# The Cyclicality of Operational Risk: The Tracking Phenomenon

**Thesis: Dynamics in numbers of operational risk events track volatile cycles in the markets.**

November 2007


Algorithmics

# TABLE OF CONTENTS

## INTRODUCTION

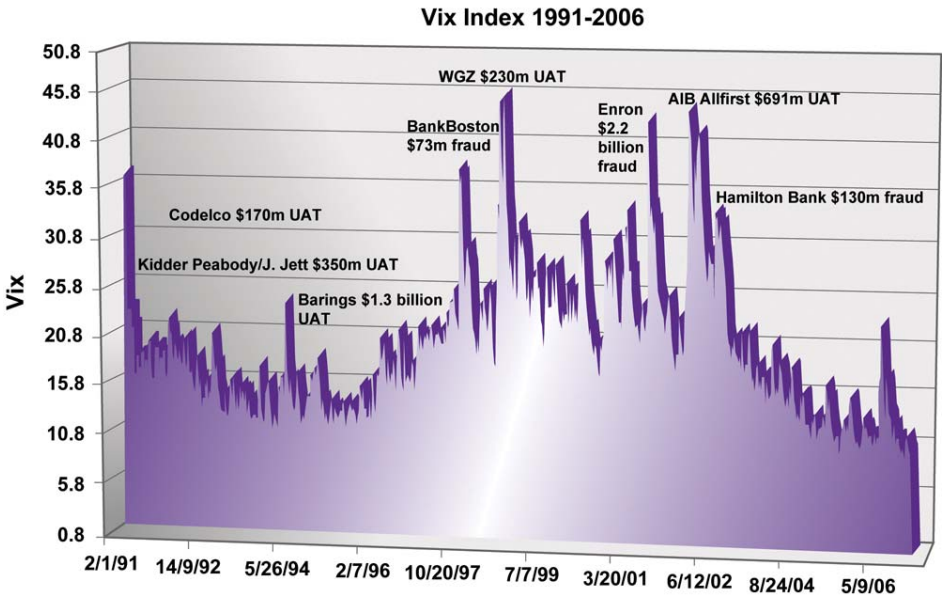
The genesis of this whitepaper began with a simple observation. We noticed that when we plotted out operational risk data there were spikes in the number and severity of loss events in 1994, 1998, and 2002. This led to more in-depth research comparing changes in operational risk loss events with a standard measure of volatility.

The first thing we noted was that these years were all periods of significant market swings, so we set out to find a measure that we could test against our emerging theory that operational risk events track market volatility. We are familiar with the work others have done on tracking stock prices and shareholder value with operational risk; we supplied loss event data to many of these studies. (See "Operational Risk in the Insurance Industry" by Ran Wei, http://irm.wharton.upenn.edu/F03-Wei.pdf and "Managing Operational Risk in Banking" from McKinsey & Co, authored by Robert S. Dunnet, Cindy B. Levy and Antonio Simoes." http://fs.mckinsey.com/Display.aspx?id=66e9b645-704c-4d1f-911d-6c4b38d2015a)

This time we wanted to test our hypothesis against a standard measure of market volatility. This approach was influenced by the events of the summer of 2007 when the stock markets experienced a liquidity crisis on the heels of the discovery of inherent problems in the subprime mortgage sector.

We settled upon the Volatility Index, or VIX, from the Chicago Board of Exchange (CBOE) as our standard measure of market volatility. The CBOE defines the VIX as "a key measure of market expectations of near-term volatility conveyed by S&P 500 stock index option prices." The CBOE also states that the VIX has come to be known since 1993 as "the world's premier barometer of investor sentiment and market volatility." The VIX index tracks investor sentiment and is reflective of what is happening in the markets. Our supposition, given some unique features of operational risk events and the lag between "begin" and "end" date, was that there are at least certain categories of risk types that might track alongside market volatility.

Graph One (From the Chicago Board of Exchange and Algo FIRST*): VIX index and large operational risk loss events:




## TRACKING CHANGES: MAPPING OPERATIONAL RISK LOSS EVENTS AGAINST THE VIX

The CBOE states that the VIX has come to be known since 1993 as “the world's premier barometer of investor sentiment and market volatility.” The start date for the VIX was ideal for our purposes, as it approximately coincided with the date when we first started collecting loss event data in the early 1990s. An empirical observation of spikes in the VIX corroborated that we were using the right index for our study and that we were onto something *(see graph one).*

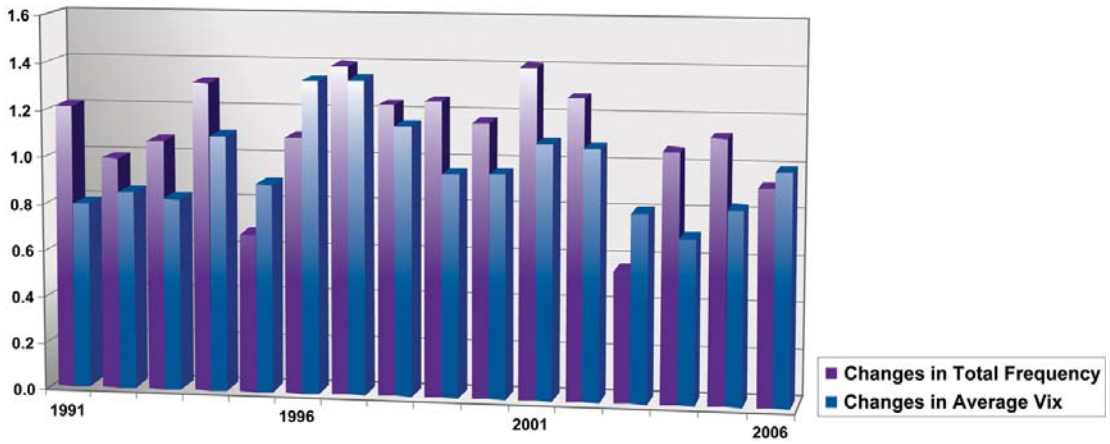
Both the VIX graph and the one representing loss events in our internal operational risk loss database represented in the broader sense the patterns of a Sine Wave, which if graphed to display the outline of a stone dropped into a still lake, would form waves at the moment of impact. We started thinking of operational risk loss events in this same way: we noticed an increase in the disclosure of operational risk loss events around the same time as the formation of “volatility waves” in the market and what we came to name the “tracking phenomenon.”

Our next step was to map loss events against the VIX index. We experimented with frequencies and slices of the data until we were able to present the two data sets in a way that made sense from both a quantitative and business perspective. Although we believe that daily data is the best barometer of volatility, for purposes of comparing both data sets, we aggregated the VIX data to an average annual frequency. We continue to investigate the use of daily volatility data in our research work in a mission to uncover a “point in time” measure that makes sense from the perspective of both the volatility and loss event data sets.

It is difficult when “dates of occurrence” are considered in an examination of operational risk events because with a few exceptions, operational risk events do not represent a point in time but a continuum that encompasses a breakdown of internal controls and a trigger that leads to the actual loss event. For this reason, we also decided that it made the most sense to use “end date” or “discovery date” as an approximation for a “point in time” when comparing loss data with volatility.

Because what we were after was volatility and a measure of change, which is essentially what the VIX measures, we mapped loss events against the volatility measure according to the change in number of total frequency of events. This also allowed us to adjust for a collection bias and the probability that as the disclosure of events becomes more transparent in the industry and media, it is more likely that we have identified a larger collection of losses during later years. When we plot the change in frequency of the total number of loss events against the changes in the average VIX, it becomes evident that changes in the two indexes track each other during key periods of volatility *(see graph two*).

Graph Two: Changes in total frequency of operational risk loss events vs. changes in the average VIX.




Graph two, which demonstrates a linkage between market changes and the change in number of loss events, was a good starting point in our analysis. The graph displays a pattern between the two data sets. They appear to increase and decrease in tandem during our targets periods of market volatility: 1994, 1998, and 2001-2002.

Our next task was to split the operational risk loss data into its five risk class components and examine if there was a type of risk that might be more pronounced either in terms of a point in time action or discovery during times of volatility. Graph Two examines all the risk classes aggregated together. We proceeded to compare the VIX data against our five risk classes: people, process, relationship, external, and technology. (See definition of the risk classes in the following discussion.) Our supposition was that when we tested the data against individual risk classes that are more homogenous groups of data, we would discover stronger dependencies between operational risk loss events and volatility.

An examination of the VIX shows that times of great volatility tend to last for relatively short intense periods. This is very different from the profile of large risk events that can continue for years, or in the most extreme examples decades, before they are uncovered or discovered. We track duration of operational risk loss events from the onset of the initial fraud until its settlement or discovery date. What we have observed is that the point in time when a large fraud or unauthorized trading event is revealed is often concurrent with market volatility. This is evident in the examples of real loss events that we provide in this paper.

The loss data itself and the sample loss events demonstrate that an event may be ongoing for a relatively long period of time but market volatility increases the probability that it will become discovered. In the case of unauthorized trading events, for instance, as market conditions become more volatile the rogue trader continues to increase his losses while he tries to trade himself out of an ever-increasing hole. (See Codelco and Kidder Peabody cases discussed in this paper.) It becomes increasingly difficult to hide the accumulating losses until almost by serendipity they are uncovered. In addition, times of volatility lead to a "tightening of the belt" mentality in financial institutions, which also raises the likelihood that a risk event will be discovered.

What this means is that contrary to general sentiment, losses do not lag behind market swings and volatility does not necessarily **c**reate a more fertile ground for operational risk losses. The rogue individuals and fraudsters are often long at work in perpetrating their misdeeds before the markets turn volatile. Instead, it enhances the severity of such losses and leads to their eventual unraveling. In other words, there is a greater chance that loss events will be ferreted out from the holes they have been hiding in during market swings.

What is interesting is that while the largest operational risk events are uncovered during volatile market conditions (Enron, Barings, BCCI, Kidder Peabody, Codelco), they were ongoing during times of relative calm and prosperity. We believe this is consistent with the general belief in credit risk that times of exuberance and positive market conditions can lead to a lax risk culture. This also holds true for operational risk cultures, which might operate under a more fluid control environment during growth periods. When markets start turning downward, both credit and operational risk officers have a tendency to "tighten their belts."

## THE IMPACT OF VOLATILITY ON RISK CLASSES

We track loss events according to five risk classes:

1. **People Risk:** The risk of a loss intentionally or unintentionally caused by an employee— *i.e.* employee error, employee misdeeds— or involving employees, such as in the area of employment disputes. This risk class covers internal organizational problems and losses.

2. **Process Risk:** Risks related to the execution and maintenance of transactions, and the various aspects of running a business, including products and services.

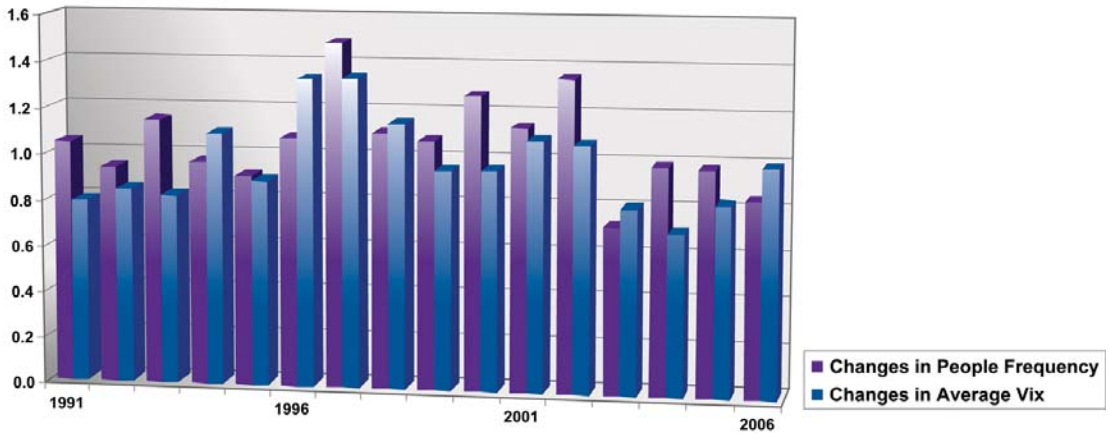
3. **Relationship Risk:** Losses arising from the relationship or contact that a firm has with its clients, shareholders, third parties, or regulators.

4. **Technology Risk:** The risk of loss caused by a piracy, theft, failure, breakdown or other disruption in technology, data or information; also includes technology that fails to meet business needs.

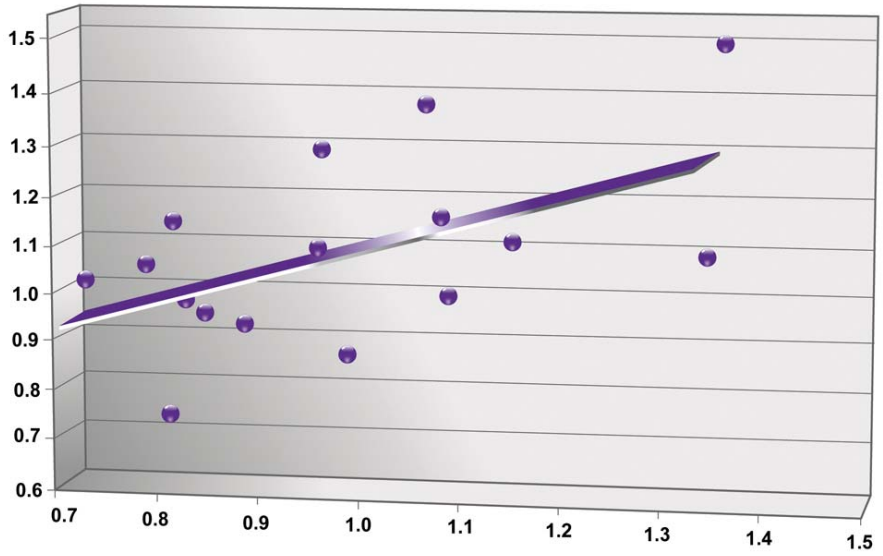
5. **External Risk:** The risk of loss due to damage to physical property or assets from natural or non–natural causes. This category also includes the risk presented by actions of external parties, such as the perpetration of fraud, or in the case of regulators, the execution of change that would alter the firm's ability to continue operating in certain markets.

When we examined the change in number of events in each of the five risk classes separately against changes in the VIX, it became evident that the closest match was the people risk class, which includes embezzlement, fraud, trading misdeeds, and other acts of intentional employee related malfeasance *(see graphs three and four).*We noticed a less pronounced but still notable tracking effect when we isolated changes in relationship risk events vs. changes in the VIX *(see graph five).*

Graph Three: Changes in people risk class vs. changes in the VIX

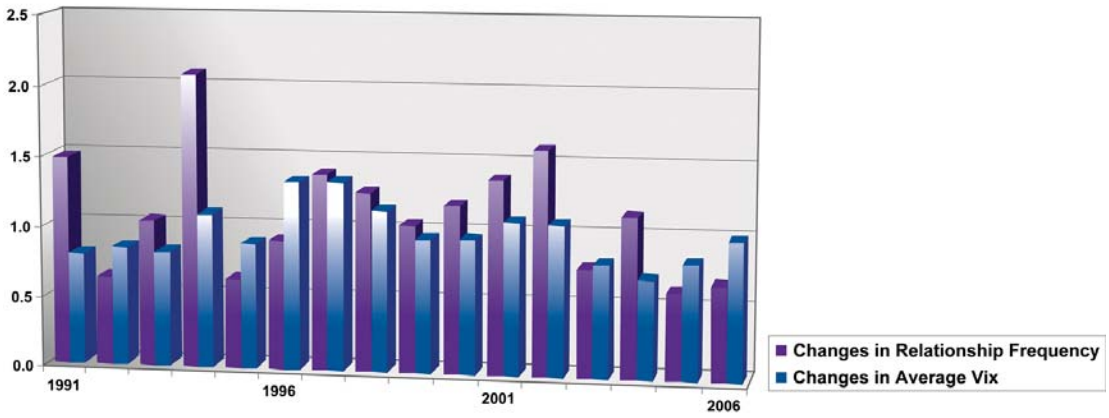



Graph Four: Diagram of changes in people risk class vs. changes in VIX

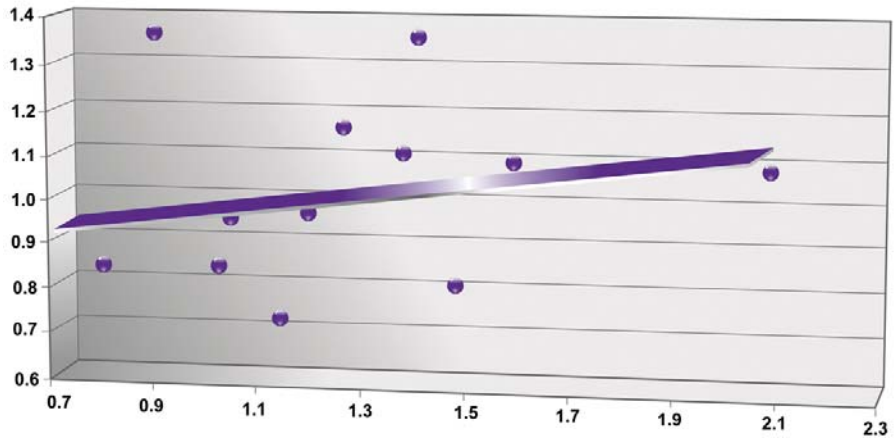



The above graph demonstrates the results of a regression analysis that was performed to illustrate the tracking phenomenon between the VIX and the people risk class. There is a 60% concordance between the two categories. This represents a statistically significant tracking phenomenon between the two VIX index and the loss events.

Graph Five: Changes in relationship risk class vs. change in the VIX




Graph Six: Diagram of changes in relationship risk class vs. changes in VIX




The above graph demonstrates the results of a regression analysis that was performed to illustrate the tracking phenomenon between the VIX and the relationship risk class of loss events. There is a 36% concordance between the two categories. This is significantly less than the 60% seen previously with the people risk category, but still demonstrates a notable tracking pattern.

## PEOPLE RISK LOSSES: THE KEY TO MONITORING POTENTIAL OPERATIONAL RISK LOSSES DURING TIMES OF VOLATILITY

The tracking phenomenon demonstrated in our people risk category of events, as viewed in graphs three and four, suggests the importance of enhancing monitoring of this category of potential events during times of volatility, such as we witnessed in the summer of 2007. It is still too early to comment on whether a large increase of people risk events occurred during this period. However, we already have tracked a $347 million unauthorized trading event that was unrelated to subprime issues but surfaced during the turbulent 2007 summer (see except from case study below).

There are a variety of archetypical people risk events that can occur during times of volatility. These include unauthorized trading, front-running, embezzlement, misappropriation of funds, and aiding and abetting. We have provided below excerpts from the full case studies in our operational risk database in order to demonstrate the scope and severity of events that have occurred in the past during times of market volatility. The following is a list of market events that led to volatility and associated people risk events.

**Market Event of 1994: The Federal Reserve raises interest rates multiple times**

The US Federal Reserve raised interest rates several times in 1994, which resulted in substantial losses across the industry for derivative products with underlying securities tied to interest rates. Interest rates had been low for a long time before this period and interest-rate derivatives felt like a safe and profitable investment; the markets appeared to forget that rates would start heading upwards at some point. Some managers of conservative mutual funds during this period added derivatives “kickers” to their portfolios. When rates started being raised month after month by the Federal Reserve, a large number of institutions that had purchased derivatives lost money, including Gibson Greetings, Procter & Gamble, and mutual fund managers. Examples of large people risk events from 1994:

- The Joseph Jett bond-trading scandal was one of a series of problems that plagued Kidder Peabody and eventually prompted the sale of the once highly profitable and elite firm by parent entity General Electric to PaineWebber in 1994. The SEC alleged that between 1991 and 1994 Joseph Jett faked nearly $350 million in profits in order to hide $80 million in losses through a complex trading scheme. The SEC ultimately targeted lax controls within the company as a contributing factor to the event and criticized Kidder’s management for poor supervision and judgment, and for creating an environment where "employees were unwilling to ask tough questions when money was being made." In March 2000, GE agreed to pay $19 million to settle a class action shareholder suit. In a final resolution of the case, the Southern District Court of New York entered a judgment on September 7, 2007 that ordered Jett to repay $8.21 million and a $200,000 fine.

- In 1994 and in an unauthorized trading case, Corporacion Nacional Del Cobre De Chile (Codelco), the world's largest copper mining company, incurred a $170 million loss from the activities of rogue trader Juan Pablo Davila. During the course of the 1994 copper futures scandal, Codelco discovered Davila, its chief futures trader, had engaged in unauthorized trading activities. Between 1993 and 1994, Mr. Davila was alleged to have made unauthorized trades that cost the company $170 million.

**Market Event of 1998: Russia defaults**

Russia was into its sixth year of economic reform in 1998, and the first one of positive economic growth since the fall of communism, when it failed to meet its debt obligations. Russia was in the process of renegotiating the sovereign debt it had inherited from the former Soviet Union when it defaulted in August 1998. On August 17, 1998, the Russian government floated the exchange rate, devalued the ruble, defaulted on its domestic debt, and restructured its ruble-denominated debt. It also suspended all payments to foreign creditors for 90 days. This led to a collapse in other unrelated sectors of the emerging markets and multi-billion dollar losses at US hedge fund Long Term Capital Management (LTCM). The effect on the market of LTCM's unwinding its position was so enormous that the Federal Reserve Bank, in a historic move, initiated a bailout of the hedge fund. Examples of large people risk events from 1998:

- On October 23, 1998, Westdeutsche Genossenschafts-Zentralbank eG (WGZ Bank) uncovered a people risk incident that cost the German co-operative bank $230 million. Two currency/FX option traders had manipulated data since the second quarter of 1997, in order to cover up losses they had incurred due to unauthorized trading. The perpetrators worked at WGZ Bank for many years and knew the vulnerabilities in the bank's computer system that allowed them to circumvent internal controls. In order to hide their losses from detection by daily market risk control systems, the traders entered incorrect values into a system that calculated dollar exchange rates.

- In a case of people risk, the former executive at BankBoston's international private bank in New York, Ricardo Carrasco, was charged with defrauding the bank of $73 million. In February 1998, Carrasco disappeared and a month later it was alleged that he had embezzled money by making fraudulent loans. BankBoston filed a $67 million lawsuit in May 1998, alleging that Carrasco had "fraudulently induced" the bank to grant $73 million loans to Argentine businessman Barreiro Laborda and companies controlled by Laborda. The Federal Reserve said that Carrasco opened at least 26 accounts for Laborda over a 3-year period, beginning in 1994.

**Market Event of 2001-2002: Spitzer focuses on market practice issues; Enron collapses**

2001 and 2002 were years of great change in the financial services industry as a result of the activist stance of former New York State Attorney General Eliot Spitzer. The former Attorney General changed the rules of the game for what was acceptable on Wall Street when he focused attention on consumer issues and how small investors are impacted by market practices.

Regulators of the financial services industry, such as the Securities and Exchange Commission and the Federal Reserve Bank, previously focused on issues of solvency and an institution's ability to preserve capital during times of volatility. This period also saw the dissolution of Enron and Worldcom – two of the largest companies in the United States – and accounting frauds that surfaced in many other institutions. Eliot Spitzer was later named "Man of the Year" by the Financial Times in recognition of the global impact he had on the financial markets. Examples of large people risk events from 2002:

- In what the Financial Times (2/7/2002) called "another chapter in the cult of the rogue trader," and the largest such case since Nick Leeson managed to topple Barings Bank, Allied Irish, Ireland's largest bank revealed on February 6, 2002 that a currency trader had disappeared after defrauding a US-based subsidiary of $691.2 million. John Rusnak was identified as the rogue trader who worked at Allied Irish's Maryland-based subsidiary, Allfirst; he initially went into hiding after the event was made public. Mr. Rusnak later surfaced and pled guilty to one count of bank fraud on October 24, 2002. He was sentenced to a prison term of seven and a half years in January 2003. It was later determined that the small Maryland-branch operation did not have the proper controls in place in order to oversee a proprietary trading operation.

- The US Office of the Comptroller of the Currency (OCC) and the Federal Deposit Insurance Corporation (FDIC) shut down Hamilton Bank N.A. of Miami on January 11, 2002. Hamilton Bank had about $130 million of potentially uninsured deposits held in approximately 3,600 accounts at the time of its closing. In 2006, Hamilton's chairman, Eduardo Masferrer was sentenced to 30 years and 2 senior officers of the bank drew shorter prison terms. A law firm that represented Hamilton's audit committee also agreed to pay fines in settlements with the OCC and FDIC.

**Market Event of 2007: Crunch in credit markets and subprime blow-up lead to volatile trading conditions**

Market conditions for all financial institutions and lenders became so precarious during August 2007 that the Federal Reserve stepped in to add liquidity to the markets. The Federal Reserve last provided cash to the banking system in 1998 during the collapse of hedge fund Long-Term Capital Management. When the Federal Reserve moved to cut the discount borrowing rate, it released a statement saying that risk in the markets had increased "appreciably." With short-term borrowing all but shut down by an associated freeze in the bank wholesale lending sector and capital market transactions halted, trading markets drifted wildly between highs and lows. Examples of large people risk events from 2007:

- Credit Agricole released a statement on September 18, 2007 indicating that a "large market position on the books" of subsidiary Calyon's New York-based "proprietary trading desk" had been uncovered. The position was in unidentified credit market indices that were acquired "during the last days of August and in excess of unauthorized internal limits." The bank said that when the cost of unwinding the trade is accounted for it will result in a €250 million ($347 million) loss. The position in question was taken by Calyon's proprietary trading desk. An unidentified six traders were allegedly involved in building up the unauthorized position. The accumulation of unauthorized positions occurred in late August 2007 and at the height of the market volatility that was caused by the credit crunch and problems in the subprime mortgage sector.

## CONCLUSIONS: MARKET VOLATILITY AND OPERATIONAL RISK

It is generally believed in the credit risk world that market booms lead to "irrational exuberance" and a certain laxity in lending standards that can create losses later on when market conditions turn downward. We also believe that this is true with operational risk and business practices. The operating environment and control structure of a financial institution may become "more fluid" and "adaptive" during exuberant times, when the implementation of controls might be viewed as counter to growth and entrepreneurship. With the present identification of people risk losses that are in particular tracking market volatility, we believe it will become possible for risk managers to more accurately and astutely track potential weaknesses within their organizations.

There are a number of controls that were apparently missing, weak, or nonperforming in the loss events that are excerpted in this paper. Supervision is a key issue and in many of these cases a lack of supervision was cited as a prominent omission by regulators. These events may have been perpetrated by a single individual or group of wayward employees, but management was seemingly looking the other way. In many of the unauthorized trading events, the rogue trader was booking returns significantly above the average. In these cases, management often abdicates its role to "manage" in favor of looking the other way. Managers and supervisors need to be willing to "ask the tough questions" at all times, but especially during times of high market volatility.

Testing for data accuracy is another contributing factor that was present in many of the events discussed above. Many of the internal frauds and rogue trading events involved some sort of manipulation of data. Many of the traders had knowledge of how their company's systems operated and had the wherewithal to figure out how to manipulate inputs into company accounts, trading books, risk management systems, or ledgers. For the most part their inputs went unchecked and were not validated by another set of eyes. Times of high market volatility demand not just double verification, but perhaps triple verification of such inputs. It is also not a bad idea to run tests on internal risk systems in order to determine where there could be vulnerabilities.

This emphasis on people risk and internal fraud does not mean that other types of risks, such as relationship risk, involving regulatory authorities, clients, and market practices, do not increase during times of volatility. In fact, some of the largest risk events fall into this category. This includes the large Enron, WorldCom, and conflict of interest settlements that global banking organizations reached with shareholders and regulators. The people risk category most closely tracks market events, but in general, all risk categories increased in terms of their rate of change along with an increase in volatility.

Times of volatility raise the stakes in the risk management game. Risk cultures are established during times of relative calm and quiet. Times of volatility, however, demand enhanced scrutiny of operational risk, with the associated prospect that additional capital may need to be set aside to cover associated losses that surface during this period. This suggests an associated move during such extraordinary times from "loss prevention" in a stable operating environment to "loss control" in a more tumultuous one. It may be that we will come to a time when we can more accurately track risk capital to market volatility and adjust the levels as necessary and according to market demands.

It is our belief that market volatility is a powerful indicator of increased frequency of operational risk events – and especially in the category of internal fraud. Extreme swings in volatility in a market or sector should serve as a warning that it is no longer a "status quo" situation. We hope this research will help create a proactive response to operational risk during times of volatility and an opportunity for our clients to approach such times with an "all hands on deck" attitude.

We will continue to track and monitor loss events against volatility measures and deepen our analytical research into the topic. Our continuing effort includes the tracking of operational risk events and the further development of an analytical framework in order to model dependencies between the VIX and possible additional indices and operational risk loss data. Our goal is to eventually develop best practices and business approaches toward the understanding of how volatility impacts the management of operational risk and what specific actions need to be taken, or practices modified, during times of high volatility.

**Note: all loss data used in this study is from Algo FIRST, Algorithmics' database of external risk loss events.*

## ABOUT THE AUTHORS

**Penny Cagan, Managing Director, Operational Risk Research and Content, Algorithmics**

Penny Cagan is a Managing Director with the operational risk division of Algorithmics. Leveraging over twenty-five years experience in financial services research, Penny manages the operational risk loss event databases Algo FIRST and Algo OpData, and leads research for the group. A highly-regarded and frequently requested speaker, Penny has delivered many keynote presentations and has published numerous articles in Risk magazine, Operational Risk newsletter, FOW, and the John Liner Review. Penny developed the case study approach to operational risk based on external events, and was the first person to go to market with an operational risk case study database. As manager of Algo FIRST for the past seven years, she has established the best practice standard for examining and analyzing industry case studies. Earlier in her career, she served as Head of Research for Deutsche Bank´s North American Business Information Services division and as Head of Reference Services with PaineWebber's investment banking division. Penny holds a MLS in Library Science and a BA and MFA in English Literature and Creative Writing.

**Yakov Lantsman, Senior Vice President, Algorithmics**

Yakov Lantsman is a Senior Vice President at Algorithmics, where he guides the company's quantitative modeling efforts. A twenty-year veteran with vast industry experience in applied mathematics and risk modeling, Yakov is a frequent presenter and author on modeling very complex processes, including fitting distributions, identifying theoretically valid computational short-cuts, and econometric modeling. Prior to joining Algorithmics, Yakov was Senior Vice President at Willis Re, leading the company's Research and Development efforts. This role built on Yakov's experience with Fitch Risk Management Services, where he was Senior Vice President and Head of Quantitative Services, as well as his experience as Assistant Vice President at Guy Carpenter & Company, where he was responsible for research and statistical modeling. Yakov received a PhD in Mathematics from Tashkent Institute of Technology and a MS in Mathematics from Tashkent State University.

## ABOUT ALGORITHMICS

Algorithmics is the world's leading provider of enterprise risk solutions. Financial organizations from around the world use Algorithmics' software, analytics and advisory services to help them make risk-aware business decisions, maximize shareholder value, and meet regulatory requirements. Supported by a global team of risk experts based in all major financial centers, Algorithmics offers proven, award-winning solutions for market, credit and operational risk, as well as collateral and capital management. Algorithmics is a member of the Fitch Group.

**Contact information:** Penny Cagan
Managing Director, Operational
Risk Research and Content
penny.cagan@algorithmics.com

Algorithmics