Innovations in Risk Management – Lessons from the Banking Industry

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I. Introduction: A Brief Historical Overview of Bank Capital Regulation

Over the past decade, significant advances in measuring and managing risk have revolutionized the role of risk management. Increasingly firms are using internal models to quantify risks and determine whether risk-adjusted returns are sufficient to justify the capital needed to support their activities. Some of the most significant advances have occurred in the banking industry, where the increasing complexity and size of financial institutions make it critical to accurately measure risk. Banks that span a variety of activities have increasingly used enterprise risk management to aid in setting managerial incentives and compensation, making investment decisions, and making internal evaluations of the performance of diverse business lines.

While the movement to quantify enterprise risk has grown rapidly, the response to incorporate these innovations in bank regulations has moved much more slowly. Since the early 1990s, banks in the United States have followed an international capital framework for maintaining minimum capital requirements, which was developed by the Basel Committee on Banking Supervision. At the time, the Basel I agreement was a major breakthrough, providing a more level playing field for financial institutions that were competing globally. While the Basel I capital requirements increased the capital cushion, particularly from the levels maintained by internationally active banks during the mid-1980s, they only incorporated very crude proxies for risk. In general, these requirements were intended as a rough proxy for the credit risk of a bank, incorporating differing capital requirements for different types of asset categories. For example,

a bank's minimum capital requirement for commercial loans was 8 percent, but only 4 percent for home mortgages.

Although Basel I promoted improved risk management, banks' internal economic capital models began diverging from Basel I's static regulatory capital framework. As a result, many of banks' safest assets were moved off balance sheets through asset securitizations because the capital requirements tended to be too high for low-risk assets. In addition, these requirements were only very crude proxies for credit risk, and banks' own internal models were far superior measures of credit risk. Finally, most banks had expanded their enterprise risk management to capture other risks, particularly operational risk.

Under the new Basel Capital Accord, Basel II, internationally active banks would be expected to calculate capital requirements using many of the techniques currently being employed by best-practices global banks. The revised capital requirements would promote greater risk sensitivity, more accurately reflect the risk of off-balance-sheet assets, and include a capital charge for operational risk. While the new regulations are expected to cause banks to hold capital more in line with their risks, they are also intended to promote best practices in risk management, since the possible systemic implications of a failure of a large international bank has grown with the globalization of banking markets.

While Basel II devotes significant attention to credit risk posed by banks' on-balance-sheet and off-balance-sheet activities, this paper is going to focus on operational risk. Not only have the recent innovations in operational risk been particularly dramatic, but appropriately measuring operational risk is a challenge facing many firms and may be particularly important in the electric utility industry.

This paper discusses several areas of operational risk management and quantification. Section II describes how operational risk is defined by the new regulations and how these definitions are being employed by banks. The standardization in nomenclature of operational risk has greatly advanced the design of databases that have facilitated peer analysis and the use of external data. This section also describes banks' internal operational loss databases, and how they can be utilized to measure operational risk. In addition, a heuristic description of some of the statistical techniques in modeling will be discussed, leaving the more mathematically inclined to refer to the references. Section III discusses the challenges in solely utilizing internal data to measure operational risk, and how banks are augmenting their internal data with external data, scenario analyses, qualitative risk adjustments, and risk mitigation techniques. Section IV discusses areas not being covered by Basel II and some of the challenges facing banks and their supervisors. The final section describes how other industries can also benefit from operational risk management and quantification methodologies.

II. Overview of the Current Proposal

Definition of Operational Risk

Prior to the Basel II proposal, one of the impediments to quantifying operational risk was the lack of a common definition. Not only did the definition of operational risk differ across different banks, but frequently, it differed across business lines within the same bank, as operational risk was often left to the business lines to manage. The operational risk definition used in Basel II was produced through extensive consultation with the industry and is defined by the Basel Committee as, "the risk of loss resulting from inadequate or failed internal processes,

people and systems or from external events." This definition includes legal risk, but excludes strategic and reputational risk where direct losses would be more difficult to ascertain.

Banks complying with Basel II will be expected to map their internal loss data to specific Basel-defined loss event types and business line classifications.[1] Basel II characterizes operational risk losses by seven event factors which include Internal Fraud and Employment Practices and Workplace Safety.[2] In addition, banks' activities are divided into eight business lines which include Trading and Sales and Retail Banking. These classifications give a sense of the scope of operational risk exposure facing the industry, as operational losses can occur in any activity, function, or unit of an institution.

While large losses have occurred in all business lines and across all event types, there are distinct differences among these business lines and event types. For example, retail banking tends to experience high-frequency, low-severity losses created by check-kiting and credit card fraud. However, even in retail banking there have been high-severity losses primarily stemming from class-action law suits. At the other extreme are losses in payment and settlement that happen infrequently but often result in severe losses, such as the failure of a major computer system.

Examples of large operational losses are widespread and discussions of large operational losses events occur frequently. In fact, more than 100 instances of operational losses in excess of $100 million for financial institutions have occurred over the past decade. Table 2 provides some recent examples of major operational losses in the financial services industry. These examples highlight the magnitude as well as the scope of operational loss events.

Because of the large losses that have occurred as a result of operational risk, many internationally active banking organizations have been allocating internal economic capital for

operational risk for some time. In a survey conducted by the Risk Management Group, a subcommittee of the Basel Committee, banks reported holding 15 percent of their capital for operational risk. In addition, some banks have begun to report the amount of capital held for operational risk in their financial reports. For example, Deutsche Bank reported holding 2.5 billion euros and JP Morgan Chase reported holding $6.8 billion for operational risk.

Elements of the Advanced Measurement Approach

The current proposal in the United States only requires large, internationally active banking organizations to be subject to the advanced risk and capital measurement approaches, including a specific capital charge for operational risk. These institutions are identified as core banks and are those with total banking assets of $250 billion or more or total on-balance-sheet foreign exposure of $10 billion or more. Non-core banks can choose to voluntarily calculate capital under the Basel II requirements if they meet certain requirements, including the ability to calculate capital using sophisticated credit and operational risk models. Implementation of Basel II in the United States differs from many foreign regulators' approaches that will require all banks to calculate capital under the Basel II Accord but will provide simpler approaches for smaller institutions or institutions unable to qualify for the more advanced approaches.[3]

Under the Advanced Measurement Approach (AMA) banks will need to incorporate five major elements into their operational risk quantification methodology. Institutions must demonstrate that they have collected adequate internal loss data, integrated relevant external data, conducted scenario analyses, performed appropriate statistical modeling techniques, and included assessments of their business environment and internal control factors. In order to use the AMA framework, banks must demonstrate that they have captured all elements

comprehensively, and while all factors will be required, there will be significant flexibility in how institutions choose to integrate them.

Banks will need to collect internal loss data to capture their historical operational loss experience. In addition, banks will need to establish thresholds above which all internal operational losses will be captured. While the threshold for collecting loss data differs across banks, the most common threshold has been $10,000. Table 3 provides an example of the type of format frequently used for capturing loss data. While the data collection process might seem to be straightforward, it is in fact quite difficult and costly. First, most banks have found that the general ledger did not capture major loss types, with operational losses often subsumed in broader business line categories. Thus they have chosen to supplement their general ledger-based data collection systems with a web-based platform whereby business units can directly report the occurrence of an operational loss. Banks can then reconcile losses reported via a web-based system with those captured in the general ledger. In addition, many operational losses can be difficult to classify by business line or by loss type.

While loss data collection is the most costly requirement of the AMA, it also provides the greatest payoff. Banks that have comprehensive loss data have found that operational risks can be much better mitigated once there is a greater awareness of the pattern of historical losses. Realizing where large losses are generated can encourage greater use of risk mitigation techniques and changes in controls. For example, reducing high-frequency, low-severity losses by eliminating fraud or automating a process where human error is common can frequently significantly improve profitability.

The second element of the AMA is concerned with utilizing relevant external loss data. Having external data is particularly useful in understanding the industry's experience, especially

in areas where a bank's internal loss history is limited. Most banks have limited historical data, and therefore some business lines or event types may have very few entries. To the extent that this reflects the short time period for collecting data, external data can provide insight into the high-severity losses that may occur but have not yet occurred at the bank.

There are several sources for obtaining external operational loss data. Commercial vendors have created operational loss databases using publicly disclosed information such as SEC filings and press reports. While this method of gathering external data can result in a reporting bias in terms of the types of losses that are publicly reported, it nonetheless provides a sobering account of how large losses can occur.[4] Some insurance companies have also begun to sell their loss data based on insurance claims. While this data also has reporting biases based on the firm's insurance business and its incentives to file a claim, it captures losses that may not be captured in other public sources.

The third element of the AMA deals with the use of scenario analyses to consider possible losses that have not occurred but could occur at the bank.[5] An example might be to estimate damages resulting from a hurricane for a bank in Miami or an earthquake for a bank in California, and derive reasoned assessments of the likelihood and impact of these operational loss events. These scenarios should provide losses that risk managers think are possible, but occur too infrequently to appear in the internal data.

The fourth element of the AMA pertains to the use of statistical techniques to integrate the internal data, external data, and scenario analyses. The loss distribution approach is the most common approach and uses standard actuarial techniques borrowed from the insurance industry to model the behavior of a firm's operational losses. The loss distribution approach produces an objective estimate of a firm's expected and unexpected losses through frequency and severity

estimation. This approach has three components which are shown in Figure 1. First, a frequency distribution is estimated from the data that models how often losses occur. Second, a severity distribution is estimated that captures, conditional upon a loss occurring, how severe the loss is. Once the loss severity and loss frequency distributions have been modeled separately, they are combined via a Monte Carlo simulation or other statistical technique to form a total loss distribution for a one-year time period.[6]

The loss distribution generated represents the full range of possible total operational losses that could be experienced in any given year. The distribution is then used to determine the level of capital required at a desired percentile, or soundness standard. If the soundness standard were 99.9 percent as shown in Figure 1, the capital that would capture expected and unexpected losses in the example would be $250 million. Note that the distributions tend to be skewed and are not symmetric. In particular the loss distributions are heavy-tailed due to the large losses in the data. The larger the tail implied by the data, the larger the capital that the bank would be expected to hold.

As Figure 1 shows, operational losses tend to exhibit "fat-tails"; that is, high-severity losses occur more frequently than one would expect if one assumed that losses were distributed normally. The fatter the tail, the more capital the bank would hold for infrequent but severe types of losses. The amount of capital held for operational losses is significantly impacted by potential high-severity losses, and therefore estimation of the tail of the distribution becomes very important. However, high-severity losses occur relatively infrequently in an individual bank's loss data, making the distributional assumptions, use of external data, and scenario analyses critical to obtaining good estimates of possible tail events.

The final element of the AMA is to incorporate more qualitative factors into the operational risk management model. Qualitative factors incorporate a forward-looking element into an institution's operational risk profile and include audit scores, risk and control assessments, key risk indicators, and score cards. These forward-looking measures can require more capital to be held where significant findings occur. For example, key risk indicators attempt to quantify the drivers of operational losses such as employee turnover statistics or transactions volume, which are not captured in historical operational loss data. Once these indicators are identified and tracked over time, management can analyze the data to determine where the major risks lie within the institution. Tying qualitative factors to an institution's internal loss experience ensures that operational risk is managed to factors related to an institution's actual risk.

Insurance as a Risk Mitigant

For some time, institutions have been using a variety of insurance products to reduce the economic impact of unexpected losses due to operational risks. Insurance should be an ideal mitigant for operational risk because insurers have the ability to achieve greater diversification than individual firms. As part of the new accord, the Basel Committee will allow banks to recognize the risk-mitigating impact of insurance in the measure of operational risk used for calculating regulatory capital requirements.

Although insurance is a well-established risk management tool that has been used by the banking sector for years, insurance policies have a number of potential problems: First, insurers transfer operational risk to credit risk as insurers may not be able to pay off a claim. Second, insurers may terminate or decline renewal policies if they encounter significant claims. Third, large claims often face legal challenges that affect the timeliness and certainty of the insurance

being paid. As a result of these shortcomings, the Basel Committee will limit the amount that banks can reduce their operational risk exposure to 20 percent. In addition, a bank's ability to take advantage of such risk mitigation will depend on compliance with a set of qualifying criteria for insurance policies.

III. Current Implementation Issues

Most large internationally active banks have made significant progress in creating operational risk loss databases. While costly, the implementation of internal loss databases often generates immediate benefits as management is able to observe patterns of operational losses and begin to take corrective actions in managing losses more effectively. The most sophisticated banks have the ability to model their exposure to operational risk based on internal data and allocate operational capital to their business lines. These banks tend to be of sufficient size to have high-severity operational losses in their business. They are also using this allocated capital in making compensation and investment decisions. However, integrating scenario analyses, qualitative adjustments, and insurance adjustments into the models remains a work-in-progress even at the most sophisticated banks.

For medium-size banks, having limited internal data can pose problems for effectively using comprehensive modeling techniques. Many of these banks have very few high-severity losses, which implies that they cannot rely primarily on internal data when modeling many of the business lines and event types. Some banks have focused on using external data, assuming their own processes are not dramatically different from their competitors. Other banks view their control systems as being sufficiently different and prefer utilizing scenario analyses that can be tailored to the business activity of their bank.

Having limited high-severity events make statistical modeling more difficult. In order to deal with this issue, institutions have been experimenting with alternative techniques. Some institutions have been using fat-tailed distributions to quantify their operational risk exposure and generate their capital charge.[7] However, with limited data it is difficult to reject alternative distributional assumptions, some of which imply a significant impact on capital.[8] Other institutions have experimented with using extreme value theory, which is an alternative to the loss distribution approach described earlier and focuses on estimating the tail of the distribution. Extreme value theory provides the basis for modeling extreme events that are rare but have significant consequences for institutions. Again with limited data it is difficult to verify parameter estimates, and implausible estimates can sometimes be generated using small data sets. However, extreme value theory is designed to get more precise estimates of low-frequency, high-severity events, in particular capturing losses over a certain high threshold. While the application of extreme value theory in operational risk modeling is still in early stages, the initial work in this area seems very promising.

As a result of these data issues, most medium-size banks have not rolled out comprehensive capital measurement models. In addition they have not integrated qualitative adjustments or insurance into their models. However, they have found the data mining of internal data extremely useful in establishing patterns in operational losses that can be managed and mitigated.

Many of these banks have tended to focus on score card approaches that utilize loss distribution techniques to obtain the overall operational risk capital. This usually involves providing management with questions on how many losses they might anticipate over the next year and comparing these losses to the firm's historical data as well as the industry’s experience.

In addition, for the more severe outcomes management is asked to produce scenarios that could generate the high severity losses.

The new Basel II proposal anticipated the need to tailor operational risk capital models to each institution and provides significant flexibility. The proposal is not prescriptive and therefore gives banks the ability to choose the techniques that fit their specific institution. Thus, some institutions have capital models that are very analytical and primarily utilize internal data, while others use much more judgment-based models and are far more reliant on external data and scenario analyses. This flexibility for operational risk differs from the proposal's treatment of credit risk, where the distributional assumptions are embedded in the benchmark formulas, and substantial modeling details are built into the proposed regulations.

IV. Challenges in Implementing Operational Risk Models

The flexibility of the operational risk proposal is appropriate given the diversity of approaches used by banks to manage risk. Nonetheless, this flexibility presents challenges to consistent supervisory implementation. Because banks are focused on internally consistent models, consistent supervisory treatment will require across-industry perspectives. However, significant challenges to benchmarking banks will need to be overcome.

One challenge facing supervisors is the inconsistent classification of operational losses, which complicates industry-wide analyses as well as across-institution comparisons. Banks' internal operational loss data are collected based upon rules set up by corporate-wide risk managers. However, the classification of loss data can be quite difficult, and reasonable individuals may classify the same event in different business lines or event types. This inconsistency becomes clear when examining external loss data where the same loss events often

are classified differently by different vendors. In addition, the structure of the data collection may be different. This is particularly true for centralized functions like human resources and information technology. A system failure at one bank may be included in an administrative account and then allocated by number of system users, while another bank might assign losses from system failures to the business line where the majority of the loss occurred. Such differences complicate the process of making comparisons across institutions.

Differences in quantification techniques will also pose challenges for supervisors. Differences may occur because control environments and business activities may vary across banks, or alternatively, may just reflect problems in estimating small samples. Until significant data have been gathered, statistical tests may have difficulty in distinguishing between alternative distributional assumptions or different modeling choices.

Scaling data is another problem facing banks and supervisors. Banks have experienced a significant wave of mergers that make merging historical data problematic. Reconciling loss data between entities is likely to be time consuming and expensive. In addition, as an institution changes, the appropriate way to scale historical data is uncertain. In some business activities, increased volumes may rise little with the additional business volume while in other activities it may be proportional to the business volume.

Because institutions currently only have limited internal operational loss data and do not have historical data on key risk indicators or metrics for the control environment, most of the modeling to date has concentrated on statistical models, which primarily rely on internal loss data. Causal modeling is not yet possible, since most institutions do not have historical data on key risk indicators or metrics for the control environment. However, with improvements in data

collection and management of operational risk it should be possible to improve the statistical modeling currently being done at most banks.

The process of integrating operational risk into enterprise risk models is likely to evolve. Currently the modeling of operational risk tends to be distinct from credit and market risk modeling. However, over time, institutions should develop models that better capture the interaction of these risks. In addition, many institutions are conducting preliminary studies on modeling reputational risk. Many reputational risks are generated by operational risks, yet this interaction is not captured in the capital requirements. Recent experiences from Arthur Anderson and Enron have focused management's attention on the need to consider reputational risk when thinking about its operational risk environment.

Finally, strategic risk should be a major risk captured by management but is not incorporated into the capital requirements. Changes in the competitive environment, changes in economic circumstances, or changes in customer behavior can significantly impact banks, but are currently not captured in many of the enterprise risk management models.

Despite the many hurdles in developing a full economic capital model for operational risk, significant changes have occurred over the past several years. Most large banks are now systematically collecting and analyzing operational loss data. In addition, most banks have also introduced some quantitative modeling and integration with qualitative measures. A few banks have also rolled out comprehensive operational risk management programs that can be used to quantify operational risk, allocate capital by business lines so that it can be used for compensation and investment decisions, and calculate capital for operational risk along the requirements of the Basel II proposal. Given the resources being spent and the progress made to date, many large banks should be ready for Basel II once the proposal has been finalized.

V. Application to Other Industries

Discussion of a possible explicit capital charge for operational risk has provided a significant boost to the banking industry's efforts to quantify operational risk. While the largest banks were already trying to quantify operational risk for their internal economic capital models prior to the Basel proposal, the regulatory discussion has spurred the industry to develop programs more quickly and have them applied to a broader set of banks than likely would have occurred in the absence of the Basel proposal.

While the regulatory impetus has caused banks to have more developed quantifiable operational risk programs, the operational risk quantification techniques are no less relevant in other industries. Many of the loss event types would apply to any industry, such as Damage to Physical Assets, Employment Practices and Workplace Safety, Clients, Products, and Business Practices, and Business Disruption and System Failures. Other categories may appear less frequently in non-transaction oriented industries, such as Execution, Delivery and Process Management. Similarly, the frequency and severity of losses may differ across industries. For example, ice storms can be very disruptive for electric utilities, but are not of particular concern in the banking industry.

While the nature of losses may differ, most of the AMA is applying risk management techniques that are applicable to any industry. First, virtually any firm can benefit from collecting operational loss data, and thereby enabling it to measure and manage operational risk. Without data it is very difficult to manage a risk since it can not be measured. Most banks that have created operational loss databases have been surprised by the size and distribution of these losses. Almost all banks have made adjustments to their management of operational risk once

they have better understood their loss experience. Similar benefits are likely to occur in other industries.

Second, the governance of large diversified firms provides a premium on identifying risk. A well-functioning operational risk management system should fit well with new regulations related to financial reporting, such as Sarbanes-Oxley. Having effective management information systems on operational risk will be crucial as senior management and boards of directors become more accountable for understanding and mitigating risks at their institutions.

Third, while many banks are focused on using statistical models, external data, and scenario analyses to measure operational risk capital, this capital is useful for purposes other than satisfying minimum regulatory capital requirements. The most effective risk management units use economic capital as an internal pricing mechanism for risk. Tying economic capital to business lines in a way that impacts investment decisions and compensation gets business lines actively engaged in thinking about the risk they pose to the larger organization.

Fourth, while most firms have qualitative operational risk management often tied to key risk indicators, they often have not been tested relative to loss experience. Management strategies that use risk indicators that are uncorrelated with loss experience can be counterproductive. Integrating qualitative adjustments into a broader operational risk framework insures that risk indicators are tested relative to internal and external loss experience.

Finally, all firms and industries have experienced operational losses. Rarely a week goes by that does not entail the discovery of a major fraud or law suit that results in losses in excess of $100 million in some industry. The statistical regularities found in the banking industry's loss experience, and the major management innovations that have occurred to date, indicate that other industries may well be underinvested in thinking about operational risk.

VI. Conclusion

Operational risk is a substantial and growing risk facing firms, due to the increased dependence on automated technology, the growth of e-commerce, and the increased prevalence of outsourcing. External data and internal data provided by banks have shown that operational losses are extensive. This reality encouraged many banks to begin allocating capital for operational risk prior to the Basel II process. As banks and bank supervisors watched developments at the largest banks, it has become clear that risk management could be improved with a more systematic approach towards operational risk.

The Basel II proposal provides a flexible regulatory environment for quantifying operational risk. This flexibility reflects the differences in operational loss experiences across business lines and the early stage of development in quantifying operational risk at many banks. Having a flexible regulatory environment provides banks with an opportunity to emphasize those quantification techniques most appropriate for the management of operational risk at their institution given the nature of their activities, business environment, and internal controls.

While the flexibility of the AMA allows for a competition of ideas to establish best practices in the management of operational risk, it also creates supervisory challenges. Since the proposed capital calculation is not solely designed for internal purposes, but also to meet minimum regulatory thresholds, consistency of application across institutions will be an important issue that needs to be addressed. In addition, supervisors will need to understand statistical modeling issues as well as the nature of operational risk at each of their business lines. Similarly, having sufficient supervisory staff capable of understanding intricate risk management

models will be a challenge, particularly as these skills will be in high demand in the private sector.

While the proposed capital regulation has encouraged banks and supervisors to better understand operational risk quantification, there is more to managing operational risk than simply quantification. Sound practices extend beyond numbers, and quantification is a tool to be integrated with a good internal control environment and a management structure that encourages risk management. A strong risk management culture that encourages a greater understanding of an institution's exposure to risk is the single most important element to any move to measure, manage, and mitigate operational risk at any institution.

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Footnotes

[1] While an institution would not be required to internally manage its operational risk according to the Basel-defined loss event types and business line classifications, it would be required to map its internal loss data to these categories. See Table 1 for a full list of categories.

[2] For a complete list of Basel-defined event types and their definitions refer to Table 1.

[3] In addition to the advanced measurement approach, foreign regulators are providing two simpler approaches to operational risk: the basic indicator and the standardized approaches, which are targeted to banks with less significant operational risk exposures. Banks using the basic indicator approach will be expected to hold capital for operational risk equal to a fixed percentage of a bank's average annual gross income over the previous three years. The standardized approach is similar, but rather than calculating capital at the firm level, banks must calculate a capital requirement for each business line and then must sum the capital charges across each of the business lines to arrive at the firm's total capital charge. The capital charge for each business line is determined by multiplying gross income by specific supervisory factors determined by the Basel Committee.

[4] For an example of using external data to quantify operational risk refer to de Fontnouvelle, et al. (2003) at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=395083

[5] Scenario analysis is a systematic process of obtaining expert opinions from business line managers and risk management experts concerning the likelihood of possible operational loss events occurring.

[6] In the case of a Monte Carlo simulation, the first step is to draw a random sample from the loss frequency distribution. For example, one selection may be a frequency of four events. This value is then used to determine the number of events to be randomly drawn from the corresponding severity distribution. For example, we might simulate four events of size 11250, 14500, 103545, and 250000. These severity samples are then summed together to generate one point on the total loss distribution. This process is repeated numerous times, and then these observed total loss points are then fit to a curve that best describes the underlying pattern of total loss occurrences. This curve will allow extrapolation from the data points to determine the capital required at any given percentile.

[7] Fat-tailed distributions tend to have more observations in the tail and to be thinner in the mid-range than a normal distribution. Fat-tailed distributions include the lognormal, pareto, and weibull distributions.

[8] See de Fontnouvelle, et al. (2004).

Table 1

		Loss Event Types						
		Internal Fraud	External Fraud	Employment Practices & Workplace Safety	Clients, Products & Business Practices	Damage to Physical Assets	Business Disruption & System Failures	Execution, Delivery & Process Management
Business Lines	Corporate Finance							
	Trading & Sales							
	Retail Banking							
	Payment & Settlement							
	Agency Services							
	Commercial Banking							
	Asset Management							
	Retail Brokerage							

Loss Event Type Definitions

Internal Fraud: Losses due to acts of a type intended to defraud, misappropriate property or circumvent regulation, the law or company policy, which involves at least one internal party.
External Fraud: Losses due to acts of a type intended to defraud, misappropriate property or circumvent the law by a third party.
Employment Practices and Workplace Safety: Losses arising from acts inconsistent with employment, health or safety laws or agreements, from payment of personal injury claims, or from diversity/discrimination events.
Clients, Products & Business Practices: Losses arising from an unintentional or negligent failure to meet a professional obligation to specific clients, or from the nature or design of a product.
Damage to Physical Assets: Losses arising from loss or damage to physical assets from natural disaster or other events.
Business Disruption and System Failures: Losses arising from disruption of business or system failures.
Execution, Delivery & Process Management: Losses from failed transaction processing or process management, from relations with trade counterparties and vendors.

Table 2

Examples of Operational Loss Events

- *Internal Fraud*: Allied Irish Bank, Barings, and Daiwa Bank Ltd - $691 million, $1 billion, and $1.4 billion, respectively - fraudulent trading.

- *External Fraud*: Republic New York Corp. - $611 million - fraud committed by custodial client.

- *Employment Practices and Workplace Safety*: Merrill Lynch - $250 million - legal settlement regarding gender discrimination.

- *Clients, Products & Business Practices*: Household International - $484 million- improper lending practices; Providian Financial Corp. - $405 million - improper sales and billing practices.

- *Damage to Physical Assets*: Bank of New York - $140 million - damage to facilities related to September 11, 2001.

- *Business Disruption and System Failures*: Solomon Brothers - $303 million - change in computer technology resulted in “unreconciled balances”.

- *Execution, Delivery & Process Management*: Bank of America and Wells Fargo Bank - $ 225 million and $150 million, respectively - systems integration failures / failed transaction processing.

Table 3

[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Event #	Event Code (1)	Event Code (1)	Date	Cost Center	Business Line	Loss	Recoveries	Insurance	Event Description
1	IF	12	960116	10003	RB	19057.25	0.00	19057.25	
2	EF	31	960116	20003	RB	40905.04	0.00	40905.04	
3	SY	22	960116	33890	CF	10194.55	3433.00	10194.55	
4	SY	11	960119	45359	CF	52831.68	0.00	52831.68	
5	PD	11	960120	11101	CB	36558.11	0.00	36558.11	
6	IF	32	960120	10003	PS	620537.37	0.00	620537.37	
7	IF	22	960122	20203	AS	10181.69	0.00	10181.69	
8	EF	31	960122	19767	AS	24783.17	13556.00	24783.17	
9	EE	17	960122	19332	TS	11963.49	0.00	11963.49	
10	EE	27	960122	18897	AS	20086.56	0.00	20086.56	
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.	.	.	.	.	.	.		.	.
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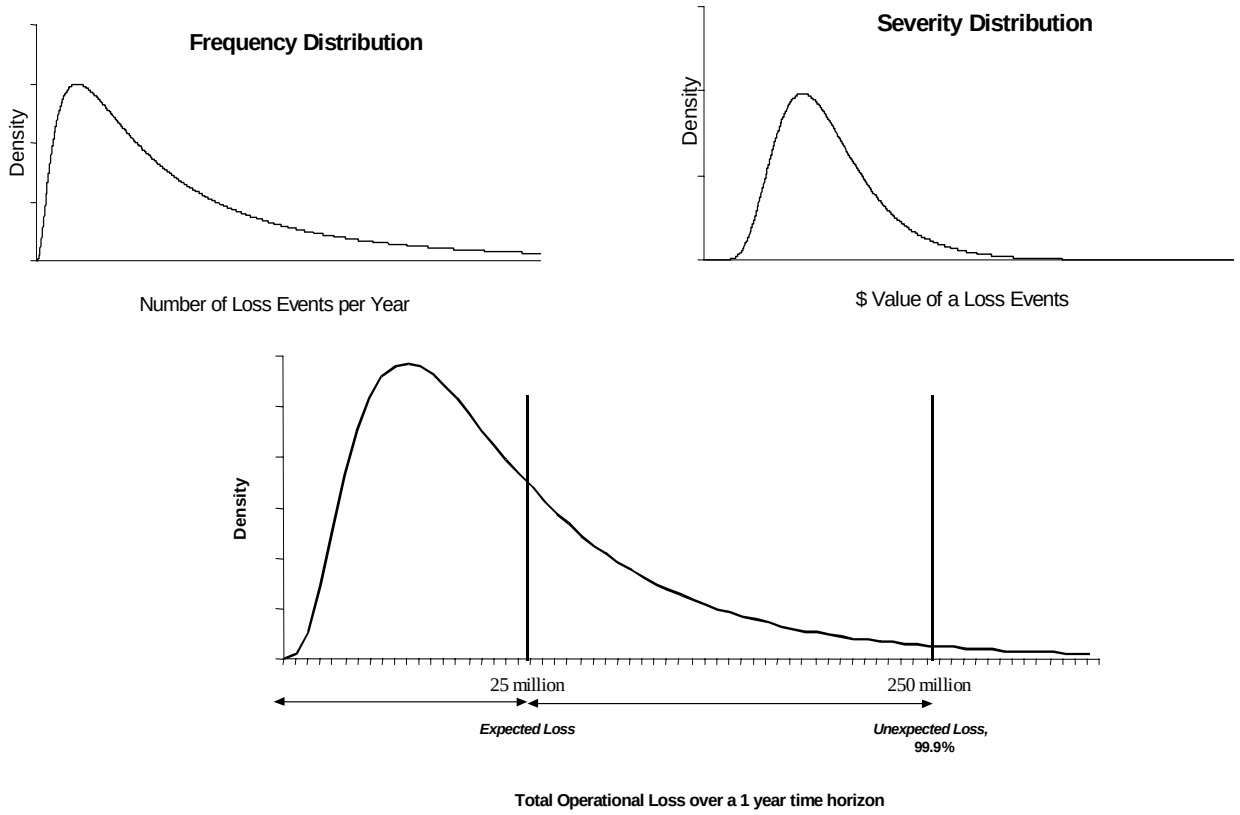
2701	UA	8	960146	10003	RB	14451.49	0.00	14451.49	
2702	UA	3	960148	10003	RB	11010.46	0.00	11010.46	
2703	WS	17	960150	33890	CF	24681.18	0.00	24681.18	
2704	SF	26	960152	23223	AM	17963.66	16963.66	17963.66	

Figure 1


Frequency Distribution
Density
Number of Loss Events per Year
Severity Distribution
Density
$ Value of a Loss Events
Density
25 million
250 million
Expected Loss
Unexpected Loss,
99.9%
Total Operational Loss over a 1 year time horizon