

Devising a market risk framework

In this first article of a three-part series on completing the market risk framework, Paul Smetanin, former global head of market risk at ANZ in Melbourne, explains his views on what it takes to complete the market risk process in the modern financial institution and the importance of determining a framework for market risk management

The holy grail of a robust and complete approach to risk management has proved as elusive as the challenges of financial prediction itself. In the case of market risk management, however, many industry pundits would argue that the independent market risk management problem has largely been solved and that the focus now should turn to credit and operational risk challenges. This is particularly noticeable in the industry, as regulators accept value-at-risk (VAR) techniques as a panacea for market risk measurement. The sense of victory, however, might be premature.

Part of the difficulty in graduating from market risk processes to credit and operational risk is that the market risk story remains incomplete. Notwithstanding all the positive work conducted in the field of quantitative analysis and IT infrastructure, market risk management still primarily describes "what is" rather than the "how" and the "why". Only a handful of regional organisations can truly boast a complete market risk framework.

Why focus on market risk management in this paper? It is the foundation for the management of other risks, such as liquidity, credit and operational risk. It would appear that those organisations that have endeavoured to resolve the market risk problem completely have a strong foundation for entry into, specifically, credit risk management and, generally, operational risk management frameworks. This paper examines the role of market risk management, the criteria to be satisfied by a complete market risk framework and a suggested framework solution. The second paper, in the October issue of *AsiaRisk*, will focus on scenario generation and how the science of market risk management can combine with the experience of the risk manager in a systematic way. The third and last paper focuses on the extensibility of a market risk scenario simulation framework into credit risk applications.

Why a risk framework?

A risk framework should provide a vision and generalised strategy under which the development of risk management techniques can

occur in a consistent and unified fashion, thereby ensuring the delivery of consistent risk information through time and a profitable and enduring investment of intellectual capital over time.

A key concern is that much of the market risk management literature available today has primarily focused on the tactical approaches to market risk management, as opposed to the vision, strategy and then tactics of a market risk framework. If this issue is not resolved, a financial institution will be continuously plagued with new techniques and changing management mindsets. What is required is a risk management framework under which the culture and risk-reward decision process of management can remain consistent through time, while incorporating new risk-reward measurement and management techniques.

The framework problem is also shared by prudential regulators, who have their own dilemma of how to cast an enduring prudential and regulatory framework across an industry that is as dynamic and evolutionary as the financial markets. US Federal Reserve chairman Alan Greenspan said that a prudential risk management process should be "necessarily dynamic and evolutionary....In particular, we should avoid mechanical or formulaic approaches that, whether intentionally or not, effectively 'lock' us into particular technologies long after they become outmoded. We should be planning for the long pull, not developing near-term quick fixes. It is the framework that we must get right" (Greenspan, 1999). This comment was made under the heading of "framework" and begs the question of why it should be any different for the practitioner!

Market risk management role and process

The determination of a set of criteria that will govern the design of a market risk framework begins with the questions: what is the role of an independent market risk management process and what are the necessary processes required to perform independent market risk management?

Corporate governance role

Corporate governance is a role that requires the market risk manager to measure and monitor risk-taking, appraise risk-reward decisions and instigate risk-mitigating action and control when required. This is performed on behalf of the board of directors.

Given the monitoring and control aspect of the corporate governance function, the board requires that market risk is understood independently and as completely as economically feasible. This requires market risk managers to have an integral understanding of the value drivers and risk dynamics of the organisation's portfolio of risky positions. As the corporate governance role is focused more on what can go wrong, the market risk manager is concerned predominantly with the loss possibilities of risk-taking. In combination with the role of reporting the risk of the organisation in a timely fashion, the role of the risk manager can easily become one of advising management on the loss possibilities of the organisation's risk-taking activities.

However, reporting a risk number does not sufficiently fulfil the market risk manager's role, because advising senior management of a loss possibility does not ensure that such information will contribute to the decision-making process. Therefore, the risk manager should not only be an adviser of loss possibilities, but also have the role of "managing the expectations" of loss at senior management level. That is, it is the risk manager's responsibility to ensure that management has a realistic expectation of the amount of money that could be lost from conducting certain activities in the market. By managing the expectations of loss across the organisation, the risk manager is, as a consequence, supporting the business process by creating some transparency over the consequences of various risk-taking activities.

The corporate governance aspects of risk management should not be viewed as a policing mechanism, but rather as a process to instigate risk-mitigating action when required. In this regard, market risk managers require the infrastructure that will enable them to participate in the process of instigating risk-mitigating action.

In the corporate governance context, the role of the risk manager is therefore summarised as:

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- Measure and monitor the value drivers of risky positions and possibility of loss;
- Advise on the loss possibilities of the organisation's risky positions;
- Manage the expectations of loss, ensuring that management has a realistic expectation of the amount of financial loss that could be incurred;
- Instigate risk-mitigating action when required.

Business support role

Business support is another role that will generally require the market risk manager to support the maintenance, growth and innovation of the business. This involves ensuring that new products are processed with appropriate risk attributes, risk-reward relationships independently understood and transparency created across the risk taking process, to ensure that business decisions can be supported across the management hierarchy.

A source of intellectual capital is generated by the market risk process in that the analysis of risk in this way brings a different perspective to that of the day-to-day business managers. Market risk is essentially concerned with loss possibilities (loss scenarios). As a result, market risk managers focus on the tails of loss distributions. The business, however, focuses on both profit and loss profiles. This is usually located in the body of probability density functions (PDFs) around the expectation. As a result, market risk managers usually generate many more aspects of risk information that the business will not necessarily be concerned with, such as daily VAR analysis, evolving PDFs through time, etc.

Thus the market risk process supports the business growth and innovation through:

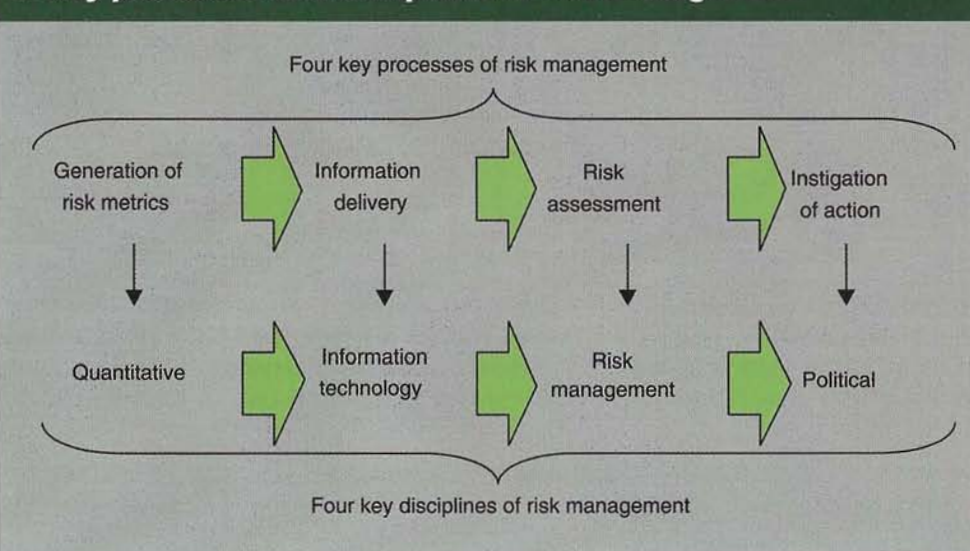
- Managing the expectations of loss throughout the management structure, thereby allowing the business managers to operate with the understanding that if they returned a loss, the possibility of that loss would have been previously understood by the management;
- Providing a rich source of scenario information, which is not usually required by the day-to-day business (eg, loss scenarios that provide information on unusual correlation or gamma profiles that exist outside the day-to-day attention of the business, which may be economically hedged sooner rather than later);
- Freeing capital and creating transparency in the risk-taking process, thereby allowing funds to flow more freely from poor risk-reward businesses to higher risk-reward businesses.

Market risk process

The corporate governance and business support roles require the market risk manager to be able to measure and assess risk in a timely fashion and, if necessary, enter into the political sphere of instigating risk-mitigating actions. Figure 1 maps the usual key processes that are required to perform market risk management. All four key processes are necessary but insufficient on their own in the performance of market risk management:

- Generation of risk metrics** is primarily a

1. Key processes and disciplines of risk management



quantitative process of determining the most appropriate risk measurement techniques that need to be performed on a periodic or *ad hoc* basis. This process is a combination of quantitative, IT and risk management processes;

- Information delivery** is an IT process that meets the requirements of speed, accuracy and flexibility of information availability. This covers the speed and stability of process, form of information delivery and the technical user interactive qualities of the risk system that allow customisation to occur and organisational culture to persist around the technology;

- Risk assessment** involves the decision-making processes that bring together risk measurement techniques and judgements of risk. This process is a complicated function of corporate culture, risk experience and the quantitative process;
- Instigation of action** is the final requirement of the market risk process, requiring the risk manager to carry out a risk-mitigating action at the right time. If the risk process does not contribute to the risk-mitigating process, then it ultimately has no purpose. Successful implementation of this aspect of the market risk process is dependent upon many factors, including quality of information, risk culture, the way information is delivered, political acumen, and past and present risk approaches.

It is sometimes helpful to restate the above process map across three phases in order to complete an understanding of the interaction of the various market risk processes:

- The risk measurement challenge of producing appropriate risk data;
- The IT structural aspects of the process;
- The risk management challenge of delivering risk information and executing a risk-mitigating decision, when necessary.

The risk measurement phase permeates through every aspect of the risk process, overlaying the information delivery and decision execution phases. Figure 2's vertical spectrum shows the order of interaction of the systems, data delivery, risk management and political

processes. The quantitative measures necessary to support a market risk management function are broadly described by the horizontal spectrum. The context and importance of each technique in market risk management will be examined in greater detail in the next paper of this series.

Figures 1 and 2 demonstrate that market risk management is not just concerned with the quantitative aspects of measurement. As stated, measurement is a necessary contribution to the complete market risk framework, but on its own it is not a sufficient contribution to a complete market risk management framework. If the IT architecture does not deliver the requisite timing of information delivery and the flexibility to mine data in convenient ways, and does not enable risk data to be delivered in a way that supports the political process of instigating action, then the market risk management process will fail.

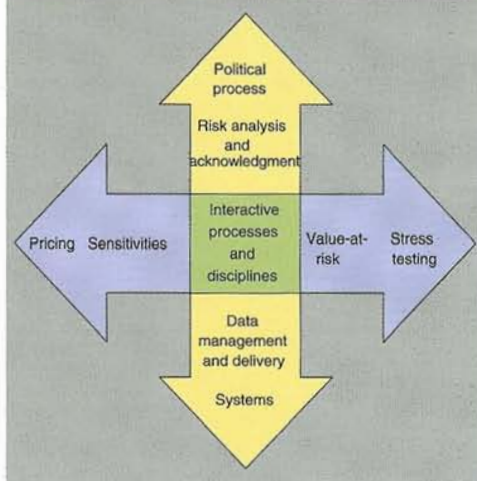
Market risk management framework criteria

Having examined the role and process features of an independent market risk function, the criteria required to be fulfilled by an effective market risk framework can now be examined. Given that the focus of this analysis is on the market risk framework to the extent that measurement and management techniques are relevant, IT infrastructure criteria and analysis have been excluded. It is more appropriate to deal with the issues of measurement and management prior to dealing with IT complexities.

The criteria necessary to be satisfied by a market risk function, in order for it to be considered complete from a measurement and management perspective are detailed in table A (note that it is assumed that if these criteria are met by a market risk function, then the business and regulatory requirements will also have been fulfilled).

The six framework criteria centre around the notion of "useful information". Useful information is considered to be a function of the following information and activity attributes:

2. Anatomy of market risk management



- Executable:** the quality and attributes of risk information must allow the story of risk to be told so as to instigate risk-mitigating action. Whereas the relevance of risk information relates to data specifically, executability relates to the ability to create action with data;
- Relevance:** when risk information is of sufficient quality to support or influence the risk-mitigating decision process in a timely manner. This requires information that allows the user to evaluate decisions of past and present risk factors and to form views and manage future expectations. Such information should also contain the attributes of "what" risk is, "how" could it eventuate and "why" is it a point of concern, thereby allowing the story of risk to be told;
- Accuracy and reliability:** when information can periodically be trusted to represent materially the risk profile of the specified activity;
- Actionable:** relevant risk information that allows the user to execute the risk-mitigating ac-

tion necessary. This is likely to involve the execution of a transaction in the financial market. As a result, actionable risk information is consistent with the way risk is bought and sold in the relevant market (Smetanin, 1997);

- Complete:** risk information that covers all possible material future scenarios;
- Transparent:** risk information that is comprehensible and able to be disaggregated down to its simplest parts;
- Timely:** risk information that is delivered in sufficient time to support or influence the risk-mitigating decision process;
- Effective representation:** when risk information is reported or delivered in a way that is appropriate for the target audience and maximises the relevance and comprehensiveness of the information to the user. Effective representation is a function of several factors that add value to the information, including data association, layout, colouring, imaging, etc;
- Consistency and comparability:** allows the user a common platform of risk measurement and effective representation to discern between risks at a point in time and through time;
- Defensible and accountable:** relates to the duty of the market risk manager to defend and be accountable for risk information that is understood to be relevant, reliable and comprehensible. It is a foundation for open dialogue with the business and senior management;
- Adaptable and enduring:** requires new quantitative, qualitative, market and cultural developments to be absorbed into the market risk management process, while neither affecting the consistency of past, present or future risk analysis or decisions, or having to re-educate the decision-making hierarchy;
- Extensible:** requires quantitative or qualitative methods to be equally applicable and extendable to the incorporation of new product classes, business activities and enterprise-wide risk measurement requirements;

- Customisable:** requires the association of risk information to be able to be customised;
- Economical:** the production of risk information that is economically feasible – ie, the benefits need to outweigh the costs.

Market risk management framework – a solution

What ultimately concerns the market risk manager? A market risk-related surprise!

To satisfy the corporate governance role and to support the business, market risk management necessarily needs to be focused upon loss scenarios. In this way, market risk managers become purveyors of loss scenarios or experts in what can go wrong. However, it is those scenarios that sit near or exceed the loss tolerances of the organisation that are of most interest. given that it is these scenarios that are likely to be regarded as a "market risk-related surprise". In this regard, VAR techniques have been revered as the panacea for the risk measurement.

Ultimately, market risk managers are only as good as their assessments and views of future states of the world, and their ability to instigate timely risk-mitigating actions. Market risk managers would not be particularly useful if they were persistently poor at assessing the range of future possible market value changes, as they would not be able to manage a market risk-related surprise.

VAR in perspective

VAR covers usual risk, handling the range of outcomes that lie between the expectation and confidence interval. Given that the market risk role requires performing a corporate governance function, it is not the expectation for which an understanding is predominantly required but is instead those scenarios that occur outside the "field of comfort". This brings the market risk manager to that part of the PDF that lies beyond the VAR number.

As a single measure, VAR does not assist the risk manager in developing a view of the future. VAR does not say much about the types of risk that exist in the tail of a PDF. What lies in the tails of these distributions are extreme or unusual market risk events. The term "unusual" is used, given that for some exotic or leveraged products, normal movements in risk factors could lead to large loss outcomes. This also covers those scenarios that investigate changes in correlations and liquidity assumptions, which can also lead to large profit and loss results.

The potential for a market risk-related surprise exists out in the tails of the PDF. In this regard, a market risk framework should pursue an understanding of what scenarios are near and beyond a VAR measure. Furthermore, the way in which an organisation generates a VAR number will affect its understanding of what lies beyond the VAR estimate. The utility of a simulation-based VAR approach far exceeds the utility of a parametric-based one, given that the simulation approach exhibits transparency and offers more information about loss possibilities.

A. Market risk management framework criteria

CRITERIA	INFORMATION AND ACTIVITY ATTRIBUTES
1. Execution: Ability of the framework to deliver risk-mitigating decisions in a timely fashion	Generally – useful information Specifically – executable, relevant, effective representation, customisable
2. Utility: Production and delivery of risk information that is useful	Relevant, accurate and reliable, actionable, complete, transparent, timely, effective representation, consistent and comparable, economical
3. Accountability: Ability of the framework to deliver risk information that is owned by the risk management process	Defensible and accountable, relevant, accurate and reliable
4. Extensible: Market risk framework that is able to make a contribution to firm-wide risk management: ● The integration of market, credit, operational and liquidity risk; and ● Risk aggregation across the organisation	Extensible, relevant, transparent, consistency and comparability, defensible and accountable, adaptable, enduring
5. Culture driver: The framework inspires an appropriate risk culture	Relevant, defensible and accountable
6. Adaptable and enduring: The framework can survive the test of changing market, qualitative, quantitative, cultural paradigms. This is a function of all of the above	

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From a market risk framework perspective, VAR has a role, but does not represent the solution. As a single number, VAR cannot tell the story of risk across large portfolios in a way that will raise appropriate and timely risk-mitigating actions.

The key weaknesses of VAR – which compromise the information and activity attributes, and therefore framework criteria – include:

- VAR models reflect observed risks and are designed to measure risk in normal conditions. VAR is therefore not useful in transition periods characterised by structural changes, additional risks, contracted liquidity of assets and broken correlations across assets and markets. In this regard, VAR, as a single measure, is at risk of not raising the alarm in a timely fashion, and therefore may fail to support the timely risk-mitigating decision;
- Dependence upon historical information. The key assumption that the future will behave as the past;
- VAR is a single measure that can be systematically biased;
- VAR is constrained by a confidence interval. As a single measure, VAR does not provide information as to how large a loss can be when the “comfort zone” is exceeded;
- Holding periods are usually short and are the same for all instruments;
- Given that the technique focuses on summarising many risk factors, VAR is limited in its ability to reveal concentration risk. However, VAR techniques do have an important role in market risk management, given that:
 - It is intuitive, so senior management tend to include it in their decision-making process;
 - It combines several different facets of risk management, namely positions, market volatilities and correlations into a single measure of risk. This simplicity allows VAR to play a role in supporting limit frameworks and communicating risk at senior levels of management;
 - VAR is a useful tool for the quick, relative view of risk across many portfolios. In this way, it behaves as a risk benchmark.

Given the inability of VAR results to raise appropriate and timely risk-mitigating action, scenario simulation and stress testing should be viewed as being as important as VAR measures.

Power of scenario simulation

As market risk managers should essentially perceive themselves as purveyors of loss scenarios, scenario simulation and stress testing have a vital importance. Scenario simulation forms the underlying measurement basis of the complete market risk framework. If a rich set of profit and loss scenarios is generated, then sufficient information is delivered, which allows:

- The market risk manager to convey and understand the risk reward drivers of a particular portfolio;
- Tail information to be analysed, thereby informing the market risk manager about the value drivers beyond the VAR measure and loss scenarios that may be unacceptable to the organisation;
- The calculation of VAR;
- The basis for stress testing;
- The unification of the concepts of VAR and stress testing, which assists in taking the uninitiated through the risk process.

The major advantage of the scenario approach to risk measurement is the ability to examine PDF tail behaviour under unusual and extreme conditions. As argued above, these conditions usually render the VAR measure unreliable at best and irrelevant at worst. Scenario simulation forms the backbone of a market risk framework that unifies the various approaches to risk measurement. The following description of the types of scenarios and figure 4 show the logical steps in this unification process.

Scenario simulation can be divided into four key categories, as illustrated in figure 4:

- **Class 1 Scenario – Valuation:** Valuation serves to locate the expectation of the PDF of an individual or class of assets. In this case, the scenario is no change in any risk factor, including time;
- **Class 2 Scenario – Sensitivities:** Sensitivities are designed to investigate the effect of small changes in the value of the asset. This is useful for limit, hedging and business communication purposes;
- **Class 3 Scenario – PDFs:** PDFs are designed to estimate the VAR of a portfolio and expected loss profiles;

Class 4 Scenario – Higher-order moments:

Higher-order moments are designed to identify the effect of extreme economic conditions on the accuracy and relevance of the VAR measure in periods of market turbulence or unusual market events. It aims to identify the risks that lie beyond VAR.

To the market risk manager, a scenario is an imagined view of a future state of the world from today. This view will encompass several different risk factors that are required to be combined into a single-value consequence. Scenarios are unique to risk managers in that they represent an exact depiction of a future state of the world. If the scenario occurs, then this is the amount of money lost. In other words, for market risk managers, scenarios are their “language of risk” (Dembo, Aziz, Rosen, Zerbs, 2000).

Scenarios themselves are not forecasts in the first instant, given that there is no weight of prediction behind the view. However, once a rich set of scenarios is created and the risk manager appropriately assesses the scenario set, it becomes necessary to determine those scenarios that are likely and of consequence. This is achieved through scenario grading techniques, such as scenario and stress barometers (Smetanin, 1999). In this way, the complete scenario analysis process does take on facets of forecasting (more will be said on the power of scenarios and grading techniques in the next paper of this series).

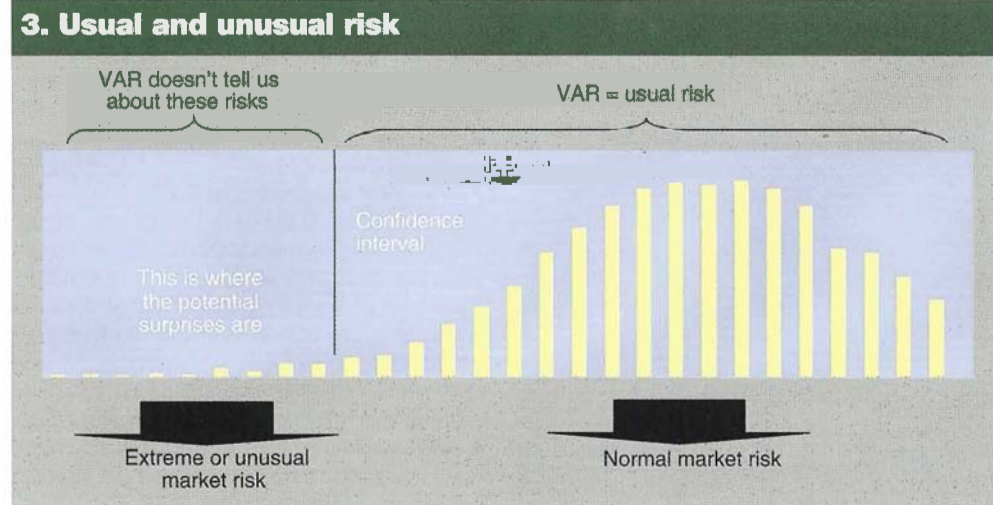
Satisfaction of market risk framework criteria

A scenario simulation framework is considered to satisfy all the relevant information and activity attributes categorised in Table A. This is attributed to the ability of a scenario simulation framework to calculate generated and customised scenarios that result in profit and loss vectors across risk factors. Provided appropriate loss tolerance and scenario grading tools are used, sufficient information exists to “tell the story of risk”.

Table B summarises how a scenario simulation approach compares with the framework criteria. To assist in the understanding of the usefulness of a scenario-generating capability, a comparison is drawn between a parametric approach to VAR (variance/covariance) and a scenario simulation-based risk process.

Such a scenario generating capability can:

- Unify the spectrum of quantitative approaches to market risk measurement through common mathematical processes. In this way, Monte Carlo techniques, enhanced by a selected set of scenarios (eg, historical sets), are the platform for the development of a complete market risk framework;
- Provide for the internal consistency of different risk assessments, which allows the risk manager to tell the story of risk by beginning with the expectation (price), understanding the rates of change of value (sensitivities), determining and assessing expected losses (VAR) and contemplating unexpected losses (stress testing), all within the same simulation framework;



B. Satisfaction of market risk framework criteria

CRITERIA	SCENARIO SIMULATION	VARIANCE/ COVARIANCE	COMMENT
Execution	●	■	The ability to mine VCV results is limited. Use of P&L vectors allows SS to be completely transparent and executable, allowing the expectations of loss to be managed and the story of risk to be told
Utility	●	■	As a single risk measure, VCV is limited in defining the "hows" and the "whys" across portfolios. P&L vectors in SS deliver how and why outcomes. More relevant and actionable information is offered about loss possibilities, allowing the risk manager to purvey the risk landscape
Accountability	●	■	VCV is difficult to defend given its attempt to summarise many dimensions of risk. Only those scenarios in SS that make sense are defended
Extensible	●	▲	VCV requires manipulation away from its core methodology in order to adapt to some risk factors. Errors in VCV become difficult to work with once applied to credit and operational risk classes. SS is able to be customised to suit new risk classes using the same measurement methodologies as the market risk framework
Culture driver	●	◆	VCV is limited in the way it can inspire new developments and the pursuance of new risk identification measures. SS development is boundless, it is only limited by the user's comfort with the current process
Adaptable and enduring	●	■	VCV method breaks down when more risk factors are introduced. Research begins to diverge away from VCV core approach. SS delivers scenarios for every occasion! This is achieved in a relevant, consistent and transparent way

▲ Does not sufficiently satisfy criteria to be of any use ■ Satisfies criteria to be of some use ◆ Satisfies criteria to be useful ● Completely satisfies criteria

□ Allow the risk management process to systematically combine the science of scenario generation with the judgements of the risk manager through the use of scenario grading techniques. Scenarios can be graded by incorporating the views of the market risk manager, economists, traders, etc. Given the decomposition properties of scenarios, a specific risk factor concern can be incorporated into the assessment of a scenario, regardless of how many risk factors are involved in the construction of that scenario. This is not practically possible with single numbers that "average" several aspects of risk;

□ Allow the risk manager to enter the sphere of the political process of instigating risk-mitigating actions by allowing the story of risk to be told. Given the decomposition properties of scenarios, the internal consistency of measurement techniques and the use of scenario grading tools, various sources of intellectual capital of the organisation can be presented in a way that allows the story of risk to be told;

□ Anticipate the connection of credit risk measurement and management to the market risk framework in a way that does not deter from the foundations of the framework. Scenarios supports

credit risk management in the same way as they support market risk management. Through common scenario generating techniques and unification of daily potential credit calculations with the market risk decision process, the mindsets of credit and market risk are integrated.

Conclusion

A market risk framework is required to provide a vision and strategy that endures the tests of time and change. This is necessary if the goal is to avoid being continuously plagued with new, in-vogue techniques and changing management mindsets. It demands a risk structure that allows new developments to be absorbed into the process without affecting the consistency of past, present or future risk analysis or decisions. A scenario simulation capability forms the beginnings of such a structure.

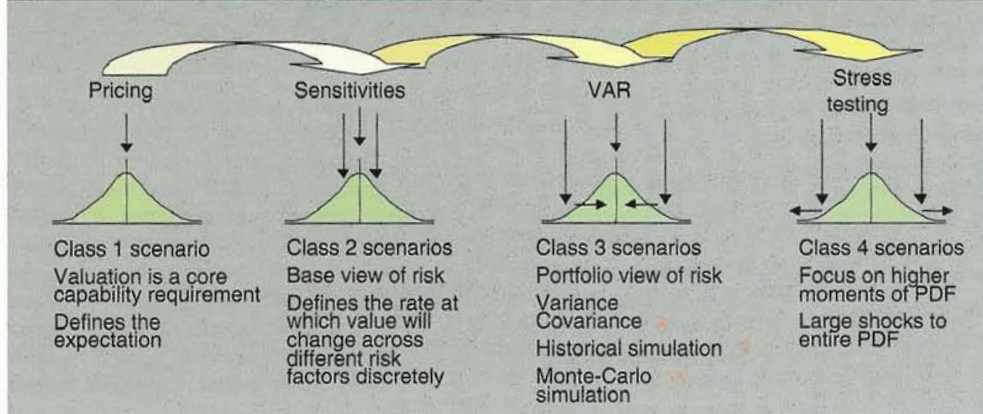
Scenarios are the language of risk and have the capacity to form a common dialogue between independent risk managers and risk takers. Such a technique allows the risk manager not only to advise of loss possibilities, but also to get proactively involved in managing the loss expectations of management. By articulating

the framework criteria, information and activity attributes necessary to complete the market risk framework, the opportunity is afforded to management, regulators and assurance providers to benchmark an organisation's risk management practices.

A scenario simulation framework that is predicated on a robust Monte Carlo process will satisfy the six framework criteria and 14 information and activity attributes to the extent that risk measurement techniques can. However, it must be remembered that a complete market risk framework is not just about scenario generation. It also involves the active participation by the market risk manager and an appropriate IT infrastructure to enable "information to be delivered". Ultimately, market risk managers are only as good as their views of the future and their powers of persuasion. ■

Paul Smetanin has over 14 years worth of risk management, quantitative and trading experience. He is a practice leader in risk management and contributor to many industry risk management initiatives
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4. Stages of scenario generation kept consistent through common Monte Carlo process links



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