EXECUTIVE SUMMARY

Having survived an unprecedented credit and liquidity crisis, the road to success for global financial institutions will continue to change dramatically. With pressure mounting on governments to take action, continuing strains in the economy, unforgiving trial in the court of public opinion, volatility of markets, and complexity of financial products, institutions face new challenges in recovering financial strength and restoring confidence. To reaffirm their credibility, the leadership teams of selected financial institutions are being tasked to build on the earlier albeit short-sighted stress tests, and address the broader purpose of sustainable performance and stability.

To thrive in a fast changing world, stress testing and scenario modeling will become a key governance practice and strategic tool at any financial institution of substance. Given the potential value that boards of directors and management teams can derive from stress testing it has been identified as a critical tool for risk management.

INTRODUCTION

Stress testing refers to the process of assessing the vulnerability of financial institutions to extreme but plausible market conditions. Stress testing covers multiple risk measures across categories and complements traditional risk models. It enables institutions to accurately assess risk and define the "risk appetite" of the organization. Stress tests also provide actionable information to senior management for decisions around capital allocation and contingency planning.

Value-at-Risk (VaR) based methods are most commonly used to assess risk across categories such as credit, market and operational risk. These methods calculate risk as the worst case loss that can be incurred over a specified time horizon with a given confidence level. However, the recent credit crisis has highlighted the limitations of these risk models and has firmly placed the spotlight on stress testing as a critical and integral tool of risk management.

Stress testing is an integral part of both Pillar I and Pillar II requirements of the BIS Capital Adequacy framework. In addition, the Basel Committee on Banking Supervision (BCBS) has issued, in May 2009, a detailed document titled “Principles
for Sound Stress Testing Practices and Supervision”. Financial institutions covered by the Basel II accord on capital adequacy are required to follow these guidelines on stress testing.

The guidelines emphasize the need to move away from the traditional, silo’d approach to stress testing and move to an integrated and enterprise-wide stress testing program. They also require banks to use stress test results as key inputs in their strategic decision making processes.

NEED FOR STRESS TESTING

Recent credit crises have highlighted the limitations of traditional risk models. Institutions typically use statistical methods and models for estimating risk and VaR is among the most commonly accepted measure of risk. It is defined as the worst expected loss over a given time horizon at a given confidence level. VaR methods are used to estimate risk across categories including credit, interest-rate, equity, commodity, etc.

However risk models suffer from certain limitations:

- VaR, as a risk measure, underestimates the occurrence and severity of tail events. It measures risk as a percentile of the potential loss distribution and ignores events beyond the percentile.

- VaR calculations are based on estimates of risk parameters such as default probability, recovery rate for credit risk and mean reversion, volatility for market risk. These risk parameters are estimated from historical data using statistical techniques such as GLM, GARCH etc. Historical data used to calibrate risk parameter models often does not cover periods of extreme
market conditions. As a result the predictive ability of these models breaks-down under extreme market conditions.

- Risk models assume normal market conditions and are often not designed to predict losses under extreme conditions

As a result, these traditional risk models were not able to predict the severity of losses during the recent financial crises.

Stress testing complements existing risk models to provide a comprehensive assessment of risk. It models tail events, therefore addressing limitations of traditional risk models and enables institutions to assess potential losses across risk categories due to extreme market conditions.

REGULATORY REQUIREMENTS AND IMPLICATIONS

Stress testing forms part of both Pillar 1 and Pillar 2 requirements of the Basel Accord. Regulators require banks to report capital numbers under both baseline and stress conditions. Regulators are highlighting the need to have stress testing as a critical component of a bank’s risk management systems. In May 2009 the Basel Committee on Banking Supervision issued the final paper on “Principles for Sound Stress Testing Practices and Supervision”. This paper focuses on principles of conducting stress testing and the use of stress test results in strategic decision making. These principles are applicable to all banks and are to be applied on a proportionate basis. Key issues as stated in the document are as follows:

- Stress testing needs to form an integral part of the governance and risk management process. Board and senior management are to be the ultimate owners of the stress testing program in the organization. Onus is on the senior management to use stress test results in operational and strategic decision making.

- Stress testing needs to complement other risk management tools and models in identifying and managing risk across the institution. It should be rigorous and be able to identify scenarios that could have an adverse impact.

- In addition to other requirements, stress testing has been made the central tool for identifying and controlling liquidity risk of the organization. Liquidity risk scenarios need to cover both bank-specific and market-wide.

- Use of multiple techniques and processes for stress testing. These techniques range from use of deterministic parameter based stress tests to much more complex and evolved scenario models that use advanced statistical methods in estimating the impact of stress tests. Stress testing processes also need to factor the inter-related impact of a shock across risk categories.

- Institutions need to have a robust stress testing framework which is flexible and scalable to address current and future requirements.
• **Stress testing program should deliver a comprehensive assessment of enterprise-wide risk.** This involves stress testing multiple measures across assets, liabilities, income and capital of the organization. This also includes use of multiple scenarios, of varying levels of severity, in assessing the vulnerability of the institution.

• **And finally, BIS requires banks to adopt reverse stress testing to identify scenarios that will cause maximum impact.**

These principles coupled with jurisdiction-specific regulatory requirements have wide ranging implications for banks across the globe. At a minimum, banks will need to put in place a central enterprise-wide stress testing framework that is able to address key requirements including complex stress testing calculations, advanced data management and ability to stress multiple risk measures across categories. In addition, critical decisions such as capital allocation, risk based pricing, contingency planning, etc. will have to factor in the results of the stress testing process. Banks will also have to develop new models (or enhance existing ones) to assess the inter-related impact of scenarios across multiple measures.

**CURRENT APPROACH AND THE INHERENT CHALLENGES**

Almost all banks have had some form of stress testing running within the organization. These include stress testing using a range of methodologies starting from deterministic parameter based to the more advanced stochastic stress tests.

However, stress tests in most institutions, especially on the banking book, are done in an ad-hoc manner. They are conducted by different “silo’s” in the bank and definitions of scenarios and methodologies used to stress test vary across sections of the portfolio.

Moreover, scenarios are not severe enough to reflect the impact of financial crises in the event of change in these conditions.

As a result, institutions potentially fail to accurately estimate the impact of a scenario at the enterprise level. Scenarios that could have had a severe impact at an organization level get ignored in the “silo’d” approach to stress testing.

Stress tests are carried out as a standalone exercise for the purpose of regulatory reporting. Institutions rarely use these results in the risk management and capital planning decisions.

Another challenge that institutions face is the “black-box” and rigid nature of their risk management systems. Stress testing within these systems is restricted to capital calculations and is used primarily for regulatory reporting. These systems do not provide the ability to slice and dice stress output by various dimensions so as to isolate the risk “hot-spots” thereby limiting its use as a strategic decision making tool.
Bank's increasingly feel the need to have industry-standard technology solutions that have robust data management and modeling capability coupled with the flexibility to rapidly develop and deliver stress test results. This includes the ability to have a common repository of scenarios that can be used to deliver stress measures across banking and trading book portfolios.

Figure 2: Business Goals and Requirements of Enterprise Wide Stress Testing

However, institutions will have to address several key issues in adopting an enterprise-wide stress testing program.

One such issue is defining coverage in terms of the measures that need to be stressed. The list of measures would include elements from the assets and liabilities side of balance sheet, P&L and liquidity areas. Stress testing this comprehensive list will provide an enterprise-wide view of the impact of a scenario.

Banks need to have a central and common repository of scenarios and models. Scenarios, defined as shock to risk factors, are to be developed taking inputs from multiple sources including judgment from business managers, economists and through use of quantitative techniques.

Specification of shock needs to allow for multiple techniques such as absolute shift, standard deviation shift, etc. and term structure twists and inversion.

In addition to a central repository of scenarios, bank's also require a central repository of models. This model repository needs to pull in models lying in multiple “silos” without altering their calibrations. A central repository is a key step.
in providing an enterprise wide assessment of stress - taking into consideration the interplay of risk factors.

An important first step in definition of a scenario is the identification of risk factors. Risk factors are indicators of economic conditions and institutions need to identify the ones that influence their risk profile. An exhaustive list of such factors is identified based on expert judgment and verified using statistical methods. Institutions typically use techniques such as auto-correlation and factor analysis to identify the risk factors relevant to each segment of their portfolio.

Banks also need to have in place, methodologies to stress each of the risk measures. The complexity of these methodologies will depend on the nature of the variable being stressed and would, in general, involve use of statistical techniques.

**CONCLUSION**

Enabling enterprise-wide stress testing would require evolved technology solutions that can couple data management capabilities with complex computations required to stress wide variety of risk measures using multiple scenarios.

Stress testing approaches and regulatory requirements are going to evolve rapidly. Banks will require technology solutions that are extensible and are able to provide a central environment that can “host” models existing in different silo’s of the organization and stress them in a holistic manner. These solutions need to enable senior management to take strategic decisions on capital management & business planning by providing extensive capabilities on enterprise-wide stress testing.