Integrated Stress Testing

A Practical Approach
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The purpose of stress testing is to quantify exposure to extreme market movements and geo-political events. Stress tests can explore potential adverse outcomes and expose vulnerable areas allowing management to set risk limits and manage liquidity and capital.

For many banks, the recent financial crisis exposed the weaknesses of their stress testing programmes including an inability to forewarn of the devastating events. A variety of issues contributed to these weaknesses including backward looking stress tests, inadequate capture of risk factors and their correlations, non granular and poor quality data, a siloed approach to stress testing, lack of governance and the lack of integration of stress testing results into decision making processes.

In recent years, regulators have started to pay greater attention to this function and have stipulated further requirements in order to make stress tests more robust and include more plausible scenarios.

To satisfy regulators and make stress testing a credible and usable tool, banks must take an integrated approach to stress testing focused around the following areas:

- Stress testing framework
- Data management
- Governance
- Application architecture
- Management information and dashboards

Furthermore, an integrated approach will help reduce overall infrastructure costs, provide a robust and scalable stress testing framework and enable enhanced control and quality, ultimately providing a greater return on investment through better risk management.

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To properly explore adverse outcomes, a bank’s stress testing framework must be enterprise wide and include an integrated scenario definition and risk models across all risk types.

Market risks become credit risks when liquidity is reduced. Counterparty exposure calculation requires market risk analysis. The divide between market and credit risk stress testing is increasingly grey.

Scenario definition and associated risk measurement models must take into account all risk factors rather than a siloed risk type approach. The stress test must incorporate the impacts of one risk type on another.

The scenario definition must involve all related stakeholders including market risk, credit risk, liquidity risk, operational risk, finance and product lines so that a stress test can be developed that encompasses all risk types. The scenarios and models should be placed in a common repository with mechanisms to insure review by all necessary stakeholders.

Taking an integrated and holistic approach to stress testing will allow a consistent, transparent framework whereby scenarios applicable to one risk type can be used for another. For example, credit exposure stress can be based on the same underlying shocks as used for market risk stress testing.

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### 2 Stress Testing Framework

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**Exhibit 1: A holistic, integrated stress testing framework**

- **Define the scenarios and shocks for each portfolio, with input from all risk type stakeholders, finance and product lines.**
  - **Stress Tests Methodology**
  - **Scenario Management**
  - **Scenario Execution**
  - **Result Aggregations**
  - **Reporting and Actions**

- **Apply the scenarios and shock as per the methodology defined for each portfolio for various risk groups.**

- **Define risk factors and their correlation for each risk group. Decide if it’s a sensitivity based shock or a full revaluation.**

- **Define senior management Dashboards and highlight the effect on capital requirements and liquidity. Decide if the stress testing methodology is adequate for each of the risk groups.**

- **Manage the risk reporting hierarchies and aggregate the results at each node.**
Banks can leverage the skills, methods and resources from one department to another and allow the rapid development of scenarios and associated models in a consistent manner, as well as ensuring cross-risk effects are taken into consideration. A holistic stress testing framework will take into account the organizational model, integrated scenario generation and testing models, as well as management information being fed appropriately into decision making processes.

An integrated stress testing framework can also allow banks to accurately define their enterprise wide risk appetite, calculate capital requirements and meet regulatory requirements by fostering the following activities:

- **Risk Appetite**: Build stress scenarios, analysis and models to cover all risk types.
- **Economic and Regulatory Capital**: Compute capital requirements under normal and stressed conditions; use scenarios and models for stress testing all risk types from a central library with stakeholder input from all risk types, products lines and finance.
- **Regulatory Requirements**: Comply with regulatory stress testing requirements; demonstrate integrated enterprise wide scenarios and models for stress testing; and demonstrate high quality and traceable data used for stress testing.
A necessary component of stress testing is the use of high quality, understood and up to-date data. The first step in the management of data for stress testing is to create a repository of trade and position data that will serve the needs of integrated stress testing. The data repository must:

- Include the risk aggregation requirements such as book and organizational hierarchies, netting, legal hierarchies and economic capital;
- Be seen as a repository to serve the needs of all risk types including credit, market, liquidity and operational risk;
- Ensure the sources of data are from strategic golden repositories where appropriate;
- Satisfy the need of historical time-series data;
- Source data real-time not end of day;
- Source data from the source of capture rather than some multiple hand warehouse; and
- Use common business driven taxonomies.

### 3.1. Data Quality

Data quality is not only a necessity for optimising and having correct reported figures but also a requirement of regulators. Typical data quality problems include:

- Missing and incorrect data;
- Data that is untrustworthy because it has not been regularly maintained or does not have appropriate overrides;
- Lack of data context; for example, is the Moody’s rating the long term or short term view?
- No identified owner for the data;
- Lack of traceability; e.g., the source, data chain and modifications of the data are not clear.

Regulators require banks to demonstrate that these issues have been addressed.

While data quality has been a hot topic in the industry for years, operationalising data quality—the implementation and governance of a data quality strategy across departmental and/or organisational boundaries—continues to be a challenge for many banks. Three key criteria must be used to determine data quality: appropriateness, completeness and accuracy.

#### Exhibit 2: Three key criteria are used to determine data quality

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>1. Appropriateness</strong></td>
<td>Data is considered to be <strong>appropriate</strong> if it is suitable for the intended purpose (e.g., the valuation of technical provisions, setting of assumptions) and relevant to the portfolio of risks being analysed (i.e., directly relates to the underlying risk drivers).</td>
</tr>
<tr>
<td><strong>2. Completeness</strong></td>
<td>Data is considered to be <strong>complete</strong> if it allows for the recognition of all the main homogeneous risk groups. Thus, data is considered to be complete if it has sufficient granularity to allow for the identification of trends and the full understanding of the behaviour of the underlying risks.</td>
</tr>
<tr>
<td><strong>3. Accuracy</strong></td>
<td>Data is considered to be <strong>accurate</strong> if it is free from material mistakes, errors and omissions. Most of these will be caused by human error or IT failures.</td>
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4 Governance

Regulators have stipulated that banks improve the governance of their stress testing programmes. Internally banks need to make programmes more credible with a buy-in by management and top down governance approach. A stress testing committee must exist that has board representation and ensures governance around the following areas.

4.1. Scenarios, Analysis, Models
- Must be integrated and include input and validation from all risk areas, finance, product lines and regions group-wide;
- Must be fully catalogued, documented, understood and transparent; and
- Must not be allowed to become stale.

Regular controlled reviews must be planned to check scenarios, analysis and models for appropriateness and up-to-dateness. Similarly, when new macroeconomic or geographic scenarios emerge, the scenarios must be reviewed for their appropriateness and establish if shocks are severe enough.

4.2. Management Decision Making Processes
The results of stress testing must be fed into all management decision making processes, whether it be strategic, contingency or acting on early warning signals.

<table>
<thead>
<tr>
<th>Exhibit 3: Application of stress testing results</th>
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<tr>
<td><strong>Capital planning</strong></td>
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<tr>
<td><strong>Capital budgeting</strong></td>
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<tr>
<td><strong>Cost of risk</strong></td>
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<tr>
<td><strong>Cost of capital</strong></td>
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<tr>
<td><strong>Portfolio management</strong></td>
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<tr>
<td><strong>Business strategy</strong></td>
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</tbody>
</table>

Governance must ensure the stress test results flow seamlessly into the planning processes in a timely manner and are in a format that is useable, can be easily understood and can be analysed appropriately.

4.3. Data and Data Quality
The data used in stress testing must be part of a bank’s overall data quality and governance program. The data must be of quality, traceable, timely and its context understood.
5 Application Architecture

An integrated IT platform is vital to support integrated and holistic stress testing. The IT platform must seamlessly integrate:

- Data that supports all risk types, scenarios and aggregation. The data must be the same date used by other risk and finance processes so no reconciliation issues occur;
- Data quality metrics and traceability;
- Scenarios and models; and
- Management information and dashboards

Tools must exist to allow efficient input and timely calculation of results. Similarly, workflow to manage scenario review and force results to relevant stakeholders must exist.
6 Management Information and Dashboards

Reporting the results of stress testing and feeding them into management decision making processes is an activity of utmost importance. Scenarios and models have various inputs and assumptions that need to be understood by decision makers. The inputs and assumptions are needed along with the results. And the results must be available at granular and aggregated levels.

The management information and dashboard layers must have analytic capabilities and allow the following reporting:

- Scenarios, assumptions and correlations;
- Results at a granular and aggregated level; and
- Results by product lines and geographical regions.

Exhibit 4: Dashboards provide the “user view” into the quality of a data population. Organizing dashboards according to quality measures, process steps and business rules usually provides the best view for subsequent remediation efforts.
7  In Practice

7.1. Stress Testing Productionisation
A leading global bank was experiencing issues due to the lack of an integrated stress testing solution. The bank was using complex, spread based calculations and was not running stress tests frequently. Over time, manual processes were leading to a lack of transparency and operational risks.

Capgemini built a robust stress testing system for our client to automate the execution of stress tests. The interface allows risk managers to configure the bumps and make changes to the risk factors that are being stressed to reflect the market moves. The system was designed with checks to validate the results of the stress tests. Exception reports and thresholds were designed to increase the accuracy of the system.

The business process was designed to be simple so that our client could execute weekly stress tests without requiring in depth understanding of the system. The new system was integrated into the bank’s existing IT infrastructure which provided round the clock support and disaster recovery backups.

Exhibit 5: Stress Test Engine - Use Case

Benefits
Capgemini’s solution:
- Provides a common infrastructure to conduct stress tests;
- Eliminates manual processes;
- Facilitates better reporting and analysis;
- Improves frequency of tests due to faster processes; and
- Supports multi-factor and complex models.
7.2. Stress Testing Credit Risk

A regional bank owned by a Tier 1 global bank was required by the FDIC to build a stress testing program within three months. The program needed to be aligned with the approach defined by the parent company and Basel II standards. The bank did not have a stress testing policy, infrastructure or components in place. Also, the bank did not have sufficient in-house expertise or experience with stress testing.

Capgemini created a solution that delivered a combination of intellectual property and services to support a stress testing program, based on both industry and Capgemini proprietary best practices. Our stress testing approach is a blend of statistical models for a top-down (portfolio level) as well as bottom-up (loan level) approach.

In addition to providing the stress testing models, Capgemini also provided the client with a scenario generator (using SAS and Excel) so that the program could be extended to other areas in the bank such as liquidity risk and market risk management. The stress testing model also produces a base line forecast of losses which is used by the bank for budgeting and capital allocation.

Benefits

Capgemini’s solution allowed the bank to:

- Comply with regulatory requirements in a timely manner;
- Kick off a stress testing program with almost full coverage for the entire portfolio using top-down and bottom-up approaches; and
- Make substantial progress in its Basel II program, for which stress testing is a key component of the ICAAP work stream.

Exhibit 6: Sample Scenario Generator
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