Risky Business

Judging the Adequacy of Risk Management Systems

Dr. Jeffrey Hunt Mantel
FNX Ltd.

The list is noteworthy and growing: Barings Bank, Proctor & Gamble, Orange County, Gibson Greetings, Bankers Trust, Metallgesellschaft, Daiwa, etc. All have been involved in serious difficulties or disputes regarding capital market risks and the resulting publicity has given the trading industry — derivatives in particular — a painful bruising. Trading volumes declined significantly immediately following these scandals, most notably in mortgage-backed securities. Although there are recent signs that volumes are increasing again, end users have become more circumspect in their trading activities. And rightly so.

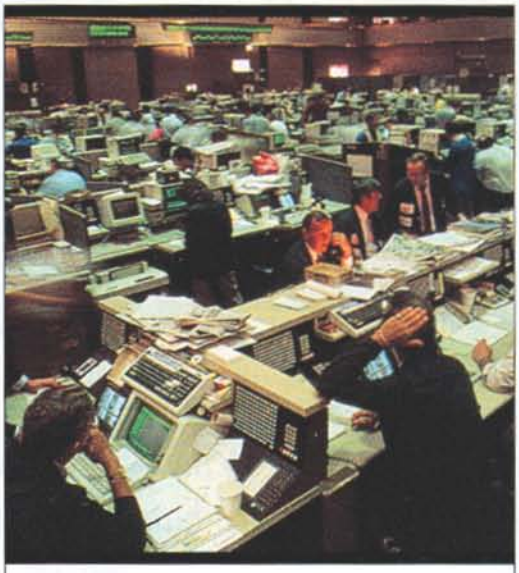
Senior management in many firms is asking the right questions with greater urgency in light of the recent scandals:

1. Have we defined adequate controls to cover the risks of all of our business activities?

2. Do we have an independent staff with the requisite talent and experience to perform the controlling function?

3. Are our risk management systems adequate?

Concentrating on the last of the three questions, this article will attempt to define the term "adequate" as it relates to risk management systems of large multinational organizations trading in many locations through many



instruments (ie: commodities, currencies, fixed income, money markets and equities). Such firms were chosen for this discussion because their risk management systems are necessarily the most complex and difficult to define, build and implement. Naturally, for those firms whose activities are narrower in scope, requirements will be simpler and not as difficult in their definition and implementation.

Defining Risk

The risks organizations assume during the course of their normal activities can generally be separated into four categories: (i) operational risk; (ii) sovereign risk; (iii) credit risk; and (iv) market risk.

Operational risk includes, but is certainly not limited to, natural disasters, power failures, hardware failures, software failures, sabotage, employee fraud, employee incompetence or error, uncooperative counterparts, vendor failure and procedural inadequacies. Typically, risk management systems do not handle measurement of these risks. While it is possible to quantify, and hence systematize operational risks, attempts to do so would require crude estimates for such things as probabilities of war and natural disasters.

While operational risk will not be part of our definition of an adequate risk management system, it should not be overlooked by management. It can in fact be the gravest risk facing an organization, as evidenced by the collapse of Barings Bank.

Sovereign risk includes regulatory, statutory and political risk. Changing regulations or laws can cause the trading environment in a country, sub-national or supra-national jurisdiction to become onerous, thus forcing the flow of business to a competitor elsewhere. Additionally, changing laws or regulations can make currently traded contracts illegal, shutting down the business entirely. This occurred in 1994 in Germany with

a ruling regarding the German state banks' ability to trade options. The decision was quickly reversed because of the great outcry it produced.

Governments also may make political decisions which can have serious deleterious effects on a market. For example, if a small number of central banks holding large amounts of gold bullion were to cease lending the metal into the market, it would create a disruption that could cause the borrowing rates of gold to rise very rapidly. Quantifying sovereign risks would require crude estimates of the probabilities of negative sovereign events and has not traditionally been within the scope of risk management systems. These risks, however, should not be ignored.

Credit risk encompasses all the risks involved with counterparts' abilities to perform their contractual obligations to the firm.

Market risk includes the risks to the assets of the firm caused by changes in any or all market conditions. These conditions include changes in prices, interest rates, volatility levels, correlations between movements in prices and rates in different markets, passage of time and market liquidity.

Risk Measurement Requirements

For the sake of brevity, this article will restrict discussion to the traditional role risk management systems play covering credit risk and market risk.

Credit risk management is a complex task with procedures often unique to each firm. Therefore, while there is some basic uniformity, each firm will customize its risk management system to suit its credit risk management needs.

At a minimum, the system should be able to report by counterpart, parent company, counterpart location (city, state, country, supra-national region), trader, trading desk and trading desk location. Additionally, the system should be able to produce the required reports on an individual trade basis, and on a gross and/or net notional basis where appropriate.

For many derivatives, replacement value is used by firms as a measure of credit risk. Consequently, the system must be able to report these values on a net or gross basis. Gross basis is deemed necessary by many firms due to the distinct possibility of "cherry-picking" by the courts during bankruptcy proceedings.

An increasing number of credit risk managers are requiring their risk management system to be able to calculate VAR, perform the same back-testing against historical data, and stress testing and Monte Carlo testing that market risk managers and traders perform, all on a counterpart basis. This enables the managers to obtain from the system not only a snapshot of a counterpart's current credit risk profile, but an idea of the increased or decreased level of credit risk that would be caused by changing conditions in the market. This includes what the quants commonly call "fat-tail" events which occur when markets suffer extreme movements of prices and rates.

Minimally, the system must be able to accurately report current values for all instruments traded, as well as the values of the more complex measures of risk associated with derivative instruments. These include the following:

1. *Delta:* the change in the value of the trade due to changes in the price of its underlying instrument;
2. *Gamma:* the change in the delta of the trade due to changes in the price of its underlying instrument;
3. *Vega:* the change in the value of the trade due to changes in the term structure of volatility;
4. *Theta:* the change in the value of the trade due to the passage of time;
5. *Rho:* the change in the value of the trade due to changes in the term structure of interest rates;
6. *Phi:* the change in the value of the trade due to changes in correlations of price movements in underlying markets;
7. *Duration:* the maturity of a bond whose change in value is due to changes in interest rates closely matches that of the asset-backed instrument (similar to delta in other markets);
8. *Convexity:* the change in the duration of an asset-backed instrument due to changes in interest rates (similar to gamma in other markets).

In addition to the aforementioned, changes in liquidity (the ready availability of trading counterparts in the market quoting normal competitive spreads for normal size trades) can have serious effects on the riskiness of a firm's assets. Liquidity can change due to sudden cataclysmic events such as war or economic meltdown. Alternatively, players may abandon a market — causing decreased liquidity — when that market remains overly quiet for long periods of time. Other causes of liquidity problems are onerous regulatory environments and fundamental changes in a market's structure.

One method of quantifying liquidity risk is to add a bid-offer spread on the valuations of all trades. These spreads would, of course, differ by market and even by instruments within a market.

System Flexibility and Robustness

Clarity and Conciseness - A system must be able to quantify all of the market risks and credit risks a firm assumes during the course of its activities. It must do so in a manner which is clear and concise, thus enabling easy understanding by traders, credit risk managers, market risk managers and, most importantly, senior management.

User Friendliness - The system also should be easy to understand without cumbersome procedures.

User Reports - A good risk management system will incorporate enough reports so that its users can obtain all the information they need. Each user should be able to set up batches of reports to be run at the touch of a key. Additionally, the same report should be able to be configured differently within a batch and between batches, and the settings should be stored in system memory.

Of importance is the ability of the system to sort data with a fine sieve. For example, a good risk management system should include the ability to sort by

counterpart, underlying object (specific commodity, currency, equity, fixed income or money market instrument), trade type (spot, forward, future, exchange traded option, OTC option, specific type of exotic option, swap and swaption), expiration date, value date, notional amount, trader, trading desk, trading group, trading location, counterpart location, trading book and virtually any other information contained in trade records.

User Defined Instruments (UDIs) - A crucial characteristic of a good risk management system is its ability to let the user quickly add new instruments as they are developed in the marketplace. An easy-to-use interface between the risk management system and externally developed valuation formulas accomplishes this. Such an interface would typically ask the user the location (library) of the formula in the computer's memory, the inputs used by this external formula and their counterparts in the risk management system (i.e., where they can be found in the risk management system). This would allow the risk management system to interface with virtually any externally developed formula applicable to the market in question.

Electronic Data Interface - It is unnecessarily time-consuming for users to manually type in market data either during the trading day or to get closing data at the end of the day. A risk management system should be able to interface with the user's choice of electronic data vendor.

Quick Risk Profile Updates - It defeats the purpose of effective risk management if a system cannot update risk reports quickly. One method to accomplish this is to have a real-time analytic risk blotter. This is a function which allows the user to update, display and/or print the portfolio's risk calculations on demand (useful after a large trade has been entered into the system or after a large move in prices, interest rates and volatility).

Regulatory Reports - The system must produce all reports required by statute or regulation in each jurisdiction in which the firm conducts its activities.

Accuracy

All values produced by the system must be accurate. This can be checked by benchmarking the values against other systems or independent sources.

Security

Clearly, only authorized users should be able to log onto the system. Also, each user should only be allowed to perform those functions on the system for which he or she is responsible. A risk manager should not be entering, deleting or changing trades. A trader should not be handling payments for settled contracts. Back office staff should not be running risk reports. Credit risk managers should not be changing futures contract definitions in the system. A flexible hierarchical security system can accomplish this. It allows management to determine to which areas of the system each user shall have access and how to set the system security accordingly.

Vendor Characteristics

If a vendor system is purchased or leased, the user should be satisfied that the vendor's staff is adequate to give ongoing support for the enhancements and small bugs which inevitably appear from time to time. The vendor staff should include a core group of talented systems analysts and programmers in addition to people who have market experience. Also, a few highly analytical quantitative people are highly desirable for development and testing purposes.

The vendor should either grant or sell to each global user the system source code. This protects the user in the unlikely event that a vendor ceases operations. With the source code in its possession, a user can hire systems staff to continue development processes.

In today's environment of heightened oversight of trading activities, it is crucial that internal auditors, external auditors, senior management and regulatory authorities are satisfied that the valuation algorithms used in the system are correct. A quality vendor should be willing to sell a description of all of the system's algorithms. This description should be detailed with all variables defined and formulas laid out in algebraic notation. In addition, the document should describe the conversion of these formulas into source code. With this document and the source code in its possession, a user can check the entire process from derivation of the algebraic formula to conversion into source code to ensure that the actual code is in place.

A high quality vendor will take a proactive and cooperative approach to its relationship with its users. It will, in general, share with all users those enhancements developed in conjunction with one user. This helps keep all users in the forefront of the technology.

Implementation

There are basically two methods of implementing a risk management system. One can be constructed in-house by information systems staff working together with traders, market risk managers, credit risk managers, middle and back office staff and senior management. The other method is to purchase a vendor system.

Senior management should be careful in putting values on the relative strengths and weaknesses of each of the two methods. Office politics, turf battles, personal likes and dislikes should be ignored in favor of hard analysis of the benefits and costs of each method.

Due to the size and cost of the staff involved, in-house construction typically is used only by larger firms with a history of expertise in risk management. Without this expertise, the systems analysts and programmers will not have enough information to properly construct an adequate system. The advantages of this method are a development staff which is dedicated to one "customer," and the continuous interface between the development staff and users.

Disadvantages of this method are: (i) the inbreeding of ideas - no input

from other industry practitioners; (ii) staffing levels tend to grow as the project progresses and the costs become a very large percentage of potential revenues; (iii) technology developed by competitors is not available; and (iv) the system is built from the ground floor while a vendor system is ready to use on a basic level forcing the leasing of a vendor system during sizable development time.

The vendor system can be used by firms of all sizes and financial strengths. A good risk management system will be modular. That is, a user can purchase only those modules it needs. For example, a firm which trades only in crude oil and currencies should only have to purchase the energy module and foreign exchange module from the vendor. This user should not have to pay a larger fee to get a system which covers more markets.

Advantages of this method are: (i) development time is short as the system is basically ready to use off the shelf; (ii) technology developed by a high quality vendor in conjunction with another user should be available to all users; (iii) overall costs should be lower as initial costs have been shared by other users; (iv) user groups can be formed for greater development efficiency; (v) the vendor is a profit-making enterprise and as such has a greater need for cost effectiveness which can be passed on to customers; (vi) an already developed source code should be available to the user; and (vii) a quality vendor will provide 24-hour global support.

Disadvantages of this method are the vendor is answerable to all of its users which can cause some difficulties in scheduling enhancement developments; and interface between vendor and user staff might not be continuous.

Postscript

There are many factors which must be considered when a firm wishes to obtain a good risk management system. Clearly, the quality of the system is most important as measured by the scope of its functionality, user friendliness, flexibility and accuracy.

If a vendor system is to be purchased or leased, the quality of the vendor as measured by the abilities and experience of its staff and its responsiveness to users' needs is paramount. Perhaps the best way to judge this is to call current users of that vendor's systems to get their opinions. ■

Dr. Jeffrey Hunt Mantel is managing director of FNX Ltd. He has more than 10 years experience managing the trading of derivative products.

FNX Ltd. specializes in the global trading environment, developing fully intergrated front-to-back office systems to support trading of commodities, foreign exchange and interest rate products.