types of risk that an institution is willing to accept, or to avoid, in order to achieve its business objectives. It includes qualitative statements as well as quantitative measures expressed relative to earnings, capital, risk measures, liquidity and other relevant measures as appropriate. It should also address more difficult to quantify risks such as reputation and conduct risks as well as money laundering and unethical practices.

**Figure 26: Risk Tolerance definitions**

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS 220</td>
<td>For each material risk, the maximum level of risk that the institution is willing to operate within, expressed as a risk limit and based on its risk appetite, risk profile and capital strength. <em>(paragraph 30(b))</em></td>
</tr>
<tr>
<td>Institute of Risk Management</td>
<td>The boundaries of risk taking outside of which the organisation is not prepared to venture in the pursuit of its long term objectives.</td>
</tr>
<tr>
<td>Financial Stability Board</td>
<td>Not defined</td>
</tr>
<tr>
<td>CRO Forum</td>
<td>The quantitative measures and qualitative assertions for the maximum risk allowed by the appetite. Risk tolerances are typically set at the enterprise/group level. <em>(paraphrased from paper)</em></td>
</tr>
<tr>
<td>Selected for paper</td>
<td>The maximum risk that an institution is willing to take for each relevant risk.</td>
</tr>
</tbody>
</table>

**Figure 27: Risk Limit definitions**

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS 220</td>
<td>Not defined</td>
</tr>
<tr>
<td>Organisation</td>
<td>Definition</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Institute of Risk Management</td>
<td>Not defined</td>
</tr>
<tr>
<td>Financial Stability Board</td>
<td>Quantitative measures based on forward looking assumptions that allocate the financial institution’s aggregate risk appetite statement (e.g. measure of loss or negative events) to business lines, legal entities as relevant, specific risk categories, concentrations, and as appropriate, other levels.</td>
</tr>
<tr>
<td>CRO Forum</td>
<td>Measurements based on forward-looking assumptions that cascade the company’s aggregate risk tolerances to lower levels of granularity. For many companies, risk limits provide operational controls at the level of the organisation that manages the risk on a day-to-day basis.</td>
</tr>
<tr>
<td>Selected for paper</td>
<td>The restrictions prescribed by an institution on the business activities to each business unit, designed to contain overall risk taking within the Risk Tolerances established in the Risk Appetite Statement. Risk Limits are operational in nature and serve to cascade the Risk Tolerances into practical constraints on business activities.</td>
</tr>
</tbody>
</table>

**Figure 28: Risk Profile definitions**

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS 220</td>
<td>Not defined</td>
</tr>
<tr>
<td>Institute of Risk Management</td>
<td>Not defined</td>
</tr>
<tr>
<td>Financial Stability Board</td>
<td>Point in time assessment of the financial institution’s gross and, as appropriate, net risk exposures (after taking into account mitigants) aggregated within and across each relevant risk category based on forward looking assumptions.</td>
</tr>
<tr>
<td>CRO Forum</td>
<td>A company’s risk profile is a point-in-time assessment of risk exposures, expressed in relation to risk limits, risk tolerances, and risk capacity.</td>
</tr>
<tr>
<td>Selected for paper</td>
<td>An institution’s risk profile is a point-in-time assessment of risk exposures, expressed in relation to Risk Limits, Risk Tolerances, and Risk Capacity.</td>
</tr>
</tbody>
</table>
APPENDIX B: RISK TOLERANCES

1. RAS EXAMPLE (CRO FORUM)

The CRO Forum has provided the following example of a Risk Appetite Statement\textsuperscript{11} which uses their four suggested categories of risk tolerance:

“1. Earnings: Our business should be monitored and managed so that we have 95% confidence that earnings will be no more than 5% lower than expected and 99% confidence that earnings will be no more than 10% lower than expected.

2. Capital
   a. Regulatory: We seek to maintain a level of capital that is 375-400% NAIC RBC, but have a long term target to operate at 350% RBC. An early warning threshold of 300% RBC is established to initiate heightened monitoring and review. If the level falls below the early warning threshold, then causes and potential contingency plans will be reviewed at the next quarterly executive risk management committee meeting. Our desired absolute minimum level of capital is 250% RBC, which represents a 50% point margin over the regulatory intervention level of 200%. If the consolidated actual capital level falls below the minimum level, then immediate remedial action plans will be implemented.
   
   b. Economic: We seek to maintain assets in excess of 130% of economic capital. The early warning threshold is 120%, and the minimum level of capital is 100%.
   
   c. We manage risk exposures so that each single risk has a maximum loss exposure of less than $500m of statutory capital at a 95% confidence level.

3. Liquidity: We seek to minimise exposure to liquidity risk and manage closely at all times, actively managing our liquidity position and collateral exposure to ensure we have ample resources to fund our obligations. At the enterprise level, we maintain holding company cash and securities of two times (2X) annual fixed charges with half of the total holdings (1X) in pure cash equivalents or commercial paper and we maintain recourse leverage below 25%. We manage leverage so that we have 90% confidence that our leverage ratio will be less than 20% and 99.5% confidence that it will be less than 25%.

4. Franchise value: Operational risks that could lead to material reputational, legal or regulatory problems should be minimised. We seek to maintain appropriate compliance with all applicable laws, have no tolerance for criminal or fraudulent activities, and maintain strict data security and privacy controls to protect customer information."

2. Risk Tolerances by Enterprise Risk

Achievement of Target Performance

In the Risk Appetite Statement, the Board might articulate its willingness (or lack thereof) for the crystallisation of the risk that the insurance margin is lower than

target over the relevant time horizon. An example of how this might be expressed in the Risk Appetite Statement is as follows:

A Board may have “an appetite to put 4% insurance margin at risk in pursuit of its business plans, with a low tolerance of a reduction in the insurance margin of more than 4%.”

Note the quantitative nature of the expression of risk appetite above. We would anticipate that elsewhere in the Risk Appetite Statement, articulation in a quantitative sense of a “low tolerance” would also be set up – for example, low tolerance might be defined as “a less than 5% chance over a one year period”.

Articulation of the Board’s risk appetite around insurance margin in this way means that when the broad strategy is turned into a formal business plan, the plan is “testable” – the total risks from all aspects of the plan, to the extent they impact the insurance margin, can be considered and quantified.

Let’s return to our example of a low tolerance for a greater than 4% reduction in the insurance margin. Articulation of risk appetite in this way assists in the demonstration, to the Board, in a reasonably objective manner, whether or not the business plan delivers a high degree of confidence (say 95% likelihood) that any shortfall in the margin will be less than 4% if things go wrong. If satisfaction of the definition of low tolerance is not possible, the Board is in breach of its appetite and should constrain risk taking in some form.

Note that the insurance margin relates to the broad category of achieving target performance. A number of underlying risks feed into this – for example, underwriting risk, reserve risk, reinsurance/aggregation risk, asset risk. This connection between enterprise level risks and underlying source risks enables the articulation of appetite and Risk Tolerances around insurance margin risk to be cascaded down to these other risks. In this way, the risk appetite can be “operationalised” so that all levels of the institution are operating in a way consistent with the Board-level Risk Appetite Statement.

Risk appetite relating to profitability may relate to one or more of several metrics:

- Net profit after tax
- Insurance margin
- Underwriting profit
- Return on Capital

Preservation of Capital

Key metrics around capital preservation generally revolve around the level of solvency ratios. For a general insurance company, the regulatory capital adequacy ratio (CAR) is likely to be a central part of the Risk Appetite Statement. The CAR is the ratio of net assets available for regulatory purposes to the minimum regulatory requirement (Prudential Capital Requirement or PCR).

Other solvency metrics that might be important to articulate a risk appetite for might include:

- Probability of ruin (CAR less than zero);
- Probability of breaching lower end of target operating ranges as set out in the ICAAP; or
• Probability of breaching some other CAR or solvency metric (such as a solvency ratio that would trigger a request for more capital from the parent/head office).

The Board may have an expressed risk appetite that “the probability that regulatory capital falls below PCR at any time over the next three years should be less than 5%”.

The probability threshold above is 5%. However, this tolerance for “regulatory impairment” will vary widely from institution to institution, in large part depending on the ease with which business can access new capital. For example, for a mutual the tolerance may be much lower (say, 2% or 1%).

For a subsidiary or branch, there may be access to capital from the parent/Head Office. However, local management may have a strong wish to avoid a request for more capital where such a request is driven by adverse performance/outcomes.

In such cases, tolerances in the Risk Appetite Statement around breaching minimum regulatory capital requirements may also revolve around key capital triggers (as set out in the Capital Management Plan or ICAAP).

For example, say the target operating range for the CAR in a branch/subsidiary was 1.60 to 1.80. The Risk Appetite Statement might have a statement as follows: “The business has a low tolerance for asking for more capital as a result of adverse performance/outcomes. Accordingly, the probability that the CAR falls below 1.60 at any time over the next three years should be less than 5%”.

Again, note the quantitative nature of the expressions above of risk appetite for solvency risk. This will allow the expressed risk appetite to be cascaded down through the institution in the form of Risk Limits (for example, aggregate exposure in Far North Queensland not to exceed $\text{X}$; reinsurance to be purchased with a retention of at least $\text{A}$ and a limit of at least $\text{Y}$; assets to be invested according to certain limits by asset class).

Beyond statements around the CAR itself, The Board may also express a view that “they have little appetite to receive regulatory censure over their practices”. This suggests that in pursuit of their business objectives they would be unwilling to act in a way that could encourage such censure. This is much more of a qualitative statement and at first glance is fairly broad. However, it articulates a sensitivity around risk which the Board has. As a result, it is useful as it can be used to design operational policies and procedures around important areas of the business which, if risks are not managed appropriately, might lead to regulatory censure. For example, unethical selling practices to increase GWP, would be frowned upon.

Possible metrics that could be used to express solvency risk appetite include:

• Likelihood of assets falling below liabilities (Solvency risk)
• Less than a X% probability of falling below statutory minimum
• Less than a X% probability of falling below statutory minimum plus x%
• X% probability of requiring extra capital
• Probability of failing to pay all policyholders and bondholders in full to be no more than 1-in-300
Maintenance of Liquidity

This area of risk is typically less important for general insurance companies than it is for banks, but should still not be ignored. Approaches to this risk type including considering the maximum cumulative cash outflow over a particular time horizon at a given level of probability, or more simply just keeping at least a specified proportion of the capital base in liquid assets (with a clear definition of what is meant by ‘liquid’). As well as policyholder liabilities liquidity, the risk appetite should consider other key payments such as coupon payments on bonds.

Protection of Franchise Value

One of the ultimate aims of shareholders is to grow the franchise value of the institution. Examples of expressions relating to this area include:

- Loss of capacity to write business due to loss of confidence by consumers, suppliers or regulators; or
- The Board will not accept risks that materially impair the reputation of the Group and requires that customers are always treated with integrity.
APPENDIX C: REFERENCES