1 Introduction

1.1 RISK AND RISK MANAGEMENT

Risk, which can impact all areas of personal and corporate activity, can be defined as the uncertainty surrounding the outcome of a future event. In order to manage and control risks — to reduce or contain possible losses caused by uncertain future events — firms should strive to use all available tools and approaches. By doing so they minimize the chance that unacceptable losses will occur. Firms active in risk-taking businesses should seek to draw on both quantitative and qualitative approaches to help them manage their exposures. Quantitative risk management, which relies on mathematical models and techniques to identify, quantify and manage exposures, is one major approach to risk control; qualitative risk management, which focuses primarily on experience, judgment and common sense, represents a second major approach. Certain firms favor quantitative approaches over qualitative processes, while others prefer a qualitative focus; in some cases firms rely on both methods. Indeed, the "combined" approach may well be the best one, as the truly effective risk process draws on the strengths of quantitative and qualitative techniques to overcome individual shortcomings and weaknesses that characterize each discipline. As we shall note later in this chapter, qualitative approaches to risk management are periodically ignored in favor of purely quantitative techniques. The prudent firm must never forget that judgment, experience and common sense can be powerful tools in helping create a strong risk process. In this text we seek to demonstrate that the creation and application of qualitative methods of risk management — combined with relevant quantitative processes — can help a firm develop the strongest possible framework for managing the risks surrounding core business. Risk takers and risk managers must never forget that experience and judgment are powerful tools in the ongoing management of all risks.

Before embarking on a detailed discussion of risk rules we frame our discussion by reviewing quantitative and qualitative approaches to risk management, failures in the risk control process and diagnosis of control flaws. An understanding of these topics provides some insight into how many of the simple rules of risk discussed in the balance of the text are actually developed. To prepare, we digress briefly and review the scope of the risks considered in this book.

Risk management is the process of managing uncertainty that arises in the normal course of activities, including those related to business ventures. Business risks can assume many forms. From a financial perspective, these may include *credit risk*, or the risk that a counterparty will fail to perform as expected on a contractual obligation, leading to a loss; *market risk*, or the risk that movements in an underlying asset or index will create a loss; and *liquidity risk*, or the risk that assets cannot be liquidated or funding sources cannot be accessed without creating a loss. Each of these broad categories can be divided further. For instance, credit risk can be separated into default risk, settlement risk, sovereign risk, and so on. Market risk can be segregated into directional risk, volatility risk, basis risk, curve risk and correlation risk, among other categories. Other types of business risks can, of course, impact a firm, including *operational risk*, or the risk of loss due to flaws or failures in control processes, and *legal risk*, or the risk

of loss due to errors in, or lack of, legal documentation; these can be decomposed into detailed subcategories. Various other types of risks can impact a company, including tax risk, strategic risk, business risk, reputational risk, and so on; in addition, non-financial operating risks, such as catastrophic property and casualty risk, business interruption risk and director liability risk, can create exposures and losses. While all of these are important, they are beyond the scope of this book and we will not consider them further. Figure 1.1 summarizes major types of business risks. A brief glossary of risk is highlighted in Table 1.1.

Each category of risk — regardless of its underlying characteristics — exposes a firm to the possibility of loss. The risk management discipline focuses on minimizing the possibility of loss, and limiting those that occur to "acceptable" levels. Though the term "acceptable" varies from firm to firm, we define it as a loss that is not significant enough to threaten the financial viability of an institution. Active management of risk, using all available approaches, is central to eliminating unacceptable losses.

1.2 QUALITATIVE AND QUANTITATIVE APPROACHES TO RISK MANAGEMENT

The management of financial business risks — particularly credit, market and liquidity risks — tends to evolve over time, as markets, products, skills and resources change. For instance, before the development and implementation of financial mathematics in the early 1970s, risk management was based largely on experience and judgment. The absence of sophisticated mathematical tools to help evaluate and analyze risks — apart from measures such as bond duration (developed in 1938), the Markowitz mean–variance framework (1952) and Sharpe's Capital Asset Pricing Model (1963) — meant that financial and corporate risk managers relied very heavily on common sense, experience and prudence in order to operate safely. Experienced line managers and financial controllers were responsible for decomposing risks thought to impact operations and developing rudimentary methods for managing exposures (e.g. broad risk limits constraining notional deal size); they often drew on experience from previous losses to help them identify and constrain potential "problem areas." There was little in the way of computing power to assist in the process — the technology focus was on mainframe-driven databases oriented primarily toward customer-related functions rather than financial analysis — and reporting of risk exposures was often manual. Given the preponderance of the "human element" — experience, judgment and common sense, supported by some basic numerical support — we might consider this a "qualitative" approach to risk management. While this method may not have prevented all financial losses, it was adequate given the environment of the time.

Markets in the mid-20th century were not as volatile as they have become over the past few decades. The collapse of the Bretton Woods Agreement in 1972, which had been implemented in the mid-1940s to create a system of fixed exchange rates, together with oil shocks in the early and late 1970s, which fuelled inflation and more active monetary policy initiatives, meant an increase in asset volatility. Currencies, interest rates and commodities began fluctuating by much greater amounts. Deregulation in the global financial and commodity markets during the late 1970s, 1980s and 1990s — including elimination of fixed brokerage commissions, removal of interest rate ceilings, passage of legislation allowing greater personal investment freedoms, erosion of the restrictions between commercial and investment banking, lowering of trade and capital barriers, and so on — translated into greater movement of capital across borders, markets and asset classes. The end result was, and continues to be, an increase in volatility — and a corresponding rise in financial risks.

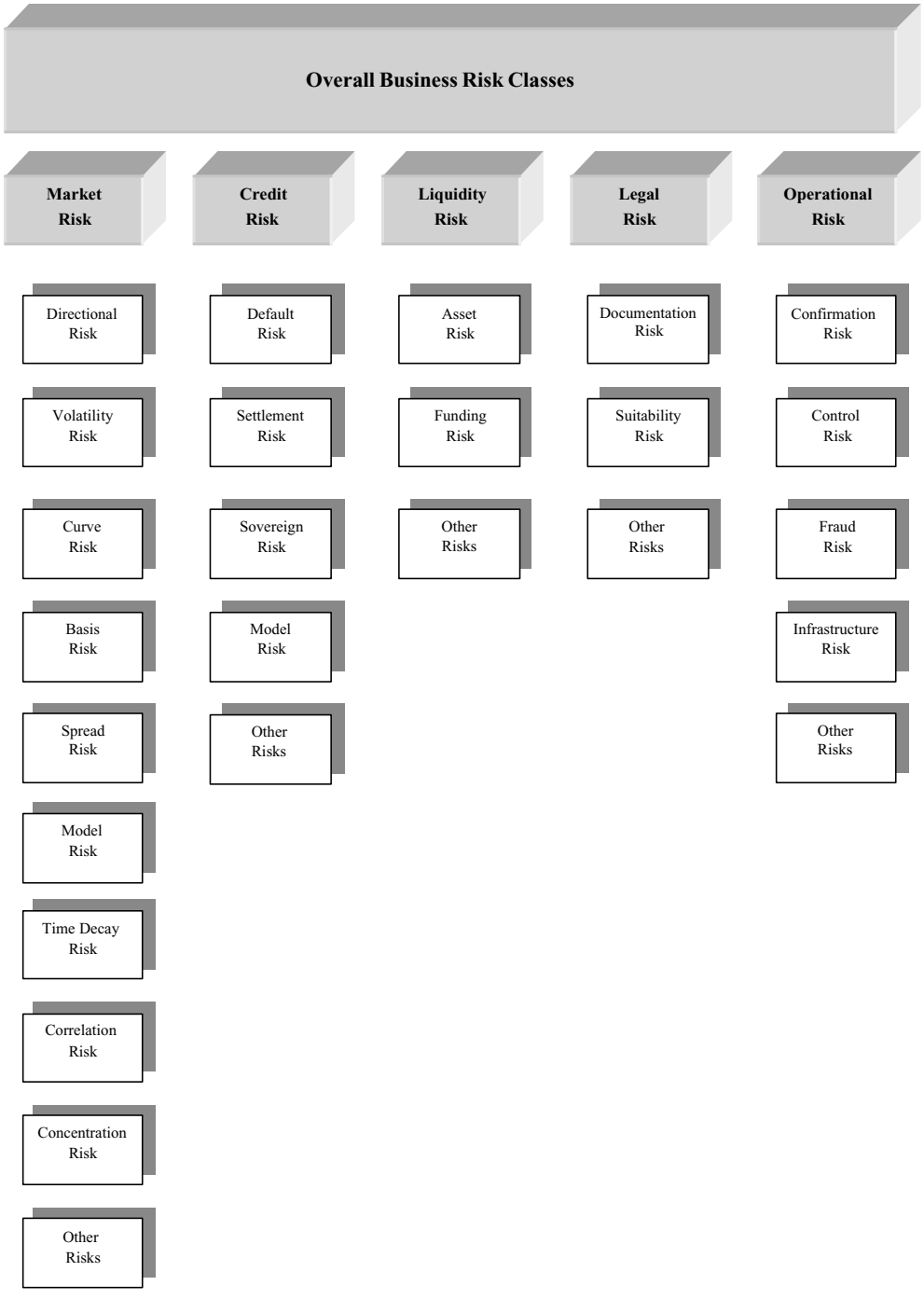

Figure 1.1 Financial business risk classes

Table 1.1 A brief glossary of risk[a]

Term	Definition
Market Risk	Risk of loss due to unfavorable movement in an underlying reference asset, index or market
Basis Risk	Risk of loss due to unfavorable movement between target instrument and hedge instrument
Concentration Risk	Risk of loss due to unfavorable movement in, or performance of, a concentrated risk position
Correlation Risk	Risk of loss due to changing magnitude/relationship of correlations between assets
Curve Risk	Risk of loss due to unfavorable movement in the shape of the reference curve
Directional Risk	Risk of loss due to unfavorable movement in the direction of the underlying reference asset, index or market
Model Risk	Risk of loss due to errors in the financial mathematics or assumptions underlying a model used for market risk management/valuation purposes
Spread Risk	Risk of loss due to unfavorable movement of a spread between two assets
Volatility Risk	Risk of loss due to unfavorable movement in volatility
Credit Risk	Risk of loss due to failure by a counterparty to perform on a contractual obligation
Default Risk	Risk of loss due to counterparty default
Model Risk	Risk of loss due to errors in the financial mathematics or assumptions underlying a model used for credit risk management/valuation purposes
Settlement Risk	Risk of loss due to failure by a counterparty to settle trade/cash flow
Sovereign Risk	Risk of loss due to sovereign action
Liquidity Risk	Risk of loss due to inability to liquidate assets or obtain funding
Asset Risk	Risk of loss due to inability to liquidate assets, risk positions or collateral
Funding Risk	Risk of loss due to inability to secure new funding or rollover existing funding
Legal Risk	Risk of loss due to legal events
Documentation Risk	Risk of loss due to errors in, or lack of, documentation
Suitability Risk	Risk of loss due to client suitability issues
Operational Risk	Risk of loss due to errors in processes and controls
Confirmation Risk	Risk of loss due to unconfirmed transactions
Control Risk	Risk of loss due to human error or lack of control over cash, securities and other assets
Fraud Risk	Risk of loss due to internal/external fraud
Infrastructure Risk	Risk of loss due to failure of internal/external infrastructure

[a] Risks can apply across a broad spectrum of asset classes, including currencies, equities, interest rates, commodities, credits, and so on.

As volatility began intensifying in the 1970s financial mathematics, the foundation of quantitative methods of financial valuation, trading and risk management, was moving into focus. Beginning with seminal work on option pricing by Black, Scholes and Merton in 1973 (followed by additional work by Cox and Ross in 1976, and many others during the 1980s and 1990s), quantitative methods for valuing and pricing a new generation of derivative instruments — financial contracts that derive their value from underlying references — gained rapid acceptance. Not coincidentally, exchanges were actively developing new risk management contracts at the same time, in order to protect against, or take advantage of, rising volatility. For instance, in 1972 the Chicago Mercantile Exchange formed the International Money Market to offer foreign exchange futures; in 1973 the Chicago Board of Trade created a sister organization, Chicago Board Options Exchange, to offer stock options. By the middle of the decade contracts were introduced on mortgage backed securities, Treasury securities and various physical commodities, and new contracts followed on a consistent basis throughout the 1980s and 1990s. The over-the-counter (OTC) financial risk management market, based on customized risk products between two parties, developed in the early 1980s through parallel loans; the structures were soon adapted to form generic interest rate swaps, a basic "building block" of the OTC market. Other derivative and structured products appeared throughout the 1980s and 1990s, including currency, equity, index, commodity and credit-linked swaps, options and notes; quantitative methods for pricing and managing the risks of these products appeared in tandem. For instance, in the mid-1980s large financial firms active in the bond market began using duration and convexity measures, bucketed by curve maturity, to limit their exposure to shifts or twists in the yield curve; likewise, corporate treasurers implemented asset–liability duration and bucketing to manage their interest rate sensitivities. By the early 1990s derivative dealers started valuing and risk-managing cross-asset risk exposures, including correlation and cross-gamma. During the mid- to late 1990s new quantitative portfolio risk measures, such as value-at-risk (VAR), credit VAR and stress testing, were created to give risk and trading managers information regarding their portfolio exposures.

Extension of quantitative processes has permitted the development of increasingly complex risk products over the past three decades. In some cases the availability of mathematical tools (and computing power) has enabled institutions to create new risk management products to solve corporate risk problems. In other cases institutions have developed products (or product frameworks) for their clients and then turned to quantitative analysts for pricing and risk management expertise. Financial mathematics have also been used to produce internal and regulatory risk management tools to help firms determine how much financial risk they have, or how portfolios of hedged risks are performing. The quantitative component of the risk process has been instrumental in allowing firms to analyze and manage their risks more efficiently and, in general, more wisely. Not surprisingly, the power and presence of "quantitative" risk management has moved steadily to the forefront since the early 1990s. Wall Street financial firms and others in the corporate world have attracted legions of quantitative specialists ("quants") — generally highly numerate PhDs from scientific or technical fields — who have helped transform the financial landscape by developing tools, algorithms, formulas and processes to create new derivative, financing and risk instruments. The availability of increasingly powerful, flexible and cheap computing resources has reinforced the process. Many of the mathematical processes now in common use, such as Monte Carlo simulation and binomial/trinomial option tree recombination, rely heavily on computing power. Quantitative approaches continue to spread throughout the financial and corporate worlds as a mechanism for creating, conducting and managing financial business and risks. For instance, quantitative

teams, working in conjunction with their marketing and structuring colleagues, routinely develop new risk management products and strategies with complex pricing/risk management characteristics.

In order to properly market, value, trade and manage such risks, marketers, traders and independent risk officers require certain quantitative skills; such skills, at one time associated solely with derivative desks, are now found in many parts of an organization. For instance, a corporate bond desk might now have its own quantitative team to deal with the complexities of optionality in callable and putable securities and credit derivatives, while a mortgage desk might feature the same expertise in order to cope with issues related to prepayment speeds, option adjusted spreads, optimal hedges, and so on. The same is increasingly true in the corporate world. While traditional industrial and manufacturing companies were unlikely to have employed quantitative specialists a few years ago, many now feature such personnel in their treasury, funding and corporate risk departments. As a result, they are able to value their own risk portfolios, risk-manage their currency, commodity or interest rate exposures, "validate" pricing received from dealers and solicit terms for complex risk management strategies developed in-house.

In addition to "front line" use of quants to create, price and manage risk products, the internal risk and financial control functions at many organizations have come to rely on the same skill set. In the 1970s to early 1980s internal credit and market risk functions were staffed primarily by loan officers and ex-traders, respectively. Most of the approaches taken to controlling credit and market risks were fairly basic; knowledge of, and need for, financial mathematics, was limited — though growing. As product complexity increased the need for quantitative specialists within the independent risk functions (as well as associated areas, such as financial control) grew. By the 1990s it became common for large financial and corporate organizations to employ risk management quants in order to vet the risk of new products and develop quantitative risk measures related to potential credit exposures, derivative risk sensitivities, VAR, and so forth. Financial controllers, needing to independently value and verify complex risk structures, required and obtained similar skills. Such quants are now an integral part of most organizations and help ensure that expertise in the control structure keeps pace with that found on the "front line." Quantitative risk management is thus an integral part of the business unit and risk control process at many institutions, and will continue to play a key role in years to come. In some cases, however, institutions have over-emphasized quantitative approaches, causing fundamental "common sense" rules of risk management to be neglected. When this occurs, risk process failures can result.

1.3 FINANCIAL LOSSES AND FAILURES OF THE RISK PROCESS

On various occasions during the 1980s and 1990s basic risk practices and discipline slipped into the background. Strong bull markets and the profitability of risk-taking ventures, along with growing willingness to place greater faith in recommendations provided by models and quantitative processes, caused some firms to ignore many of the fundamental rules of risk management. As market dislocations, and associated losses, followed, a considerable amount of "post mortem" analysis went into discovering what had gone wrong. Failure to focus on basic risk processes was found to be a central cause of problems in many cases. While it is unlikely that qualitative approaches alone would have protected against all financial difficulties, it appears that proper implementation and use of basic risk discipline would have helped in certain situations.

Financial crises typically reveal problems, mistakes and weaknesses, and lessons on preventing future problems can often be drawn from these crises. Prudent companies follow such lessons diligently, while others may follow them for a period of time, until unpleasant memories have faded, and then revert to their previous behavior and practices; still others ignore the lessons entirely, carrying on as if nothing had occurred. Though financial crises have occurred regularly for many decades, even centuries, we need only review those which have appeared in the recent past to gain a general understanding of the nature of the risk process failures — valuable (and often expensive) lessons are contained in each crisis. For instance, following the asset inflation in Japan during the 1980s (fuelled, primarily, by loose monetary policy and imprudent lending standards), the bursting of the speculative asset bubble left hundreds of Japanese banks with hundreds of billions of dollars of bad loans. The banking system entered a massive write-off, restructuring and consolidation phase — a process that continues to the present time. Lessons related to the need for strong credit risk management, lending standards and internal controls abound from the Japanese experience. Many of the same lessons can be found in the Asian crisis of the late 1990s, where liberal monetary policy and speculative capital inflows led to sharp, and unsustainable, asset inflation; subsequent collapse caused significant regional bad debts, forcing the banking sectors of Indonesia, Thailand and Korea to be restructured and recapitalized; once again, lessons related to the need for prudent management of credit risks, leverage and credit concentrations are plentiful. Various crises in the mid- to late 1990s highlighted the linkages between financial markets and pointed out the frailties of credit and market risk controls. For instance, following the Mexican peso crisis (1994–1995), Asian currency crisis (1997) and Russian/hedge fund crisis (1998), many leading financial institutions that had significant market and credit exposures (such as CSFB, Goldman Sachs, Merrill Lynch and ING, among others) lost large amounts of money. Lessons related to the need for disciplined treatment of credit and market exposures, liquidity risk, collateral valuation and stress testing can be drawn from these episodes. Though the list of financial crises impacting the global system is quite large, a sampling of major dislocations that have occurred since the 1980s is featured in Table 1.2.

Individual corporate losses/defaults can also provide important lessons on failures of the risk process. As with broader macro-crises, the list of individual problems is extensive and varied; a very small sampling is illustrated in Table 1.3.

Table 1.2 Major financial dislocations

Year	Crisis
Mid-1980s	Latin debt crisis
Late 1980s/early 1990s	US savings and loan crisis
1987	Stock market crash
1990s	Japanese speculative asset deflation
1990	High yield bond crash
1992	European currency crisis
1994	US interest rate spike
1994–1995	Mexican peso crisis
1995	Latin American crisis
1997	Asian crisis
1998	Russian default/hedge fund crisis
1999	Brazilian crisis
2000–2001	Technology stock market crash

Table 1.3 Select individual financial losses

Entity	Loss
Local Authority Swaps (1986–1988)	£500MM swap loss
Drexel Burnham Lambert (1990)	Varied counterparty losses
Allied Lyons (1991)	£150MM FX options loss
Showa Shell Seikyu (1993)	¥165B forward foreign exchange loss
Procter and Gamble (1994)	$195MM leveraged interest rate product loss
Codelco (1994)	$200MM copper futures loss
Askin Capital (1994)	$600MM mortgage derivative/financing loss
Air Products and Chemicals (1994)	$113MM interest rate/currency derivative loss
Metallgesellschaft (1994)	$1.3B oil futures loss
Kashima Oil (1994)	$1.5B currency derivative loss
Orange County (1994)	$1.8B leveraged interest rate product loss
Glaxo (1994)	£130MM asset backed/derivative loss
Chemical Bank (1994)	$70MM currency derivative loss
Capital Corporate Fed Credit Union (1995)	$126MM mortgage derivative loss
Barings (1995)	£830MM index and interest rate futures loss
Daiwa Bank (1995)	$1.1B bond trading loss
Wisconsin Investment Board (1995)	$95MM currency/interest rate derivative loss
Postipankki (1995)	$110MM mortgage derivative loss
Sumitomo Corporation (1996)	$2.5B copper future loss
Long Term Capital Management (1998)	Varied market losses
Enron (2001)	Varied counterparty losses
Allied Irish Bank/Allfirst (2002)	$691MM foreign exchange loss

The list will, of course, expand as new crises strike. Despite learning from each successive dislocation, there will always be new lessons to consider, problems to solve and processes to strengthen. However, as firms learn from each crisis and use the lessons to create new, or strengthen existing, processes, the hope and expectation is that future losses will be minimized. While we do not wish to replicate much of the excellent work that has been done in analyzing these crises, it is helpful to consider several prominent institutional failures in order to illustrate basic flaws in risk processes that caused, or contributed to, losses. Though we simplify very complicated issues, valid summary conclusions can be drawn from each. These lessons provide important insight on how the lack of risk management focus can lead to financial problems. Indeed, some of the lessons from these failures contribute to the development of the rules discussed in this book.

1.3.1 Showa Shell Seikyu

Showa Shell Seikyu (SSS), a 50% owned subsidiary of Royal Dutch/Shell, is an importer, refiner and distributor of oil in Japan. As an importer paying dollars for crude oil, SSS has historically hedged a portion of its currency exposure using foreign exchange forwards. In 1989 the company entered into a series of forwards where it was required to buy dollars forward at an average rate of ¥145/$. Over the next few years the yen strengthened against the dollar. By the time the forwards matured, the currency was trading at ¥125/$, meaning that the company had a large loss on its forward position (but presumably a gain on its crude purchases, to the extent it operated a legitimate hedge program). Rather than recognize the losses, SSS's treasury department, apparently without approval, rolled over the forwards at historical, and

by then well off-market, rates (in the form of "historical rate rollovers"). By doing so the losses were concealed in the new forwards; indeed, the banks involved in rolling over the contracts were effectively granting SSS loans to cover the losses. This process continued until the end of 1992, by which time the company had over $6.4B of forwards on its books. At that point, management revealed that total financial losses hidden through the contracts amounted to $1.4B, or 82% of shareholders equity — a significant amount given the size of the company. The practice was not, unfortunately, unique to SSS; other Japanese companies engaged in identical practices, generally with similar results.

Risk management lessons: any internal business unit capable of assuming risk must have its activities approved and independently monitored; dealing without appropriate approval in any type of instrument that generates a credit or market exposure can result in financial losses and should be regarded as an infraction of the control process; concealing a loss in hopes of "making it right" may lead to even greater losses and should be considered a violation of governance and control processes; financial controllers and auditors must be vigilant toward any practice that can result in the concealment of a loss or risk.

1.3.2 Procter and Gamble

In January 1993 consumer products company, Procter and Gamble (P&G) entered into a relationship with US banking firm Bankers Trust (BT, since acquired by Deutsche Bank) where it purchased derivatives structured by the bank. The company's apparent motivation was to use interest rate derivatives to help lower its funding costs; in the early 1990s it featured $5B of debt and had already executed certain simple, or "vanilla," derivative transactions. In November 1993 the company bought the first of several leveraged derivatives from BT. Most of the transactions were based on complex payout formulas that required P&G to pay BT increasing amounts as interest rates rose, and receive flows from BT (and thus lower its effective financing costs) as interest rates declined. P&G initially benefited as rates remained stable. In February 1994, however, the Federal Reserve commenced hiking interest rates, causing P&G to lose on its swaps. Indeed, the inaugural November 1993 trade required the company to pay 450 basis points (bp) over its commercial paper (or short-term funding) rate — a significant problem, and shock, for a company that hoped to use derivatives to lower its borrowing costs; in fact, the 450 bp premium was equal to an incremental $40MM of interest costs. By the time P&G arranged for BT to "lock in" rates on the leveraged deals in April 1994, it had accumulated $195MM in incremental financing costs. The company took a $157MM pre-tax charge on the transactions and, in October 1994, filed a lawsuit against the bank for failing to disclose important information related to the deals (such as how to compute the payout profile of the leveraged swaps under various scenarios), misrepresenting the risk of the transactions and breaching the fiduciary/advisory relationship. P&G noted that it was not the only end-use client to lose money from BT's sales of highly leveraged products — others had sustained similar losses, including Gibson Greetings, Sandoz, Jefferson Smurfit, Air Products, Sequa and Federal Paper Board, among others. The court case was accompanied by the disclosure of highly embarrassing material from the BT trading floor tapes, which reflected "aggressive" sales practices and attitudes by select BT employees. Prior to the conclusion of the court case the two parties reached an out-of-court settlement, with P&G agreeing to pay BT only $35MM of the $195MM due under the derivative contracts.

Risk management lessons (gained from both perspectives): an optimal hedge must be selected when trying to protect a balance sheet or income statement; leverage dramatically compounds

the positive and negative effects of a risk position and must be factored into any trading/risk decision; a thorough understanding of the downside scenario of any risk position is vital, particularly under stress scenarios; the risks of a complex product must be thoroughly identified and understood; regular disclosure of risk to those who may be less capable of valuation is a sound practice.

1.3.3 Metallgesellschaft

Metallgesellschaft, a large German commodity and financial services firm, sustained significant losses through its US subsidiary, MG America (MGA), in 1994. Between 1991 and 1993 MGA sought to build up its US market presence and entered into long-term contracts with various counterparties where it agreed to supply 155MM barrels of oil products at fixed prices over five and 10-year terms; counterparties were also given the option of terminating contracts if market prices increased above the fixed prices. In order to hedge its risk, MGA entered into exchange-traded and OTC derivative contracts, including 55MM barrels equivalent in New York Mercantile Exchange (NYMEX) futures and 100–110MM barrels equivalent of OTC swaps and forwards. In order to manage its risk, MGA structured most of its hedges in the short-end of the curve, where liquidity was greatest. This hedging (known as a "stack and roll" strategy) necessitated constant rehedging as maturing contracts expired. In order to construct its hedge, MGA had to post margin on its exchange-traded hedges and collateral on its OTC trades.

Once the hedging program was underway, it became clear that the rehedging exercise would be difficult, as a significant number of contracts were needed to keep the position balanced; it also became evident that MGA was very exposed to the changing shape of the forward oil curve. As the value of spot crude oil fell, MGA found that the long-term contracts (a liability) were increasing in value, while the short-term hedges (an asset) were declining in value. Since the company marked its futures and OTC contracts to market — but did not do the same with its long-term forwards — it sustained large cash outflows; the losing hedges required MGA to post more margin with the exchange and more collateral with OTC counterparties, squeezing its liquidity. When it was finally unable to withstand the continuous cash outflows, it sold its hedges. As the spot price of crude recovered, the company sustained further losses on its unhedged position. The total loss attributable to the episode amounted to approximately $1.3B and resulted in a restructuring of the company.

Risk management lessons: a thorough understanding of how accounting conventions can affect valuations and risk behavior is vital; imperfect hedges can be extremely damaging; basis and curve risks are real and can generate losses; synchronizing time horizons is crucial in any hedging program; large, concentrated positions can create liquidity problems and may generate losses; financing margins and collateral is a requirement in many risk-taking strategies and must be factored into an overall funding program; failure to secure adequate financing in advance can lead to forced liquidation at the worst possible time.

1.3.4 Orange County

Orange County, a large county located in South California, operated an investment pool under the guidance of Robert Citron, the county treasurer. The pool invested proceeds on behalf of county institutions and organizations and, over a period of several years, posted very strong returns. Indeed, Citron's investment performance record was so strong that local school districts

and other municipal entities in Orange County issued their own short-term debt and channeled proceeds to Citron for investment. By late 1993 Citron had $7.5B under management and, betting that interest rates would remain low (or decline), continued to amass larger interest rate positions, primarily in five-year agency securities. Citron made extensive use of repurchase agreements (e.g. buying securities and pledging them as collateral for more loans, using those loans to buy more securities, pledging those securities for more loans, and so on). He also purchased structured products with embedded leverage (e.g. notes with inverse floating coupons). The $7.5B of investable funds was leveraged to $20.5B, meaning that even a small increase in interest rates could have a damaging effect. In fact, when the Federal Reserve began raising rates in February 1994 (a process it continued for the balance of the year), Orange County's leveraged portfolio suffered massive losses. Though the duration (or average life and, hence, interest rate sensitivity) of the portfolio was only 2.74 years, the effects of 2.7 times leverage made the effective duration equal to 7.4 years — the portfolio was thus extremely sensitive to rate changes. By the end of 1994, after rates had risen by 300 bp, the portfolio sustained total losses of $1.6B — short of cash, the county was forced to declare bankruptcy and restructure its debt. The portfolio was liquidated and a spate of lawsuits commenced against those who had actively dealt with Citron. The municipal bond market in general suffered sharp price declines as investors began to search for excess leverage in other government investment portfolios; normal conditions did not return to the municipal market for many months. Unfortunately for Orange County, the liquidation of the portfolio coincided with a turn in the interest rate cycle — by the time the process was over, the Federal Reserve was back in an easing mode; indeed, rates dropped far more rapidly in 1995 than most expected. Several of the lawsuits emerging from the case were settled out of court; for example, Merrill Lynch pleaded "no contest" and agreed to pay $437MM as a settlement. However, the County's ultimate recoveries left it woefully short of its liabilities.

Risk management lessons: leverage can compound returns but may also compound risks; the lack of basic financial risk measures, which incorporate the effects of leverage and illiquidity, makes it difficult to manage a portfolio of risks; full disclosure of risks and returns to internal and external stakeholders is essential; concentrated, and leveraged, positions can damage individual institutions and broader markets; stress scenarios, focused on the seemingly "unthinkable," are an essential part of any risk process; client suitability issues can impact financial providers.

1.3.5 Barings

Barings, the British merchant bank that now forms part of the Dutch banking group ING, was the scene of considerable risk and control failures in the mid-1990s. Specifically, in 1992 Nick Leeson, a settlements specialist at Barings in London, moved to Singapore and soon assumed an additional role as an arbitrage trader, ostensibly capitalizing on discrepancies between the Nikkei 225 index futures contracts traded on the Singapore International Monetary Exchange and the Osaka Securities Exchange. In his capacity as an arbitrage trader Leeson was not permitted to sell options or take outright positions. In reality, however, he very quickly began taking outright positions and hiding them in an "error" account. Since no independence existed between the front- and back-offices — Leeson controlled both — he was able to disguise, over a two-year period, a growing number of outright, loss-making positions. Reporting was suppressed or altered in order to obtain funding necessary for exchange margins, and profits were inflated to make the arbitrage business appear very profitable.

The fiction continued through early 1995, when Leeson's positions began to grow so large that they became more difficult to disguise. The charade came to a halt following the January 1995 Kobe earthquake, which sent the Nikkei plunging and index volatility soaring. Prior to the earthquake Leeson had sold a large number of straddles (puts and calls with the same strike prices), taking in premium income and hoping the market would remain calm. The opposite happened, forcing Leeson to take larger outright bets. By late February, as margin calls increased and internal/external scrutiny intensified, Leeson fled the bank. The subsequent investigation revealed that Barings was technically insolvent, as £830MM of accumulated losses exceeded the firm's capital. The bank was ultimately subsumed by ING, which paid £1, plus assumption of liabilities, for the remaining assets. As the "post mortem" unfolded, the extent of Leeson's risk positions proved considerable: on a notional basis, he commanded $7B of Nikkei futures, $20B of Japanese Government Bond and Euroyen futures and $6.7B of Nikkei straddles. Allowing for replacement cost factors (since the notional principal is not at risk in futures) the exposure was equal to 2.5 times Barings' total capital. The "fictionalization" of profits was also considerable. While Leeson claimed to have made £8.8MM in 1993, £28MM in 1994 and £18MM in early 1995, the reality was sharply different: he lost £21MM in 1993, £185MM in 1994 and £619MM in early 1995. Arbitrage businesses, which seek to take advantage of small price discrepancies, rarely produce such large profits — unless risk is being taken or results are being manipulated.

Risk management lessons: segregation of front- and back-office duties is essential, as is the existence of a strong, knowledgeable and independent risk management function; control officers (risk managers, auditors, controllers) must question circumstances where behavior is suspicious or explanations appear illogical; senior management must be actively involved in managing risk takers, wherever they reside; management must understand the nature of the business it is engaged in; profits and losses must be decomposed in detail by controllers to provide intelligence on how money is being made or lost; risk reporting must be produced independently and be of sufficient detail to provide relevant information; risk limits must exist to constrain activities.

1.3.6 Sumitomo Corporation

Like Barings, Sumitomo Corporation, one of Japan's largest industrial conglomerates, was the victim of very large losses that occurred primarily as a result of a breakdown in internal controls. The company, a large player in the global metals market, tasked Yasuo Hamanaka with building a metals trading capability in the early 1980s. Hamanaka became so successful at trading in the copper market (through the physical and OTC derivative markets, as well as the London Metal Exchange (LME)'s copper futures) that the company eventually gained a reputation as being one of the world's savviest and most powerful copper players. Indeed, as Hamanaka's influence grew, he became known as "Mr. 5%" for routinely being able to control 5% of the global copper market. Hamanaka apparently posted strong profits for Sumitomo, particularly between 1991 and 1995; as a result, he commanded considerable influence within the company. His success allowed him to remain in the copper trading role for many years, a process that is contrary to the rotation schemes practiced by most Japanese firms; over a period of years he built a team of copper traders around him, and gained control over all front- and back-office duties associated with his business.

Global copper prices began to weaken in the early part of 1996, as years of copper oversupply overwhelmed demand (e.g. average supply growth of 7% versus average demand growth

of only 0.5%). At that point Hamanaka, who had successfully manipulated LME copper prices for at least six years (and perhaps as long as 10 years), had a very large long position in both physical and derivative copper that was highly vulnerable to a downturn in prices. As his attempts to drive the direction of prices became more obvious, regulators in the UK and US began making enquiries into his positions; almost simultaneously, Sumitomo launched an internal probe of its own and soon "promoted" Hamanaka out of the copper trading department. Hedge funds and other speculators, recognizing that Hamanaka's "promotion" meant irregularities, systematically drove down the price of copper over a four-week period, from $2700 to $2000/ton — much closer to equilibrium supply/demand clearing levels. As the internal investigation unfolded, it became apparent that Hamanaka, through control of both trading and back-office processes, as well as price manipulation/squeeze techniques on the LME, had managed to influence the copper market for several years. He was able to continue the fiction by having broad authority to trade significant amounts of copper (in the early 1990s he routinely accounted for 50% of LME's turnover) and keeping unauthorized deals in special accounts that were not recorded in the company's official records. Even when he was advised to reduce positions to 30% of LME's volume by internal managers, he used his special account to repurchase Sumitomo's own positions. Internal controls failed to detect any irregularities; since Hamanaka's early years were very profitable, he was given wide latitude to operate outside of traditional corporate practices. By the time the review unfolded, Sumitomo Corporation was forced to declare $1.8B of losses, equal to approximately 10% of its equity; the figure was ultimately increased to $2.5B.

Risk management lessons: As in the instance of Barings, segregation of front- and back-office duties is essential, as is the existence of a strong, independent risk management function; independent scrutiny of positions must be performed by an independent function capable of interpreting the risks; any time a significant share of an asset or market is under the control of a business, concentration risks must be reviewed and understood; profits and losses must be decomposed in detail by controllers to provide knowledge of how money is being made or lost; management must understand the nature of the business it is engaged in.

1.3.7 Long Term Capital Management (LTCM)

LTCM, a hedge fund, was founded in 1993 by John Meriwether and various ex-Salomon Brothers arbitrage traders (the fund also included option pricing pioneers Myron Scholes and Robert Merton as partners). LTCM based its investment strategies on relative value positions, such as convergence plays (theoretically "market neutral" strategies between two assets that are maintained until asset prices converge); the fund's relative value trades included on-the-run versus off-the-run Treasuries, callable bunds versus Deutschemark swaptions, and so on. LTCM also established certain directional positions, including a very large short position in equity volatility. In order to maximize returns, the fund employed significant amounts of leverage — though just how much was unclear until the fund unraveled in late 1998. Following its launch, LTCM quickly attracted large amounts of investment capital; by 1994, after it posted a strong performance, the fund had a total of $7B of capital on which to build positions. In 1997 it returned $2.7B to investors, but did not reduce positions — effectively increasing its leverage. By mid-1998, market turmoil in US interest rate products caused the fund to unwind certain positions at a loss. In August 1998, the Russian debt moratorium roiled the financial markets, causing a spike in volatility and a flight to quality — which converted convergence plays into divergence positions; all of these movements were detrimental to LTCM. On August 21 the

fund reported losses of $550MM and, by the end of the month, increased the total to $2.1B. Attempts to raise new capital, which had declined to $2.3B, were fruitless. By mid-September the Federal Reserve became increasingly concerned about the systemic implications of a potential LTCM collapse — particularly after reviewing LTCM's portfolio, and discovering that its on-balance sheet leverage was already considerable at 30 times, while its off-balance sheet leverage was perhaps 10 times larger. All VAR and collateral liquidation stress testing was rendered ineffective by those seeking to quantify LTCM's exposures — this was an unprecedented multi-asset/market dislocation, well in excess of anything predicted by financial models. Another $500MM loss in late September caused the Federal Reserve and leading bankers to finally take action. Realizing that the collapse of LTCM threatened the viability of other financial institutions and, thereby, the financial markets at large, a "self-preservation" bailout group was formed. After several attempts at negotiating a rescue, 11 international banks agreed to contribute $300MM apiece to keep LTCM operating as a going concern (three others contributed smaller amounts). The management group was able to retain 10% of the fund, but a risk committee from the bailout group was tasked with the orderly liquidation of positions over a period of months. After some initial market jitters caused more losses, the environment stabilized and liquidation proceeded according to plan. By mid-1999 the 14 banks received $1B and were ultimately repaid in full. Meriwether eventually went on to form a new fund.

Risk management lessons: financial risk and trading models used to estimate exposures have limitations; stress testing of portfolios is vital, as the "unthinkable" tends to happen; collateral values can deteriorate rapidly, especially in an illiquid market; if an institution is extending credit to a high profile account, it is almost certain that others are doing the same — providing even greater leverage and magnifying potential losses; changes in correlation can increase the risk of positions; seemingly low risk trades (e.g. convergence/divergence trades) may not be as low risk as believed, particularly during times of market stress.

1.3.8 Enron

Enron, a large US energy company, was created from various small pipeline companies in the mid-1980s. Over the course of a decade it acquired more pipelines, expanded its operations into gas and power trading, and ultimately ventured into new areas it believed would benefit from market deregulation (e.g. water, broadband services, certain hard commodities). As the US power markets deregulated in the late 1990s Enron increasingly turned its efforts toward merchant trading, selling many of its physical assets (e.g. generation and pipeline) in the process. By 2000 the company derived most of its revenues from gas and power trading; indeed, its trading presence was so significant (i.e. 25% market share in certain energy sectors) that it became the seventh largest company in the world by revenues. In mid-2001, however, the company's growth began to slow and the value of its investments in areas such as water distribution and broadband services was called into question. In October 2001 the firm announced that it was bringing certain off-balance sheet items back onto its financial statements, causing a $1.2B reduction in its equity base; this move shocked many analysts, who were unaware of the company's off-balance sheet obligations. From that point on analysts, who had widely supported Enron's "asset light" trading model, began to scrutinize available financial information (in fact, Enron's financial disclosures had historically been very opaque, meaning credit and equity analysts, as well as bankers, were not necessarily making decisions based on all relevant information). As pressure built for the company's management to provide more information, new details came to light, including the fact that Enron had used multiple special purpose

vehicles (SPVs) (with clever names such as JEDI, Chewco and Raptor) to move debt off-balance sheet and inflate earnings. As this information was disclosed the company was forced to restate five years' worth of earnings, causing the stock to plummet and rating agencies to downgrade the company's debt to one level above "junk" status. In order to assuage investors and creditors, Enron's CFO, Andrew Fastow, was fired and executive management was re-aligned. It was, however, too late: a liquidity crisis ensued and Enron was forced to post more collateral to keep its trading operations functioning; certain firms withdrew their credit lines entirely and the company began having more difficulty sourcing cash to sustain its businesses. By November 2001 the banking and investment community had effectively lost confidence in Enron and its management, and it became necessary for the company to seek a merger partner. An 11th hour merger agreement with cross-town rival Dynegy was struck; however, the agreement only lasted a few days and was cancelled by Dynegy after Enron's managers revealed new liabilities and rating agencies downgraded Enron to junk status (forcing it to post collateral that it did not have). Shortly thereafter Enron filed for bankruptcy, becoming the largest corporate failure in US history. Following the default many of Enron's executives (as well as its board members) claimed to be unaware of Fastow's actions, the creation of SPVs or the misstatement of earnings. Numerous congressional and legal actions began against Enron's management, a process that continued well into 2002; indeed, findings and actions may take several years to determine. Enron's auditors, Andersen, were also damaged by the disclosures, as they had effectively given the company a clean "bill of health" during the entire period; in the aftermath, Andersen lost a number of important audit clients and was found guilty of obstructing justice by destroying crucial Enron documents.

Risk management lessons: opaque or inadequate financial disclosure may ultimately lead credit providers, investors and rating agencies to lose confidence in a firm; when risk analysts are dissatisfied with management information they should question and probe until they are satisfied; a "credit cliff" (significant downgrading event) can lead to a liquidity spiral; lack of a robust and committed liquidity program can lead to significant funding losses and may ultimately lead to default; senior management and board members must not claim to be unaware, or be in a position where they are truly unaware, of a firm's financial activities; the ability to explain how profits and losses are generated is paramount.

1.3.9 Allfirst

Allfirst, a US bank subsidiary of Allied Irish Bank (AIB), was the scene of significant losses caused by John Rusnak, one of its foreign exchange traders. In February 2002 AIB announced that it had lost $691MM at its Baltimore-based subsidiary through the unauthorized currency trading activities of Rusnak. AIB's management indicated that, over a period of five years, the trader manipulated controls to hide losses in Allfirst's foreign exchange trading operation. Rusnak took dollar/yen positions well in excess of his authorized $2.5MM daily loss limit; when he began posting losses and violating limits, he attempted to cover up by creating fictitious trades. In particular, Rusnak booked fictitious hedges that made his book appear properly balanced and within risk limits, when it actually was not. Lax operational, financial and risk controls apparently permitted false trades to be accommodated (Rusnak was also permitted to trade from off-premises systems, contrary to most market and regulatory recommendations). Rusnak also engaged in certain high risk options strategies to help disguise losses; these ultimately compounded the damage. For instance, in order to generate cash to cover his losing positions, he sold deep-in-the-money currency options (e.g. he executed a $75MM trade with Bank of America through a prime broker account to cover a $50MM loss on spot positions);

while these brought in a significant amount of premium income, they were virtually certain to be exercised at a future time (requiring Allfirst to make a large payment to its counterparty) — this just delayed inevitable recognition of losses. As losses mounted it became increasingly difficult for him to disguise the positions; an internal investigation that commenced in mid-December 2001 eventually brought the problem to light. It is worth noting that other institutions in the dealer community expressed concern about Rusnak's activities and some even refused to deal with him; this information, however, was either not received, or not acted on, by Allfirst/AIB management. Risk control oversight by AIB over its subsidiary appears to have been minimal; Allfirst's treasury, responsible for foreign exchange trading, supplied basic risk information to AIB's Dublin-based risk control function (including the fictitious hedge positions), but scrutiny and control from head office appear not to have been strong.

Risk management lessons: an appropriate risk management/control system must be used to capture and monitor all trades and risks; risk-taking should not be permitted through off-premises systems; financial controllers need to verify and reconcile all positions and movements of cash; monitoring of risk activities in offshore subsidiaries by head office risk managers is essential; local managers must be responsible for the activities and oversight of their local employees; credit and market information related to a counterparty's activities should be shared whenever possible (within the confines of legal rules).

1.4 DIAGNOSING RISK PROCESS PROBLEMS

As noted through the brief examples above, valuable lessons can be gained by examining institutional risk management failures; by understanding how others have failed, firms can strengthen their own operations. To continue this theme, it is instructive to highlight some of the "telltale" warning signs that characterize flawed risk management processes; this can reveal possible problems and can be used to take corrective action — hopefully in advance of any losses. For ease, we consider flaws that can appear in each stage of the risk process. A typical process begins with a governance structure, which defines control responsibilities and authorities. It is followed by individual components of the risk management cycle, including identification, quantification, monitoring/reporting and ongoing management. Infrastructure, centered on technology and data, supports the entire risk process.

1.4.1 Flaws in Governance

- *The risk process is not independent of the business units it is attempting to control.* This indicates that no independent group of professionals is overseeing the risk-taking activities of the firm; those who take risk also monitor it, and do not necessarily impose limits/constraints when needed.
- *Senior/executive management does not understand the nature and/or magnitude of the risks it is taking*. This is indicative of a management team that is uncomfortable with risk, fails to understand the impact risk can have on operations, or views risk as unimportant or irrelevant in the larger scheme of business operations.
- *Accountability for risk-taking is ill defined.* This reflects problems with communication and potential unwillingness by those in the management chain to accept responsibility for the actions of those taking, or controlling, risk.
- *Management's expression of its risk appetite — in terms of types, amounts, markets, classes — is unclear and ill defined*. This, again, suggests an inability by management to

understand the nature and intricacies of risk-taking; the absence of clear expression suggests key executives are unable to grasp the essentials of the business.

- *Risk limits and policies are routinely violated without penalty.* This suggests that the risk control function lacks authority or management support and that management lacks control over those violating the rules. It also indicates that others in the governance structure, including executive management and the board of directors, are not discharging their fiduciary duties appropriately.
- *New products or commitments can be executed without prior approval or scrutiny by control functions*. This suggests that a formal process for vetting new risks does not exist and that entry into new markets, asset classes and instruments can proceed unchecked. It may also signal management's belief that new risks are not important enough to review in advance.
- *New risks appear on the firm's books without prior knowledge by those in the risk function or senior management.* This indicates disregard for risk policies/limits governing new types of risks, absence of policies designed to control new activities, or inability by senior management to control its business leaders.
- *Risk policies are vague and incomplete, and are routinely misinterpreted and "arbitraged" by businesses*. This indicates that the independent risk management function does not fully understand the nature of the business risks it is meant to be controlling or is unable to communicate directives clearly. It may also mean that business units have a disregard for policy and are willing to interpret rules in the broadest possible fashion.
- *Employees are unaware of general risk processes and regular internal risk education is not undertaken.* This suggests that managers do not feel broad knowledge of risk is a corporate imperative. It may also reflect a general lack of understanding regarding the importance of risk management.

1.4.2 Flaws in Identification and Measurement

- *Risks are not identified correctly*. This may indicate that the risk function is not given enough information to evaluate the risk of products and businesses, or that risk analysts are too junior or inexperienced to discern different types of risks.
- *The firm experiences losses that are greater than expected, or which are a complete surprise.* This suggests the independent risk function is unable to distinguish between different sources of risk or risk measurement analytics are too liberal in their underlying assumptions. It may also mean that risk limit structures are ineffective in controlling exposures.
- *Risk analytics used to compute exposures routinely underestimate or overestimate the amount of risk being taken.* This suggests the independent risk function is unable to understand the nature of underlying risk-bearing products or uses imprecise risk quantification methods.

1.4.3 Flaws in Reporting and Monitoring

- *Risk reporting cannot be done on a timely basis, or is routinely inaccurate.* This indicates that the firm lacks automated reporting processes, or that its central repository for aggregation and evaluation are incomplete. It may also indicate that risk analytics used to compute the value of specific risks are erroneous.
- *Regulatory risk reporting requirements cannot be met.* As above, this suggests the firm is unable to collate risk information in an automated fashion and distill it into the form required by different regulatory authorities.

- *Sources of profits and losses cannot be decomposed and monitored; the firm is unaware of how it makes or loses money and cannot attribute earnings to specific activities or risks.* This reflects a fundamental lack of understanding regarding the nature of the firm's business and how much risk is being taken, and whether different sources of business risk are profitable or unprofitable. It may also indicate problems with technological infrastructure.
- *Positions and trades cannot be reconciled to the firm's official books and records.* This may indicate deficiencies in the technological platform as well as the use of multiple sources of data to control a single business. It may also reflect ineffective audit and financial control processes.
- *Risk limits and decisions are not properly documented and provide no verifiable audit trail*. This suggests lack of discipline and procedure in basic risk policy and governance; it may also indicate an unwillingness by decision-makers to commit their decisions to writing.

1.4.4 Flaws in Management

- *Models and analytics are used blindly, without full comprehension of underlying assumptions.* This may indicate that senior management and risk managers are unaware of the power and complexity of models, their potential weaknesses and the general effects of model risk. It may also suggest that quantitative personnel are able to "intimidate" or "influence" those who might question or critique the underlying models.
- *Risk valuations are not tested or questioned.* This may reflect the presence of a weak financial control function that is unaware of the impact of potential misvaluations in a risk book or one that is easily influenced by risk takers and business managers. It may also suggest a willingness to accept a manager's view on the value of a position or risk, without question.
- *Backlogs of essential legal documentation are permitted to increase.* This may indicate lack of knowledge regarding the critical effect of legal documentation on risk exposures, presence of an understaffed/inexperienced legal department and/or absence of an automated mechanism for tracking past-due documentation. It may also indicate lack of knowledge or respect by the business units for the legal process.
- *The precise nature of collateral taken to secure trades cannot be verified; ongoing valuation of collateral is inaccurate and calls for additional collateral do not occur on a timely basis.* This might suggest the technology infrastructure is incapable of tracking collateral and sourcing automated price feeds. It may also indicate inexperienced settlements personnel who do not understand the critical nature of calling for additional collateral on a timely basis.
- *The exact legal counterparty to a trade cannot be verified with certainty.* This, again, may indicate flawed infrastructure. In addition, it may reflect a lack of understanding by business managers regarding the nature of their client relationships and the importance of identifying precise legal entities within a corporate structure.
- *Risk officers are not active/visible in the risk management process and are easily intimidated by business managers; experienced risk personnel do not form the bulk of the risk function*. This indicates the presence of a large number of junior risk personnel (perhaps administrators rather than managers) who do not possess the requisite knowledge and depth to work with, question or challenge business managers. It may also reflect senior management's unwillingness to spend resources on hiring more experienced, and qualified, risk professionals.
- *Risk managers are crippled by indecision; inaction on critical risk decisions occurs with frequency*. This suggests that risk management professionals do not possess sufficient risk,

product or market knowledge to make risk decisions, or are granted insufficient decision-making authority.

- *Business managers routinely appeal negative risk decisions.* This suggests that junior risk managers have little experience or decision-making authority, and are not held in high regard either by business managers or their own managers. It may also indicate senior risk officers are not capable of proper management and communication or wish to micro-manage the risk decision process.
- *Communication between risk officers and business managers is strained and counterproductive.* This might indicate lack of professional respect between the two groups. It might also indicate that risk officers are not visible and responsive, or that business managers violate or ignore risk processes frequently (without penalty).
- *Risk policies are not applied consistently.* This, again, indicates that risk personnel lack the experience needed to recognize that similar risks should be treated in a similar fashion. It may also indicate the presence of "favoritism" for some businesses over others, or the existence of ambiguous policies that are left open to wide interpretation and application.
- *The risk limit structure does not control the risks it is intended to constrain.* This may reflect problems in the identification and quantification of risks by risk personnel. It may also indicate that risk personnel are not sufficiently knowledgeable about the risks they are meant to be limiting and monitoring.
- *The firm has an excessively large market share of risk-sensitive business in certain sectors.* This may indicate the presence of flawed analytics and pricing tools (that consistently underprice risk), undisciplined risk takers who assume risk without understanding or caring about risk/return, or risk limit mechanisms that permit excessive risk to be taken.
- *The firm has excessive concentrations of risk in illiquid assets and long-term contracts*. This may reflect the fact that risk takers are not penalized for keeping assets on their books for long periods of time. It may also indicate the existence of a skewed compensation policy that allows risk takers to be paid for taking long-dated risks, with profits "present valued" to the current bonus period. As above, it may also reflect a liberal limit structure that does not effectively constrain risk concentrations.
- *Business managers are free to take and release discretionary reserves in their business lines.* This may indicate a weak financial control function that is unable to impose proper rules governing treatment of reserves. It may also indicate lack of senior management understanding on how the firm makes and loses money, and the types of risks it runs.

1.4.5 Flaws in Infrastructure

- *Significant manual "workarounds" exist to address shortcomings in the control process.* This indicates a lack of resources dedicated to the automated technology effort, a lack of understanding by senior management about the necessity of investing in technology and/or the ability for businesses to expand into new areas without creating proper infrastructure.
- *Risk takers are not required to input their risks into authorized systems.* This may indicate that management is unaware of the ramifications of an incomplete trading/risk population on its financial books, operational processes and risk reporting; it may also indicate that risk takers are able to circumvent systems requirements without notice or penalty, or that the firm lacks the resources to purchase or create a proper technology platform.
- *Off-system risks are permitted to grow without constraint.* This may indicate the firm is moving rapidly into complex businesses/risks that do not lend themselves to the functionality

provided by current systems. It also indicates that the governance process does not impose a strict new product standard and businesses can embark on new ventures without first implementing an operating plan.

- *Technological infrastructure is inflexible and incapable of keeping pace with business innovation and growth.* This suggests that the firm's technology platform is outdated and that resources for upgrading are not forthcoming. It also suggests that implementation of flexible technology designed to cope with changing products and markets is not seen as an internal priority.
- *Multiple sources of data are used to compute risk/financial/control information for a single business.* This suggests the firm continues to make do with legacy technology that draws information from multiple repositories. It also suggests that reconciliation processes are necessary or that erroneous information is being supplied to managers and decision makers.

These are, of course, only some of the risk process "warning signs" that can appear. It is fair to say that virtually every firm that is active in risk-taking has experienced some of these problems — few organizations can avoid difficulties as they expand and grow. Most firms are sophisticated and experienced enough to recognize a deficiency when it arises, and most are quick to resolve problems. Greater issues arise when numerous flaws plague a firm at the same time. In such cases it may be indicative of a general unwillingness, or inability, to solve the problems. In a risk-taking business inability to address control process issues greatly increases the chance that losses will occur; in the extreme, outright failure can follow.

1.5 STRENGTHENING RISK PRACTICES

New risk rules and regulations tend to emerge after financial crises. Though occasionally frustrating for those who have to adhere to new directives, the efforts are well intentioned and can be beneficial. For instance, in the aftermath of the LDC crisis of the mid-1980s, the Bank for International Settlement (BIS) established the BIS Capital Accord to set minimum capital standards. The credit standards were subsequently amended in 1992, and new market risk/VAR model amendments were introduced in 1996; consultative stages related to new credit models and operational risk modules commenced in the late 1990s/2000. These efforts are designed to ensure that the world's financial institutions have enough capital to support their credit, market, liquidity and operational risks. Following the derivative debacles of the mid-1990s (including those impacting P&G, Allied Lyons, Gibson Greetings, Air Products, and others), the Group of 30 (G30) released its voluntary "Derivatives Principles and Practices" guide, and the Derivatives Policy Group, comprised of leading financial institutions, created its "Framework for Voluntary Oversight;" both sought to create better internal derivative control and sales practice frameworks. After the LTCM debacle, a voluntary "blue ribbon" panel of risk experts from 12 top financial institutions[1] assembled to analyze what went wrong and what could be done to prevent the financial system from coming as close to a "meltdown" in the future. The end result was a series of prudent recommendations focused on fundamental risk management processes and procedures. While we will not review the recommendations in this book — though urge readers to do so — we summarize one very important observation. In particular, the group indicated that:

[1]Members: Goldman Sachs, Bear Stearns, Deutsche Bank, UBS, Morgan Stanley, Citibank, JP Morgan, Barclays, CSFB, Merrill Lynch, Lehman, Chase.

> "Risk management is not simply a matter of better computer models to measure volatility and correlation more rapidly and precisely. Indeed, too much public focus has been placed on the sophistication and precision of risk estimation models, and not enough on the more important managerial and judgmental elements of a strong risk management framework. In the end, experience, market knowledge, management discipline, internal risk transparency and strong internal controls will be the more important determinants of how well financial institutions fare when the next storm comes."[2]

This thought echoes the theme we will explore at greater length throughout the book. In particular, an effective risk management process is one that is built on sound "common sense" rules. Many of these rules — which are based on judgment, experience, intuition, and other qualitative factors — are truly "art" rather than "science." Though they are not measured formulaically and cannot be quantified in any particular manner, they form the core of any prudent risk management process. In an era where quantitative risk management has moved to the forefront and become an important component of the risk process — rightly so — it is useful to recall and reinforce the simple rules of risk — rules that might be regarded as the art of risk management.

Effective risk management thus centers on a combination of quantitative and qualitative processes. The prudent risk manager, business manager, chief financial officer or chief executive officer should have as many tools as possible to protect against potential losses; this means that neither approach should be ignored or over-emphasized. Mathematical models cannot always quantify the exact price or risk of a structure, portfolio or business; equally, human judgment cannot always arrive at the correct risk decision or strategy. Together, however, they stand a better chance of producing the best possible answer or approach. The quantitative and qualitative intersect with some frequency in the world of risk management. The obvious place where this occurs, as we shall note later in the book, is in measuring and quantifying exposures. Risk managers, traders and bankers require quantitative tools in order to crystallize the economic impact of the exposures they are attempting to manage. The only practical way of doing so is to make use of the financial models that have been developed over the past years — even those with known limitations or flaws. As we shall discuss in Chapter 5, there is nothing wrong with using a financial model that is based on naïve or unrealistic assumptions, or that is limited in some fashion, as long as the shortcomings are recognized in advance and factored into the decision-making process. Quantitative and qualitative approaches can also come together in other areas. For instance, in monitoring and reporting risks, quantitative tools can be developed to produce reporting filters that provide an early indication of possible future problems — warnings that might not be readily apparent to the risk manager, absent some quantitative filter. Creating a true "best practices" risk framework therefore means uniting the quantitative and qualitative whenever it makes sense to do so.

1.6 THE SIMPLE RULES OF RISK

In order to create a top-tier risk framework, we propose that a firm can focus its efforts on applying certain "simple rules." Our aim in this text is to discuss the simple and obvious — though sometimes overlooked — rules that contribute to the effective management of risk; our aim is not to critique the quantitative aspects of risk management, as they form a core component of any risk process. Indeed, the two should be regarded as "partners" — where qualitative approaches fall short, or fail entirely, quantitative approaches can provide important

[2] "Improving Counterparty Risk Management Practices," June 1999, Counterparty Risk Management Policy Group, pp. 10–11.

solutions or answers; likewise, when quantitative approaches fail, qualitative approaches stand ready to strengthen the process.

This book addresses risk management rules that apply to a range of risks that a typical financial or corporate organization might encounter. As indicated earlier, risk comes in a variety of forms, and not all firms face the same types of risks. Financial firms may be very concerned with the market, liquidity and credit risks arising from their financial trading, derivative, financing and underwriting operations. Industrial corporations might be concerned about commodity input and output risks, funding and liquidity risks, and credit risks from their receivables. Municipalities might be concerned with any risk factor that can impact government finances, including interest rates, tax collections and public expenditures. Our intent is to express the simple rules of risk generically, so that they can be applied across a range of industries; however, given that risk-taking is often associated with the financial markets and the financial system at large, many of our examples and comments draw on concepts from the financial sector.

In the balance of this book we present a variety of rules related to the art of risk management; these are presented in some detail, in order to provide appropriate context and background, and to help illustrate why the rules are important. We find it helpful to consider the topic by dividing the rules into categories that reflect individual steps in the risk management process. We begin with rules that help define a firm's philosophy of risk. We then consider those that relate to the development of a governance structure; proper governance is vital, as it creates the framework around a firm's risk management beliefs and processes. Thereafter we turn to the individual steps that comprise a typical risk management process: identification, quantification, monitoring/reporting and management. Each step builds sequentially on the others — thus, in order to manage risks, a firm must be able to monitor and report them. Before it can monitor and report them, it must have mechanisms that quantify and measure them. And, before risks can be measured, they must be identified. We conclude with rules related to infrastructure. If governance defines the risk philosophy, "chain of command" and operating rules, infrastructure — based on data, technology, analytics and control documentation — mechanically and technically combines the components to create a cohesive risk platform.

1.6.1 The Cardinal Rules

The balance of this book focuses on a detailed presentation and discussion of simple rules that should form the core of any effective risk management process. To commence, we consider in summary form fundamental elements that are so important in any risk process that they should never be overlooked. We regard these as the 10 "cardinal rules" of risk management — the essential building blocks of any effective process; time and experience support the fact that these rules are vital in creating a strong risk framework. We highlight the fact that these cardinal rules span the broad steps of the risk process outlined above. This is by design, as the robust risk process features strength in every stage. The function is doomed to failure if governance, identification and reporting are strong, but management is weak. Likewise, poor infrastructure can render the entire process ineffective — regardless of the strength of identification, analytics and management.

The cardinal rules are thus based on the following:

- Risk capacity is not free and proper compensation must be obtained; the process should be disciplined and applied without exception.
- Human judgment is remarkably valuable; years of "crisis experience" can be far more valuable than recommendations generated by models.

- "Worst case scenarios" happen with considerable frequency in an era of volatility and event risk. The lessons of history — financial cycles and crises — provide useful risk management information.
- The risk governance structure should assign responsibility for risk to senior officials from various parts of the organization; officials must ultimately be accountable to the board of directors.
- Independence of the risk function must be undoubted.
- All dimensions of risk must be identified. Risks that might be less apparent at the time of analysis should not be ignored, as they can become more prominent as market conditions change.
- Models should not be used to the point of "blind faith" — they are only ancillary tools intended to supplement the risk process.
- The ability to relate profit and loss to risk, in detail, is paramount.
- Active management of asset and funding liquidity is vital in order to avoid potential losses.
- Data is the fundamental component of any risk process — bad data leads to bad information and bad risk decisions.

We believe that by considering these cardinal rules in conjunction with new or existing quantitative procedures, an institution with risk exposures can create a more efficient and effective risk management function; application of more detailed rules, contained in the individual chapters that follow, strengthens and deepens the process even further. Naturally, these rules do not eliminate the possibility of loss; eliminating loss, however, is not the function of risk management. Firms generally assume risk in order to earn a return, and thus expect to sustain some level of loss. But the rules cited above can help minimize the possibility of unexpected or "surprise" losses. If a firm has a properly functioning risk management mechanism, it then understands its risk, knows how much risk it has and how much it can lose under different scenarios; accordingly, it should not face any surprises by experiencing losses that are larger than expected or which come from unknown sources.

Obviously, creating a top-tier risk function requires considerable work and effort — including application of many of the other rules we present in the balance of this book. Though the rules we discuss are simple to understand in the context of a firm's business, a great deal of thought and effort must be devoted to the process in order to ensure proper implementation. Ultimately, this requires support and guidance from an organization's senior managers and executives, and must be sanctioned by the board of directors. When risk management is driven from the top down, it has every chance of being implemented successfully and followed diligently. If the commitment by senior management to effective risk management is weak, the process will ultimately fail. This eventuality can, and must, be avoided.