AMA Implementation: Where We Are and Outstanding Questions

David Wildermuth, Managing Director
Goldman, Sachs & Co
Agenda

- Goldman Sachs in perspective
- Operational risk framework
- Advanced Measurement Approach
- Implementation Challenges & Solutions
- ‘Outstanding Questions’
Goldman Sachs in Perspective

<table>
<thead>
<tr>
<th><strong>Size:</strong></th>
<th><strong>Other Panelists</strong></th>
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<tbody>
<tr>
<td>Employees</td>
<td>20,722</td>
</tr>
<tr>
<td></td>
<td>&gt; 160,000</td>
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<tr>
<td>Net Revenues</td>
<td>$ 21 bln</td>
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<tr>
<td></td>
<td>$ 43 - $86 bln</td>
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<tr>
<td>Equity Market Value</td>
<td>$ 53 bln</td>
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<td>$97 - $243 bln</td>
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<th><strong>Nature of Business:</strong></th>
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<tr>
<td>Investment Banking</td>
<td>16%</td>
</tr>
<tr>
<td>Trading &amp; Principal Investments</td>
<td>65%</td>
</tr>
<tr>
<td>Combined (1)</td>
<td>81%</td>
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<tr>
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<td>19 - 27%</td>
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| **Net Revenues / Employee** |             |
|                            | $ 992 thd   |
|                            | <= $300 thd |

| **North America / Total Net Revenues** |             |
|                                       | 63%         |
|                                       | 67 - 94+%   |

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<th><strong>Other:</strong></th>
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<tr>
<td>Acquisitions last 3 years</td>
<td>Limited</td>
</tr>
<tr>
<td>Operational Risk Dept. formalized</td>
<td>2000</td>
</tr>
<tr>
<td>Consolidated Regulator</td>
<td>SEC</td>
</tr>
<tr>
<td></td>
<td>Various</td>
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Sources: Public financial statements for last fiscal year end, GS estimates

(1) JPM - "Investment Banking" business line, BAC - "Global Capital Markets and Investment Banking" business line

C - combined "Global Corporate and Investment Bank" and "Proprietary Investment Activities" business lines
Qualitative and quantitative information is integrated in a global framework that facilitates risk identification, measurement and management.
Our AMA approach needs to take into consideration our business and organization

- More ‘wholesale’ business lines with high capital reliance on tail events
- Leading positions and long history in primary business lines
- Strong control culture with Firmwide mandates
- Embedded risk management practices in the business areas
- Broad awareness of benefits and limitations of models
- Senior and business-line management support and buy-in of approach
 AMA Scenario Approach

- We decided on the scenario approach since it ...

  • is transparent and allows us to understand the types and magnitudes of operational risk losses that most importantly contribute to the operational risk loss distribution

  • relates to our current levels of control, allows for assessment of the control infrastructure and uses all the available operational risk data as input

  • is forward looking and relatively sensitive to changes in the external and internal environment

  • uses well established statistical tools and techniques for modeling purposes

  • creates appropriate incentives to manage and mitigate operational risk

  • is more stable than our LDA benchmark model and less prone to extreme reaction to modest changes in modeling assumptions
AMA Approach – Overview

- BIS level one event types are used as the core of our risk categorization for the scenario based capital model.
- For each BIS event type we have identified several firm specific risk types that we use to develop one or more scenarios for that event type.
- All available operational risk information, including expert judgment, is then used to derive a frequency and a severity distribution for each scenario.
- Monte Carlo simulation is then run to generate a cumulative loss distribution for each scenario.
- Individual scenarios are at last aggregated into a firmwide loss distribution, providing the operational risk capital at the appropriate confidence interval.
All available operational risk information is used to generate the frequency and severity distributions

- Empirical evidence (internal loss & external loss history)
- Business environment and control factors (metrics and risk assessment)
- Expert judgment incorporating inputs from senior business experts
- Econometric and other risk based models, such as from the insurance industry

Substantial documentation of modeling and input decisions and rationale relative to all available information
Our scenario methodology

Firmwide aggregated capital number for all risk types, businesses and jurisdictions

BIS Level One Event Types used as a basis for the firmwide risk categorization

Firm specific risk types are used to develop 1-3 scenarios for each BIS Event Type

Severity and frequency distribution is developed for every scenario

Monte Carlo Simulation generates a loss distribution for each scenario

Our scenario methodology

- Firmwide
  - Internal Fraud
  - External Fraud
  - Business Disruption & System Failure
  - Execution, Delivery & Process Management
  - Employee Practices & Workplace Safety
  - Clients, Products & Business Practices
  - Damage to Physical Assets
- Scenario
  - Frequency Distribution (Poisson)
  - Severity Distribution (Exponential / Log Normal)
- Scenario Loss Distribution
Our scenario methodology

**Scenario severity**

- Internal losses
- Case studies
- Scale of business
- Control environment*
- Business environment*
- External losses

**“Tail” events derived from the expert judgment process**

**Actual loss experience (n data points)**

**Scenario frequency**

1. Select severity distribution
2. Parameter estimation
3. Monte Carlo Simulation
4. Average # of internal events
5. Frequency parameters (Poisson)

**Base capital**

- Average # of internal events
- Frequency parameters (Poisson)

**Periodic adjustments to frequency based on changes in control and business environment**

**Case studies**

**Control environment**

**Scale of business**

**Business environment**
Our scenario methodology

- Internal losses
  - Used directly as data points in the distribution for each scenario
  - Also used indirectly through the expert judgment process

- External losses
  - Not used directly as data points for the distributions
  - Used as one of key inputs into the expert judgment process
  - We have developed external loss case studies analyzing the key operational risk themes of financial services firms

- Business environment and control factors
  - Examples are our Health Indicators & Risk Assessments
Implementation Challenges/Solutions

- **Approach to incorporating external data**
  - Inherent data quality and relevance issues (accuracy, completeness, business and control environments, scaling, etc.) would require expert judgment adjustments
  - Solution: Incorporate as a consideration in broader expert judgment analysis whereby obtain benefits of this valuable information through a single more transparent process

- **Ongoing risk sensitivity of capital calculation**
  - Capital calculation needs to be sensitive to changes in risk
  - Too frequent recalibration of most senior expert judgments may impact management focus and value
  - Solution: update capital calculations based on internal losses on an ongoing basis and update specific expert judgments annually and upon material changes to any of our risk inputs
“Outstanding Questions”

- Focus areas
  - “Use Test”
  - Comparability to Credit and Market risk standards
  - “Home/Host”
  - Model ‘validation’
  - Hybrid approach and allocation
  - Correlation / Diversification
  - Expected Loss
  - Disclosure standards