

# **The Global Stress-Test Automation Market: Stress, Uncertainty, and Moral Hazard**

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## IMPACT POINTS

- The stress test, a process in which a bank examines its capital levels under a variety of projection scenarios in order to assess its financial strength, is becoming a bigger concern for banks. In the United States, the Federal Reserve increased from 19 to 30 the number of banks subject to its most demanding level of stress tests and for which it will audit stress-test results. Outside of the United States, where stress tests are required by global Basel III, the percentage of participant countries that have issued final stress-test-related rules and begun implementing them increased from none as of October 2012 to 41% in March 2013.
- The stress-test automation market is expected to grow at a rapid pace, from an estimated US\$32 million in 2013 to an estimated US\$79 million in 2016. Opportunities exist for vendors to provide capabilities for the gathering of portfolio data, the automation of projection calculations, the crafting of scenarios, and the integration of portfolio performance results with financial statements, reporting, analysis, and dashboards.
- Factors identified by Aite Group as promoting the adoption of technology that automates stress tests include significant and growing regulatory demands and the opportunity for management teams to use the stress-test process to achieve insights about their operations and risk profiles.
- Factors identified by Aite Group as inhibiting the adoption of stress-test automation technology include regulatory uncertainty, the persistence of manual techniques and simplistic models in stress-test processes, and the enterprise-wide nature of stress tests, which results in a large number of stakeholders and decision-making processes that tend to be complex and lengthy.
- Banks should have a solid understanding of how their stress-test roadmaps and goals match up with vendor competencies. Some smaller banks may seek merely to satisfy regulatory requirements and need little in the way of stress-test automation. Other banks that are larger or seek risk-related analytic insights during the stress-test process will require more capabilities, such as scenario automation and Monte Carlo analyses.
- Based on information provided by vendors through request for information (RFI) responses during Q2 2013, phone interviews, and product demonstrations as well as Aite Group's own knowledge of the industry, this Impact Report evaluates the capabilities of each of the leading stress-test automation vendors.

## INTRODUCTION

General Motors, AIG, Bank of America, Citigroup, JPMorgan Chase, Fannie Mae, and Freddie Mac—the list of recent taxpayer-financed bailouts is almost as painful to consider as the persistence of speculative bubbles that cause such financial disasters. Though the public and many government institutions may have played meaningful roles in the most recent speculative cycle, it is the largest financial institutions that are the subject of not-unreasonable ire as governments attempt to learn from the financial collapse of 2008. Primary among the corrective actions is the requirement that banks evaluate their own capital adequacy using something called a "stress test": the pro forma analysis of a large financial institution under a variety of economic scenarios, some quite severe, in an effort to determine whether that financial institution has sufficient capital to survive the next financial catastrophe—indeterminate though that may be—without turning yet again to the taxpayer as a financier of last resort.

Two primary stress-test regimes demand that banks perform stress tests. Basel III (or the Third Basel Accord) is a global, voluntary regulatory standard for bank capital adequacy, stress tests, and market liquidity risk. It is international in scope, yet lags in implementation due to the multitude of participant governments that must locally craft and enforce stress-test guidelines. In the United States, the Federal Reserve, in anticipation of Basel III and seeking to enforce the capital-related components within the sprawling Dodd-Frank Act, has built a fully enforced and relatively demanding stress-test regime that extends even to mid-tier institutions, complete with highly prescribed projection scenarios, governed reporting, and full audits of banks' stress-test results and capital plans.

Completing a stress test is no easy task. Banks must ascertain the exact risk profile of each of their exposures so that their financial performance, including losses, can be estimated over a projection period of up to nine fiscal quarters under a variety of projection scenarios. Done poorly and with little automation, a bank must divert many of its underwriters and lenders from traditional banking activities to regulatory tasks that are labor-intensive and likely to contain errors that imperil compliance. Done effectively—with automated data extraction, scenario calculations, and reporting—a bank can cost effectively comply with stress-test regulations and even obtain risk-related analytical insights that can improve performance.

Banks must find a way to cost effectively complete stress tests. In this context, Aite Group has undertaken a thorough examination of the requirements for stress tests and the vendors that automate this challenging process. This Impact Report is designed for bankers who have already been through one or more stress tests but want to make these processes more cost effective or analytic as well as senior management teams seeking information that will allow them to respond to internal capital requests related to automating stress tests. This report will also be helpful to vendors seeking to sell capabilities that make banks' stress tests less costly and more analytic.

## METHODOLOGY

This Impact Report is based on comprehensive RFIs sent to 10 global providers of stress-test automation tools during Q2 2013, as well as discussions with three financial institutions in North America and Europe that use these technologies. The number of financial institutions able to participate in this study was limited due to the sensitive nature of stress tests, which speaks to a bank's ability to maintain sufficient capital to avoid turning to its government for financial assistance during an economic downturn. Stress-test-related documentation and guidance provided by both the U.S. Federal Reserve (the Fed) and the Basel Committee on Banking Supervision was also a significant data source for this piece. This research was further bolstered by the knowledge of the author, whose career spans eight years in software analysis, most of which were spent considering analytics-related deployments, and 13 years in commercial banking.

## STRESS TESTS

With the majority of global economies still recovering from the 2008 burst of the speculative real estate bubble, many countries are using capital adequacy tests to prevent their financial institutions from becoming "too big to fail." Concurrent with the risk that governments will again need to bail out large financial institutions is the peril of moral hazard; the more often large financial institutions are rescued by their governments, the more likely they will consider the taxpayer as a last-resort capital source and use that capital to compensate for poor credit decisions or deliberately risky activities.

Although it comes in different forms, has a variety of aliases, and is promulgated by different regulatory regimes, the premise of stress tests is relatively simple. Under stress tests, banks are required to forecast their performance under a variety of scenarios, some quite severe; determine their level of pro forma capital adequacy; and devise plans that ensure adequate levels of capital at all times. A variety of terms are used to refer to stress tests, including capital adequacy testing, Basel III, Dodd-Frank Act Stress Testing (DFAST), comprehensive capital analysis and review (CCAR), and capital plan review (CapPR). Two primary regulatory bodies mandate stress tests to differing degrees: the Basel Committee and the Federal Reserve.

### BASEL III

The Basel Committee on Banking Supervision requires stress tests as a result of capital-specific rules set forth in Basel III. Local participating governments, listed in Table A, enforce the requirements.

**Table A: Countries With Representatives on the Basel Committee**

Basel-participating countries		
Argentina	India	Saudi Arabia
Australia	Indonesia	Singapore
Belgium	Italy	South Africa
Brazil	Japan	Spain
Canada	Korea	Sweden
China	Luxembourg	Switzerland
France	Mexico	Turkey
Germany	The Netherlands	United Kingdom
Hong Kong	Russia	United States

Source, Aite Group, Basel Committee on Banking Supervision

Across the countries participating in Basel III are 210 banks, including 13 of the largest banks in the United States, which are subject to stress-test requirements under Basel III. Although Basel III sets forth minimum regulatory capital levels, its enforcement and the creation of stress-test-related rules and guidance has been delegated to the regulators in each of the participant countries (Table A), and their creation of stress-test regimes remains a work in progress. Table B shows the increasing degree to which Basel-participating countries have established local rules and enforcement for Basel III.

**Table B: Overview of Progress in Implementation of Basel III by Member Jurisdictions**

	As of October 2012	As of March 2013
Number of countries that have issued final rules and implemented them	0	11
Number of countries that have issued final rules but have not yet implemented them	6	3
Number of countries that are at various stages of finalizing rules	19	13
Number of countries that have not initiated any significant action to implement rules	2	0
Total	27	27

Source, Aite Group, Basel Committee on Banking Supervision

## THE DODD-FRANK ACT

In the United States, stress tests are required under the Dodd-Frank Act, and regulatory oversight is provided by the Fed. Although Dodd-Frank set forth many regulatory reforms, primary among its goals was the aggressive implementation of a stress-test regime, as such tests were expected to eventually be required under Basel III. Unlike the Basel Committee, the U.S. Fed benefits from one set of accounting standards within its jurisdiction. As a result, U.S. stress tests are far more mature in their structure, scope of demands, and level of scrutiny of bank submissions than are stress tests elsewhere in the world. Aite Group sees the stress-test mandate impacting virtually all banks in the United States; the level of stress tests required of these banks varies according to their size and regulators' estimation of the degree of systemic risk they pose.

## COMPREHENSIVE CAPITAL ANALYSIS AND REVIEW

The CCAR is the most demanding level of stress tests. CCAR banks are required to complete five nine-quarter projection scenarios—three crafted by the Fed and two by the banks themselves—and the Fed performs thorough audits of these stress tests, including banks' assessment of their own risks, the crafting of their down-case scenarios, the calculations performed during scenario testing, and management teams' capital plans.<sup>1</sup> Each scenario is a nine-quarter, forward-looking analysis of a bank's performance, including the resulting capital levels, based on a particular set of assumptions defined by assumed levels of a variety of macroeconomic indicators during each of the forward-looking quarters. Banks in the CCAR group that have international trading operations are also required to complete a "Global Market Shock Scenario" in order to test their ability to survive asset price declines across a variety of geographic markets and asset classes commensurate with the economic decline during 2008. The CCAR level of testing is set aside for banks that are both among the largest in the country and thought to pose systemic risk due to their size and the nature of their operations. In July 2013, the number of CCAR banks was increased by the Fed from 19 to 30; these institutions are identified in Table C, and the banks recently added to CCAR are indicated by an asterisk.

**Table C: "Too-Big-to-Fail" Banks Tested by the Federal Reserve**

CCAR institutions		
Allly Financial	Comerica*	Morgan Stanley
American Express	Discover Financial Services*	Northern Trust*
Bank of America	Fifth Third Bancorp	PNC Financial Services Group
BNY Mellon	Goldman Sachs	Regions Bank
BBVA USA Bancshares*	HSBC North America Holdings*	State Street Corporation
BB&T Corp	Huntington Bancshares*	SunTrust
BMO Harris*	JPMorgan Chase	U.S. Bancorp
Capital One	Keycorp	Wells Fargo
Citigroup Inc.	M&T Bank*	UnionBanCal*
Citizens Financial Group*	MetLife	Zions Bancorp*

\*=banks added to CCAR in July 2013; Source: The Federal Reserve

1. See Aite Group's report, *Capital Adequacy Testing: Don't Stress, Be Analytic*, June 2013.

## CAPITAL PLAN REVIEW BANKS

The banks added to CCAR had previously been subject to the Fed's CapPR, a less onerous process designed for smaller banks thought to pose less systemic risk. CapPR requires banks to perform four projection scenarios, and their submissions are not audited by the Fed. No banks are categorized as CapPR banks as of the writing of this piece; however, with the transfer of all 11 CapPR banks to CCAR, it is expected that banks previously too small to fit the CapPR profile will be reclassified as CapPR banks.

## GUIDANCE BANKS

In addition to requiring specific lists of banks to participate in either the CCAR or the CapPR, the Fed in 2012 released stress-test guidance for all FDIC-supervised and OCC-supervised banking organizations that have between US\$10 billion and US\$50 billion in total consolidated assets. Vague and brief, this guidance requires these smaller banks to "adopt stress testing principles" and highlights the importance of stress tests as an ongoing risk management practice that supports a banking organization's forward-looking assessment of its risks and better equips the organization to address a range of adverse outcomes.

## PERFORMING A STRESS TEST

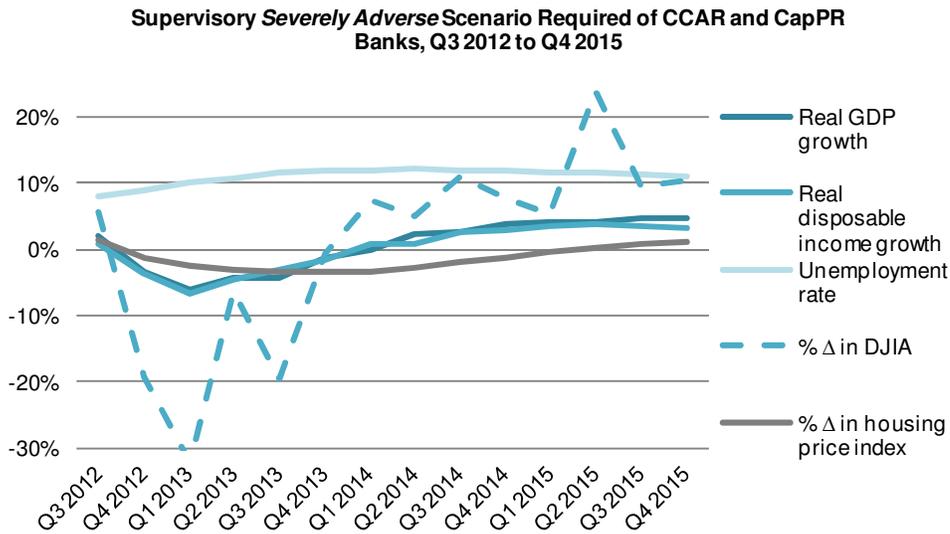
Tests recently performed by CCAR and CapPR banks in the United States provide a strong proxy for illustrating the requirements and difficulties involved in completing a stress test. Depending on a bank's classification, the largest banks, deemed "too big to fail," must annually complete either four or five projection scenarios, all covering a nine-quarter pro forma analysis. In the United States, "stress-test season" commences annually in November, when the Fed releases its requirements for CCAR and CapPR banks, including highly structured projection scenarios, defined by up to 26 domestic and international macroeconomic factors.

Although some scenarios are defined by the Fed and comprise predefined domestic and international macroeconomic factors over the projection period, other scenarios, deemed "Bank Holding Company Scenarios," are to be crafted by the banks themselves and designed based on the banks' individual business models and risk profiles. While the Fed's "Severely Adverse Scenario," one of the predefined scenarios provided by the Fed during the 2012 round of stress tests (Figure 1), describes a double-dip recession in the general economy, the Bank Holding Company Severely Adverse Scenarios are crafted by the banks themselves to reflect their own specific risk profiles and business models. For example, an agricultural lender would likely involve assumptions such as significant reductions in grain prices that would adversely impact their borrowers' abilities to repay loans. The banks performing these stress tests must detail in a series of reports the impacts of these scenarios on their institution in general and on capital levels in particular; the reports are highly governed by the Fed. Also required are capital plans that assure the Fed that adequate capital levels can be maintained under all scenarios. Throughout the stress-test process, the Fed examines bank data to determine whether the banks undergoing stress tests have adequate infrastructure in place to accurately monitor the levels of risk in their businesses.

Some of the challenges that make stress tests particularly difficult endeavors for banks follow:

- **Data:** Loan data, which often resides in separate loan origination systems and core banking systems, typically lacks the credit- and risk-related context required to estimate how a loan will perform under the scenarios.
- **Breadth:** Stress tests must incorporate the exposures of all commercial and retail operations as well as non-loan assets held by treasury departments, including derivatives.
- **Calculation complexity:** Substantial amounts of computing power are required to estimate the impacts of 26 macroeconomic indicators on all exposures, whether such calculations are performed at the individual loan level or the portfolio level. Complicating matters are interactions among outcomes and key risk indicators. For example, an increase in the inflation rate might cause changes not only to loan-to-value ratios but also to these factors in response to one another. Ideally, in order to deliver highly granular data to the Fed, stress tests should be performed at the loan level, increasing the complexity and volume of calculations.
- **Scenario severity:** In order to survive the Fed's Severely Adverse Scenario (Figure 1), banks require significant levels of capital and the ongoing generation of net income to bolster that capital.
- **Capabilities gap:** Although asset liability management systems have significant capabilities for modeling interest rate environments, they are less capable of enterprise-wide modeling based on the Fed's 26 macroeconomic metrics. Budgeting and planning tools can generate highly detailed projection scenarios, but they are only capable of dealing with a set of assumptions far narrower than those within the Fed's scenarios. Banks' highly trained employees are capable of building the spreadsheets and analyses required by stress tests, but such an approach is error-prone and can be cost-prohibitive.
- **Broadening regulatory scope:** Although many banks are accomplishing stress tests with a combination of manual reporting and automated analysis, banks tell Aite Group that these are extremely demanding processes that divert staff from their normal duties of acquiring customers, structuring loans, and underwriting risks. Further, should the scope of Dodd-Frank extend to the testing of liquidity levels, manual techniques for such analyses are unlikely to scale, and if they do, will serve only to further divert staff from normal banking activities.

**Figure 1: The Federal Reserve's Severely Adverse Scenario**



Source: The Federal Reserve, Aite Group

## BENEFITS OF STRESS TESTS

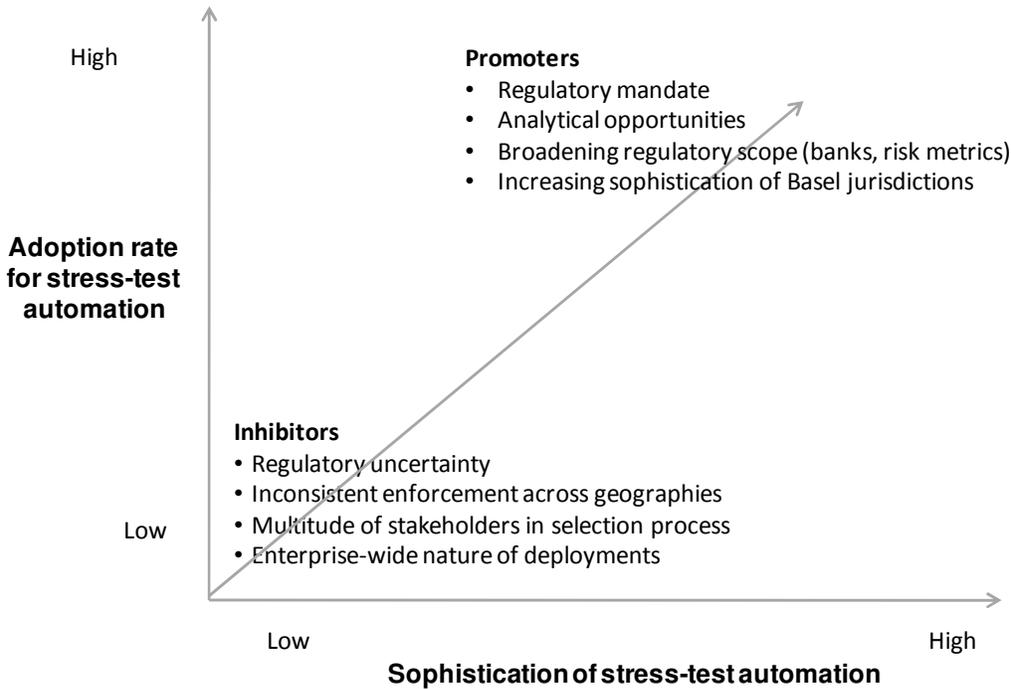
Although primarily thought of as a way to fulfill a regulatory mandate, stress tests are analytical tasks that can lead to valuable insights for bank management. In performing a stress test, a bank must document all of its significant risk exposures. With data scattered across so many different applications, an enterprise-wide analysis of risk is a rare opportunity to objectively assess all risk positions. It's also an opportunity to incorporate new parameters into risk analysis. For example, while banks are traditionally good at identifying all loans based on parameters such as industry, location, or risk rating, performing a stress test will enable a bank refine its risk analyses, such as by identifying the level of exposures that are highly sensitive to inflation or housing indexes.

## MARKET CONDITIONS

While strong regulatory mandates Basel III and Dodd-Frank promote the automation of stress tests, Aite Group has identified significant inhibitors to adoption in both U.S. and non-U.S. markets (Figure 2). Some of these inhibitors include:

- **Inconsistent regulatory pressure:** Outside of the United States is an absence of consistently well financed and structured stress-test regimes. Although the Basel III Accord, the capital-related set of regulatory standards set out by the Basel Committee on Banking Supervision, defines minimum capital levels, only 11 of 27 Basel countries have issued final rules and fully implemented them (Table B). Rule issuance, funding, and enforcement that include the examination of bank's stress-test results are critical to a successful stress-test regime. Such infrastructure is not readily built by regulators, however. In fact, despite the European Central Bank's issuance and implementation of regulatory guidelines, a 2012 round of European stress tests—in which all banks performed strongly—was followed by the embarrassing failure of one of the tested entities due to a lack of test-result audits by the central bank.
- **Moderate regulatory uncertainty in the United States:** Although stress testing, as governed by the Fed, is currently highly prescribed and structured, a shift in political power to the more *laissez-faire* Republican party could lead to defunding of the Fed's stress-test capabilities. Under such conditions, audits of banks' stress-test results could be far less thorough, sanctions could become more infrequent and mild, and banks might be called upon to dedicate fewer resources to stress tests and their automation.
- **Reliance on simplistic models:** In the face of regulatory uncertainty and the limited funding of stress-test authorities, many banks accomplish cost-effective stress-test compliance with models that are narrowly defined and emulate regulators' scenarios but have limited ability to achieve insights needed by risk managers and senior management. This is particularly true of smaller banks—such stress-test practices are often advocated by staff who are responsible for forecasting and planning and who don't want to see their budgets or staffs pared down as a result of automated analysis. Resistance to such automation is particularly strong in Europe, where a history of geographic fragmentation and pre-EU regulatory diversity has prevented the formation of a large ecosystem of software vendors such as those available to U.S. banks.
- **Organizational scope:** The performance of a comprehensive and accurate stress test requires data, insights, investments, and personnel in departments such as lending, credit management, risk management, accounting, treasury, and IT. In addition to their involvement in the process, each of these departments is a stakeholder in any potential investment in automated stress tests. The involvement of so many parties in such a decision, and the attendant uncertain championing, funding, and data sharing, lengthens vendors' sales cycles.

**Figure 2: Summary of Forces Impacting Adoption**

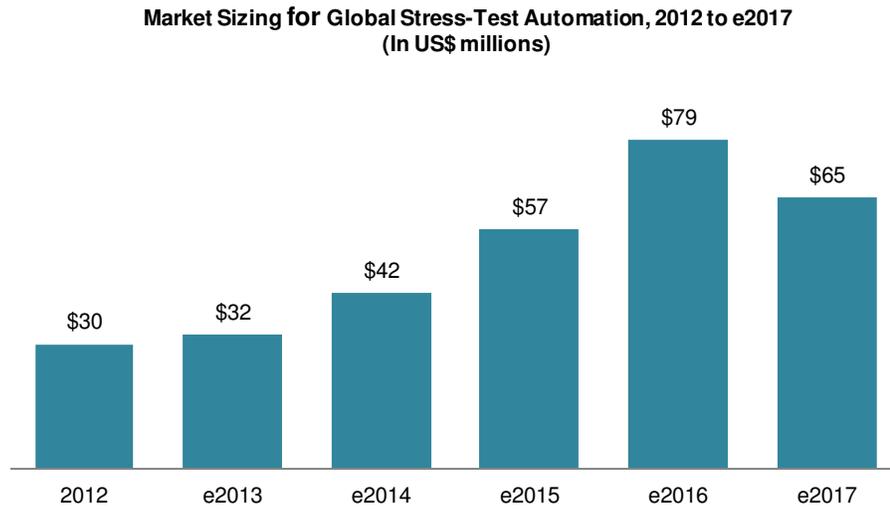


Source: Aite Group

## MARKET SIZING

The global market for vendor-provided stress-test capabilities is expected to grow at a moderate pace over the next few years, with an estimated US\$32 million revenue in 2013 growing to US\$79 million in 2016 (Figure 3). Revenue is expected to grow through 2016, with all CapPR banks reclassified as CCAR banks and an increasing number of Basel jurisdictions finalizing their rules and devising enforcement apparatuses. As revenue grows and jurisdictions comply, more banks are turning to automation to make stress tests more cost effective. This will be offset, however, by banks' preferences to build their own capabilities, which Aite Group expects from among 10% to 14% of the largest banks. Revenue is expected to peak in 2016 as the largest players, those categorized by the Fed as CCAR and CapPR banks in the United States and those Basel-regulated banks with Tier-1 capital greater than US\$4 billion elsewhere in the world, automate their first stress tests.

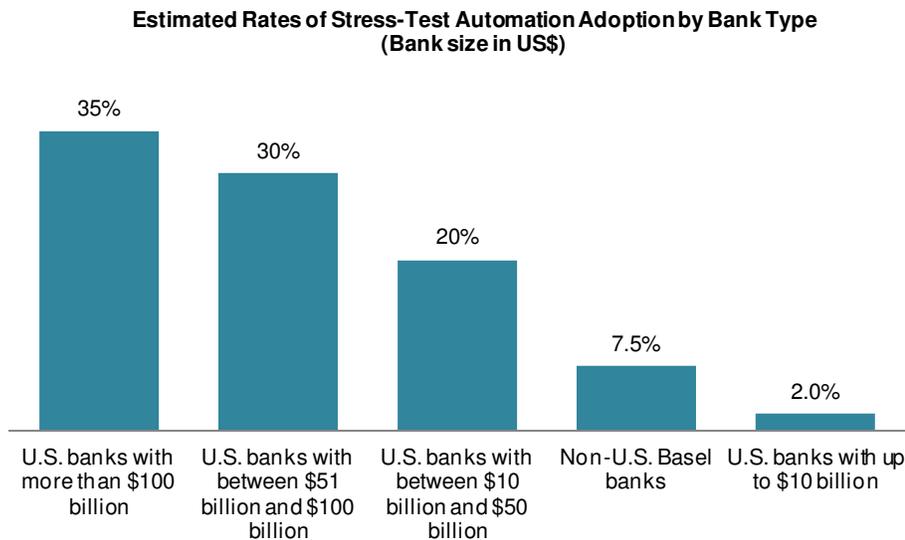
**Figure 3: Global Market Sizing for Stress Tests**



Source: Aite Group

Specifically, Aite Group estimates that the current levels of stress-test automation are 35% for banks with more than US\$101 billion in assets, 30% for banks with between US\$51 billion and US\$100 billion in assets, 20% for banks with between US\$11 billion and US\$50 billion in assets, and 2% for banks that have less than US\$10 billion in assets (Figure 4).

**Figure 4: Stress-Test Automation Adoption Rates Highest Among Larger Banks**



Source: Aite Group estimates

## THE COMPETITIVE LANDSCAPE

Most vendors offer stress-test capabilities by leveraging either existing bank infrastructure or their own proprietary risk-related data sets. Aite Group also sees most vendors using consulting services not only to deploy software but to also improve their clients' stress-test skill sets. While most vendors' capabilities are relatively similar in their ability to incorporate a relatively broad range of data into a stress test, vendors vary with regard to the analytical capabilities brought to bear in a stress-test process.

- **Leveraging existing bank infrastructure:** Many of the vendors offering stress-test automation leverage existing deployments and capabilities. Oracle's Flexcube and IBM's Algorithmic Credit Lifecycle Management are examples of existing data sets that already have—or can readily be given—the credit and risk contexts required to conduct stress tests. These vendors, as well as smaller infrastructure providers such as Fiserv and Harland Financial Services (recently acquired by Davis + Henderson), are able to rapidly tap into existing loan-related data stores in order to apply regulators' scenarios, simulate those scenarios using a narrower set of assumptions, or build bank-specific scenarios using metrics that may or may not be contained within regulators' scenarios.
- **Leveraging proprietary vendor data:** Many ratings agencies have analytics-focused subsidiaries that have entered the market by complementing banks' existing data sets with proprietary ratings data. These vendors deliver value by providing large data sets from which metrics, such as probability of default (PD) and loss given default (LGD), can be calculated for loans and borrowers within a bank's lending operations. Ratings agency data can also be used to select publicly held companies that can be used to simulate privately held companies, for which relatively little data exists in projection models.
- **Consultancy services:** Although capabilities and data enable vendors to enter the stress-test market, consultancy is one area in which vendors differentiate themselves. Stress-test vendor consultancies, most of which have completed more stress tests than any individual bank, can deliver significant value as a result, transferring knowledge related to critical tasks with which bank compliance teams are unfamiliar. These include scenario construction, the selection of down-case scenarios to be presented to regulators, the construction of capital plans, and the proper presentation of stress-test results to regulators.
- **Performance:** To a lesser degree, vendors also differentiate based on performance. Modeling the financial performance of a bank's entire portfolio of exposures over a nine-quarter projection period can be a resource-intensive task, especially for banks at the CCAR and CapPR level. Additionally, the faster computations can be performed and scenarios run, the more intuitively and iteratively an analyst can experiment with different projection scenarios while determining which scenarios should be in a bank's regulatory submissions. In-memory computing and multicore processing are technologies that some vendors use to accelerate the turnaround time for scenario results and required regulatory reports.

## MARKET OPPORTUNITIES

In the automated stress-test market, Aite Group sees a challenging environment for new entrants. The space is dominated by a large number of sizable vendors that enjoy entrenched bank deployments, existing data-related service contracts, established brands, and longstanding relationships with C-level executives, leaving little room for new entrants with unproven capabilities.

For existing entrants, Aite Group sees opportunities to increase revenue with services or performance. As shown in Figure 5, vendors' analytic capabilities are far more differentiated than is the scope of data analysis incorporated into their product offerings. Vendors seeking a larger share of the market should consider investing in capabilities such as reporting assets that go beyond regulatory requirements; consultants who can provide assistance in the regulatory process; and technologies such as Monte Carlo analyses, which enable compliance staff to spend less time constructing scenarios and more time evaluating and analyzing potential for inclusion in their presentations to regulators.

## VENDOR COMPARISONS

Vendors in the stress-test space deliver value to their bank customers in two ways. First, they improve a bank's productivity by automating many of the labor-intensive tasks completed during a stress test, such as the gathering of data and the construction of spreadsheets for performing projections. Second, stress-test vendors reduce risk. Risk reduction occurs as a result of both the scope of data sources incorporated into stress tests as well as the breadth of capabilities for constructing scenarios analyzing their results. In order to help banks evaluate potential vendors and assemble a short list, Aite Group has ranked the vendors in Figure 5. The two parameters used to evaluate the vendors are "scope of data integration" and "degree of analytical insight."

### SCOPE OF DATA INTEGRATION

The more data is brought to bear in a stress test and the more granular that data is, the more a stress test will generate insights that improve risk-related decision-making and enable institutions a better dialogue with regulators. Vendors in this space are ranked higher if they are able to automate data acquisition from common sources such as core banking systems and loan origination systems. External data sets—ratings or proprietary information such as public or private company probabilities of default PDs—are also important to stress tests. Vendors receive credit for the ability to integrate with such data sets and even more credit for providing the actual data. Key to the scope of data evaluation is also the granularity of the data; vendors that perform tests based on loan-level data (which boosts credibility of analysis with regulators) rather than portfolio-level data rank higher.

## ANALYTICAL INSIGHT

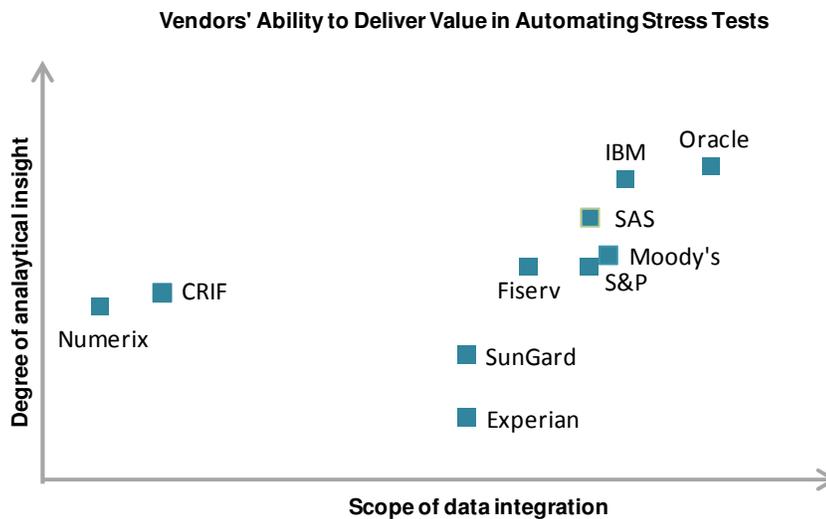
Of course, the more analysis and reporting are available to a bank's compliance specialists and risk managers during a stress test, the more decision-makers can learn from the process.

Capabilities for which vendors are ranked higher in the matrix include:

- **Enterprise-wide analysis:** Automated estimations of PDs, exposures at default (EDs), and LGDs under different scenarios are a terrific capability, but a vendor delivers more value when it can estimate the impact of such estimations on a bank's income statement, balance sheet, and capital levels. The more extensively scenario-driven default data is used to calculate capital levels and populate reports and dashboards, the higher a vendor ranks.
- **Assistance in the regulatory process:** Given the newness and uncertainty of stress-test regulations, many compliance officers are unsure about how to construct bank-specific scenarios and fulfill all the quantitative and qualitative demands of stress-test regulators. Consultative capabilities for which vendors receive credit in the matrix include data quality management, scenario selection, and assistance with presentations to regulators.
- **Monte Carlo analyses:** Monte Carlo analysis is a problem-solving technique used to approximate the probability of certain outcomes by running multiple trial runs, called simulations, using random variables. In stress tests, this technique can be used to rapidly generate a large number of specific scenarios with designated outcomes such as insufficient regulatory capital or nearly insufficient regulatory capital. The technique can be used to rapidly generate a large number of worst-case or reverse scenarios, leaving stress-test performers more time to determine which scenarios are plausible, which should be included in regulatory presentations, and how the bank would respond were such a worst-case scenario to actually arise.
- **Contingency planning:** Vendors' consultancy service also extended to strategic planning. In performing stress tests, banks are able to identify the specific economic scenarios that can lead to insufficient regulatory capital. While this is an important analytical exercise, preparing for such an outcome is even more critical for both planning and regulatory purposes. Some vendors' consultancies and capabilities are able to assist banks in crafting plans that can be implemented to ensure that, should regulatory capital erosion begin, it can be mitigated by measures such as asset sales and the cancellation of capital distributions. Although more important for the largest banks that truly pose systemic risk, the creation of such living wills is viewed by Aite Group as a valuable stress-test capability.
- **Non-stress-test analyses:** In addition to providing the analyses and reporting that enable compliance with stress-test mandates, some vendors also provide related analytical capabilities, such as a comparison of a bank's actual risk profile to its intended profile, the identification of exposures that are a mismatch with that risk profile, and the estimation of the impact of potential strategic changes—such as acquisitions, divestitures, or entries into new markets—on a bank's projected regulatory capital.

Although the breadth of a vendor's analytic capabilities is the primary factor, Aite Group also values criticality of insight by a specialist. For example, Numerix's analytics capabilities are narrower than most of its rivals in the space; however, its ability to analyze the risk of derivatives held by treasury operations, where poor risk management can incur losses as significant as poorly managed loan operations, can deliver significant value.

**Figure 5: Stress-Test Vendor Value Matrix**



Source: Aite Group

## CONSTRUCTING A SHORT LIST

The stress-test vendor value matrix (Figure 5) and a consideration of the capabilities offered by vendors can be useful tools for bankers preparing to turn to vendors as they automate their stress-test processes. The first step in this process should be an assessment of whether a bank will automate stress tests merely to comply with stress-test requirements or to seek analytic benefits beyond compliance. Although stress testing is primarily thought of as a regulatory process, it is actually capable of delivering significant analytical benefits. Stress tests can reveal undetected hypersensitivities of a loan portfolio to macroeconomic factors. A bank can also use stress-test-related assets, such as data marts and ad hoc reports, to identify how well its risk profile aligns with management's intended profile. Banks seeking merely to comply with stress-test requirements can rely primarily on the vendors on the left-hand side of the matrix; those seeking analytics that can improve managerial decision-making and capabilities that better relationships with regulators can focus on vendors on the right-hand side of the matrix.

The second step should be a consideration of which of the capabilities offered by vendors will be required to achieve the goals on a bank's stress-test roadmap. These capabilities are detailed, in increasing level of maturity, in Figure 5. For example, in order to take an enterprise-wide approach to stress tests that is cost effective, granular in its analysis, and provides a bank-specific, down-case scenario that credibly tests the organization, banks in the CCAR group should

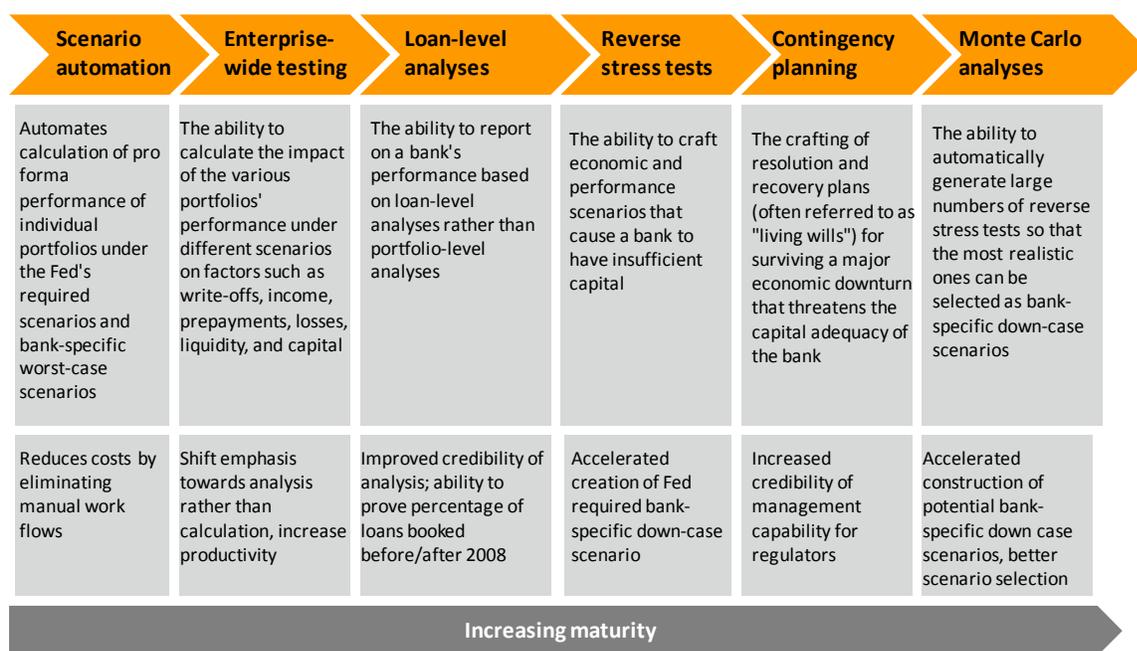
strive to automate their tests with a vendor that has as many of the following capabilities as possible:

- Scenario automation
- Enterprise-wide tests
- Loan-level analyses
- Reverse stress tests
- Contingency planning
- Monte Carlo analyses

Such banks should also implement contingency plans that assure regulators of management's ability to take corrective action should capital become stressed.

Although the stress-test submissions of CapPR bank stress-test activities are less thoroughly reviewed by regulators than those of CCAR Banks, and no banks are currently assigned this designation by the Fed, banks approaching US\$50 billion in assets should also prepare for this designation by obtaining as many of these capabilities as possible. Though automated Monte Carlo analyses and contingency planning may be overkill for banks with less than US\$50 billion in assets, banks in this size bracket can benefit from automated (and therefore cost-effective) stress tests that are also based on granular, loan-level, internal risk analyses. Such a level of analysis can be the basis for reporting the true level of risk in the bank rather than that arrived at by cursory analysis from an overextended team of examiners.

**Figure 6: Stress-Test Capability Grid**



Source: Aite Group

## SAS INSTITUTE VENDOR PROFILE

With a background in providing vertical-specific predictive analytics tools to companies in a variety of industries, SAS Institute (SAS) has recently configured its banking-specific tools to accommodate the analyses required to comply with Dodd-Frank and Basel III. Most of SAS's stress-test clients are banks with more than US\$100 billion in assets, and the remainder are banks with between US\$50 billion and US\$100 billion in assets.

### SOLUTION ANALYSIS

SAS has built four primary risk-related capabilities for banks:

- **SAS Risk Management for Banking** reports on and makes enterprise-wide predictions about risk types that include credit, market, and ALM/liquidity risk exposures.
- **SAS Credit Risk Management for Banking** is a similar capability but more narrowly focused on credit risk.
- **SAS Risk Dimensions** is a tool for building scenarios and performing pro forma financial analyses based on a variety of parameters.
- **SAS High Performance Risk** uses technologies such as in-memory computing and grid computing to perform stress-test calculations more quickly.

Though not originally built for stress tests, these solutions have recently been enhanced with functionality that supports stress tests and the ability to examine pro forma liquidity measures required under Basel. Capabilities available as a result of this offering include:

- **Data management:** Both SAS Risk Management for Banking and SAS Credit Risk Management for Banking provide a risk-specific data warehouse that comprise transaction-level data for modeling credit risk, market risk, regulatory capital, and economic capital. The capability combines bank-provided data with S&P data in order to enhance calculations of risk-weighted assets and regulatory capital. The warehouse uses a data model that is preconfigured to cover a broad variety of exposures and instruments, including counterparty risk, commercial loans, car loans, mortgages, and derivatives.
- **Modeling:** Using data warehouses within SAS Risk Management or SAS Credit Risk Management, SAS Risk Dimensions can perform stress tests, including reverse stress tests derived as a result of Monte Carlo analyses, at both the portfolio level and firm-wide level. SAS provides a set of risk factors that can be used as the basis for automating the crafting of bank-specific worst-case scenarios and what-if analyses based on economic metrics and assumed default levels. Risk Dimensions also provides a "sandbox" environment for developing new data models, metadata management, analyses, and reporting.
- **Reporting:** SAS can perform aggregated risk across a bank's entire portfolio of exposures or at the individual-exposure or portfolio level. Documentation of all changes to critical assets such as data models and projection scenarios improves the

auditability of reporting and stress-test results for regulators. The vendor can configure reporting for audiences at a variety of management levels and for a bank's specific risk-management culture and goals.

Capabilities that enable a bank to perform risk management tasks that go beyond the scope of capital adequacy tests include (1) key risk and leverage indicators for which reporting is required under Basel II and (2) the creation of management-facing dashboards that track key risk indicators on an intraday basis. (Table D lists the stress-test capabilities.)

**Table D: SAS Institute Stress-Test Capability Grid**

Capability	Available	Unavailable, on 18-month roadmap	Unavailable, not on 18-month roadmap
Automated data extraction from common data sources	X		
Integration with external data sets such as credit ratings	X		
Scenario automation	X		
Enterprise-wide test	X		
Loan-level risk analyses	X		
Dodd-Frank-compliant report formats	X		
Reverse stress tests	X		
Assistance with regulatory presentations			X
Contingency planning			X
Monte Carlo analyses	X		

Source: Aite Group

Major new stress-test releases occur on an annual basis, with maintenance releases occurring between two and four times a year. Slated for inclusion in SAS's stress-test capability are the addition of metadata to projection scenarios and the filtering of risk factors based on the categories, drivers, and portfolios selected by a model-builder.

#### **AITE GROUP'S RECOMMENDATION**

With their ability to perform highly complex projections on loan portfolios (Table E), SAS's capabilities are recommended for CapPR banks and CCAR banks that want to introduce as much automation to the process as possible and aggressively seek analytic benefits that go well beyond compliance.

**Table E: Key Strengths and Challenges—SAS Institute**

Strengths	Challenges
Extensive risk-specific data warehouse construction capabilities	Missing the soft-analysis skills such as assistance with regulatory presentations and crafting contingency plans
High calculation speeds enable iterative and ad hoc scenario analysis and fine-tuning	

Source: Aite Group

## USABILITY AWARD

SAS gets the usability award for fulfilling the need for speed in the stress-test process with SAS High Performance Risk. Although sometimes thought of as merely a shiny bright thing, speed plays an important role in stress tests. As with many analytic processes, the construction and fine-tuning of stress-test scenarios, including the selection of macroeconomic variables and their settings, can be a very ad hoc and iterative process. Unfortunately, stress-test scenarios require vast computations, involving dozens of macroeconomic variables that impact a variety of key risk factors which then interact with one another over the nine-quarter projection period. If such computing demands result in an overnight batch run—or even 30 minutes to calculate a bank's performance under a given projection scenario—it's unlikely that analysts will be able to use a rapid succession of ad hoc experimentations to select the best scenario to include in a regulatory presentation. With speed comes more iterative and thoughtful analyses, and speed should therefore be on the list of vendor requirements for large banks seeking analytical outcomes from their stress-test processes.

## CONCLUSION

Required by regulators as a tool for preventing financial institutions from becoming "too big to fail" and requiring taxpayer-funded bailouts, stress tests place significant analytic and reporting demands on banks. Here are a few recommendations for financial institutions developing or otherwise wrangling with stress-test capabilities:

- **Expect more regulation, not less.** With a growing number of Basel-participating countries finalizing their stress-test requirements and following the Fed's reclassification of all 11 CapPR banks as CCAR banks, the observed trend is increasing stress-test demands on smaller banks. In fact, having reclassified all CapPR banks as CCAR banks, it's possible the Fed will soon reclassify as CapPR banks any number of banks with between US\$10 billion and US\$50 billion in assets.
- **Assess your stress-test roadmap.** Vendors offer a variety of stress-test-related capabilities, from automated acquisition of loan data to the use of Monte Carlo analyses in the creation of down-case scenarios. Naturally, not all banks will need all capabilities. In devising a stress-test strategy, banks should consider their rates of organic growth and whether they'll be undertaking acquisitions, since regulators place the most significant demands on banks thought to pose systemic risk due to their size. Banks, however, should not think of stress tests as an exercise required of only the "too-big-to-fail" institutions subject to CCAR. Banks between US\$10 billion and US\$50 billion have been given guidance that they should adopt stress-test principles, and Aite Group expects the largest of these banks to soon be classified as CapPR banks, for which a highly prescribed stress-test regime is required by the Fed. Banks should also keep in mind the enterprise-wide nature of a stress test, which encompasses every exposure on a bank's balance sheet, including the entire loan portfolio and all non-loan assets, including derivatives.
- **Automation can't wait.** With even small changes in regulations come changes in stress-test project scope that will severely stress the automated work flows on which many banks rely to complete stress tests. For example, banks recently reclassified from CapPR to CCAR will now need to perform stress tests with sufficient reporting granularity, process documentation, and data lineage to satisfy the Fed auditors who examine banks' stress-test results and capital plans. The more these banks continue to rely on manual stress-test work flows, the more difficult it will be for them to comply as CCAR banks. Additionally, should the Fed add liquidity measures to its stress-test requirements, manual work flows will likely become entirely insufficient.
- **Obtain senior champions.** Although stress tests are enterprise-wide and their automation involves a variety of stakeholders and committees, automation cannot be postponed indefinitely. Proponents of automated and cost-effective stress tests should obtain senior-level sponsorship by crafting business cases in which the productivity improvements and analytical insights of stress tests exceed the costs of automating it.

## RELATED AITE GROUP RESEARCH

*Capital Adequacy Testing: Don't Stress, Be Analytic*, June 2013.

*Predictive Analytics in Commercial Banking: Cashing In on All That Data*, August 2012.

*Commercial Loan Underwriting: Opportunities for Lenders, Vendors, and Ratings Agencies*, November 2012.

## ABOUT AITE GROUP

Aite Group is an independent research and advisory firm focused on business, technology, and regulatory issues and their impact on the financial services industry. With expertise in banking, payments, securities & investments, and insurance, Aite Group's analysts deliver comprehensive, actionable advice to key market participants in financial services. Headquartered in Boston with a presence in Chicago, New York, San Francisco, London, and Milan, Aite Group works with its clients as a partner, advisor, and catalyst, challenging their basic assumptions and ensuring they remain at the forefront of industry trends.

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