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HRG Assessment:

Risk Management in the Securities Industry - Challenges for Data Management

Risk management is about consciously taking the risks we want to take, for a fair price, without taking on too much risk or being blindsided by the unforeseen. Executed well, risk management helps a firm maximize its return and general prosperity. Poor risk management practices, on the other hand, can lead to ill-conceived financial commitments, undetected fraud, and, as was the case with the Barings collapse in 1995, insolvency and collapse.[1] Vital to business success, and mandated by regulatory law, risk management is increasingly a firm-wide, board-level concern.

Some risks are more easily quantified and subjected to data analysis than others. Market, credit, liquidity, and interest risk are prime examples. Some operational risks, such as reputational risk, or the risk of a calamitous event, are more difficult to measure. Still, practically any risk can be modeled, scenarios defined, policies set, and conformance reported. In almost all its forms, effective risk management requires the capture and access to the right information, all of it, at the right time.

What is risk management, and to what extent do effective practices depend on superior data management? What are the issues, and what are some practical ways of addressing them? This paper examines these topics, and then suggests criteria for selecting a data management solution and technology business partner.

Effective risk management can mean the difference between financial success and business failure. Market and credit risks combine to establish the margin parameters of the trade: how much risk are we taking, and how much of a spread do we require – or are we willing to pay – because of it?

A sea of data must be analyzed to come up with the answers. Market prices, historical experience, interest rates, and numerous risk factors feed complex models, which will run hundreds of times for each assessment. The data must be reliable, instantly accessible, continually updated, and selectively replicated. This requires a strong information management foundation, a unified, adaptable approach that enables central management and distributed operation. Effective solutions must protect vast investments in proprietary applications, while enabling continual evolution to new technologies and architectures.

Sybase brings together all of the elements necessary to create this foundation, to achieve what it calls "Information Liquidity:" the unimpeded flow of information across diverse technologies, vendors and locations. Sybase offers significant advantages that merit consideration for serious, run-the-company applications.

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Risk Management – a brief introduction.

In the world of the broker/trader, risk management has been institutionalized, as an integral part of the way products are priced and business conducted. It is factored into fundamental decision support: can we do this deal, in what form, and at what price? Will the counterparty be able to meet its obligations? Is the trader acting within approved limits? How will the trade impact the portfolio and risk position of the trading desk, and of the firm?

Market and credit risk analysis are at the heart of the answer. Both are highly quantified and well integrated within the day-to-day operation of the broker/dealer.

Market Risk addresses major elements in the marketplace that can impact market prices and rates, and so impact the value of positions in a given instrument. Component risks include:

- *Interest Rate Risk* addresses the possibility that interest rates will change and adversely impact the value of the instrument;
- *Equity Risk* considers the sensitivity of a security's price to general changes in market values, as well as to changes in value of the security's underlying assets;
- *Currency or Foreign Exchange Risk* deals with the potential for fluctuation in currency rates, individually and relative to floating indices (such as LIBOR).
- *Liquidity Risk* addresses the possibility that an institution may not be in a position to raise the necessary cash to roll over a position at a future date, or that, for some reason, trading of the instrument may not be possible due to a lack of interested buyers.

Modeling market risk for a given security is fairly data intensive. You are dealing with multiple risk elements, each of which are defined by actual market data. The situation gets more complex for options, particularly OTC derivatives that rely heavily on future projections and lack the instant market price of the securities market. For these, complex option pricing models have become indispensable.

Credit Risk addresses the possibility that the counterparty, the other side of the trade, will be unable to meet its financial obligations associated with the transaction. The risk of default is obviously of huge importance to financial services firms. Unlike market risk assessment, which covers a broad array of factors and assumptions, credit risk requires narrow and deep understanding of an organization's business circumstances. Credit rating organizations, such as Moody's and Standard & Poor's, assess credit histories and issue ratings. These, together with the broker/trader's own records and research, combine as inputs to credit models.[2]

There are certainly other forms of risk, the lion's share of which fall under the general category of *Operational Risk.* Human error, fraud, inadequate management, and system and facility failure are examples of operational risks. Worst case scenario analysis, including assessment of very unlikely but potentially disastrous occurrences, is a critical aspect of operational risk management. Unlike market and credit risk analysis, which are mandated by regulatory law, operational risk management has been left to the discretion of individual firms.

This is about to change. The Bank for International Settlements (BIS), the global organization responsible for setting international banking regulatory practices, published its recommendations for operational risk management practices in July of 2002. The recommendations place responsibility for operational risk management squarely on the board of directors, and outline ten principles for sound risk management practices.

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BIS is expected to formally adopt requirements, triggering regulatory actions worldwide, sometime in 2003 as an update to its 1998 Basel Accord on Capital Adequacy. The 1998 accord defined strict requirements for implementation of credit and risk management practices, including the use risk management models, and established requirements for capital set-asides against these risks. The 2003 accord, "Basel II," is expected to add similar requirements for operational risk.[3]

Measurement and reporting of operational risk will be on the ascendancy in coming months, and will certainly add to the data management challenge. But for now and the near future, market risk and credit risk analysis place the greatest stress on data access and management.

Data Analysis – Making the Trade

Market and credit risks combine to establish the margin parameters of the trade: how much risk are we taking, and how much of a spread do we require – or are we willing to pay – because of it? Risk factors combine with information about the security itself, the underlying assets, interest rates, probabilistic views of future rates and market conditions, to feed the instrument valuation models.

Once priced, the proposed transaction needs to be tested against the overall firm's portfolio. Capital and liquidity requirements need to be understood, and limits tested, before the deal can go through. All of this requires real-time access to tremendous amounts of data, most of which fall into a few major categories:

- *Market Data*: These are dynamic, observable pieces of information about the market. Values of traded securities, swaps, OTC issues, interest rates, currency exchange rates, underlying indices, risk factors associated with given issues, market volatility, daily theoretical option valuations, and more fall into this category.

- *Product Data and Positions*: Includes information about each traded security, with trade details and your position in each. Data elements include issue date, issuer, coupon rate, date of maturity, unique security identification (CUSIP), how the issue is quoted, as well as information from the prospectus. Portfolio values are marked to market daily, updating all positions based on values at market close.

- *Client Data*: Client credit history and credit ratings, portfolio positions, limits and preferences, contact information, everything that defines the firm's relationship with its clients is captured here.

Market information comes to the broker/dealer through contractual relationships with financial market data services, such as Reuters and Bloomberg, and feeds from stock exchanges. Large broker/dealers may bring in fifteen or more such feeds, to ensure that they have the highest quality product and market information upon which their decisions are based. Somehow these multiple feeds need to coalesce into one data set that can feed valuation models. One approach, used by several large firms, is to research the capabilities of the various data services, and select a primary data source for each individual data element. Data from other feeds serve as secondary sources and quality checks. The result is a single, integrated data set drawn from multiple sources.[4]

Data arbitration, then, is a fundamental challenge. Whether combining and normalizing across multiple data inputs, or creating a data mosaic of favored sources, a methodology must be in place. A related issue is *data quality and completeness.* Externally provided data feeds may be missing fields, have garbled segments, or contain outright errors. Data need to be compared and scrubbed. And finally, the data need to be ready to use, in a *central location*, in a *common format*.

The complexity of these efforts is compounded by the sheer *volume* of data. Consider the fact that, at any point in time, roughly 4.5 million individual securities and options are being traded worldwide. The largest

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broker/dealers need to track all of these, so that their global models can represent a complete picture. And these data are *constantly changing*. You need the latest information, updated continuously. However, you also need history, which provides much of the grist for the valuation models. How much history? In some cases, six months, in others, up to a year or even more. These can be enormous databases, measured in Terabytes.

Using the Data - Modeling Value and Risk

Derivatives themselves serve as basic tools in the management of risk, presenting the ability to hedge against risks of other positions. Beginning with the 1973 publication of the Black-Scholes and Merton option pricing models, the relative sophistication of pricing and market models has increased with the explosive growth of the derivatives market. Derivative pricing models are major consumers of market data, including interest rates, the value of underlying assets, and option theoretical values supplied by such organizations as the Options Clearing Corporation.

Derivatives themselves are inherently risky, however. When we speak of risk management, we are more likely to refer to the models that help to actually quantify and manage risk. The idea is to establish the downside risk of a contemplated trade, so that the firm can decide its risk posture, and set aside sufficient capital to protect against it.

Value at Risk (VaR) has become the centerpiece of risk management methodology. Without getting into details, VaR calculates the worst loss that might be expected by holding a security over a given period. Using historical values, product data, rate information and a number of risk inputs, a VaR model will generate a distribution curve of possible returns and their associated likelihood. The portfolio manager selects the risk threshold he can live with, a point on the distribution curve, which corresponds to the greatest loss that might be expected under that scenario.[5] This in turn helps an organization ensure that it has enough capital set aside to weather such an occurrence.

There are three forms of VaR analysis: Historical VAR, Parametric VaR, and Monte Carlo simulation. Typically only one form is run for a given trade, but sometimes multiple models are used. In each case, a model may run as many as 1,000 iterations, using different historical data, aggregating and reporting results. A given analysis could take several minutes, or as long as twenty minutes. Multiply this by the number of trades on a given day and you begin to see the magnitude of work involved.

VaR methodologies are also used to quantify credit risk, and establish necessary capital reserves to protect against possible default. Even with this, the risk assessment will not be complete. VaR cannot cover all eventualities. For example, it does not deal with event risk, so additional tests are recommended, such as portfolio stress tests. And models are only as good as the programs and the data they process, so model risk must be considered and managed.

Between VaR and other forms of market risk assessment, credit risk analysis, and the pricing processes that bring it all together, modeling is a multi-hour, high performance, data- and compute-intensive process. Results need to be tested against limits for the trader, the trading desk, and the firm. One has the sense of a sea of data in constant flux, feeding the heart of the system that generates risk-adjusted, profitable trades. Effective data management could not be more critical to the business: doing it right is absolutely essential.

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Data Management and the IT Challenge

The intensity of data access, analysis, and continual flow presents the information technology organization with numerous challenges. At the top of the list: get the information you need to process into a *centrally managed database*. The database itself may be distributed, but it must function as a unified system, to ensure:

- *Maximum performance*: with potentially millions of simulations run daily, high volume data access and processing is critical.
- *Data integrity and quality*: data must be complete, current, correct, and readable.
- *Continuous availability*: all of the data must be readily accessible, all of the time; there can be no downtime.
- *Data Security*: data must be protected from tampering and unauthorized access.

This represents an enormous challenge to many of the broker/dealers and investment banks that grew so rapidly in the '80s and '90s. There just wasn't time for integration. The result was the independent creation of numerous systems and databases, all acting as individual data silos, unrelated to one another, in different formats, based on products from multiple vendors.

There are really two issues here. The first is to bring the data together under one logical roof. Middleware offers the vehicle to get this done. Since the massive amounts of product and market data comprise many different types of data, they are most likely contained in multiple, special purpose databases. Data replication software provides the vehicle for intelligently moving needed data to the right location, in the right format, and in near real-time as values change, without compromising the function of the special-purpose databases.

There is a second, much larger issue: *how to provide data access to legacy applications without reengineering them?* Most applications currently in place were custom developed, and they are often at the heart of the firm's competitive differentiation. Countless staff-years go into development and quality assessment to ensure that they are completely reliable and function non-stop. Any change will require repeating the arduous quality assurance process. Is there an alternative?

Again, the answer can be found in middleware solutions. Some large firms are turning to a sort of *"hub and spokes"* model (Figure 1), creating a central database and using middleware adapters to connect with the legacy system and application "spokes." Middleware applications handle format differences between different databases and programs, serving as protocol and format "adapters," without impacting the legacy applications. Some IT organizations choose a very deliberate, case-by-case approach to adapters, to minimize performance impact and ensure quality.

The creation of centralized databases raises a critical need for *scalability and overall system performance*. By definition, these are very large, dynamic databases. They need to be able to grow flexibly, without disruption, and deliver the rapid response required by real-time applications and the trading functions they serve.

Not all of this needs to be implemented in-house, although larger firms, with their scale advantage, typically do. In an outsourced model, the firm becomes the spoke to the service bureau's hub. A decision to outsource really comes down to the need for scale and competitive cost structures. A service bureau can take on the problem of managing market data, integrating multiple feeds, handling data arbitration, achieving economies of scale that can be passed along to outsourcing clients.

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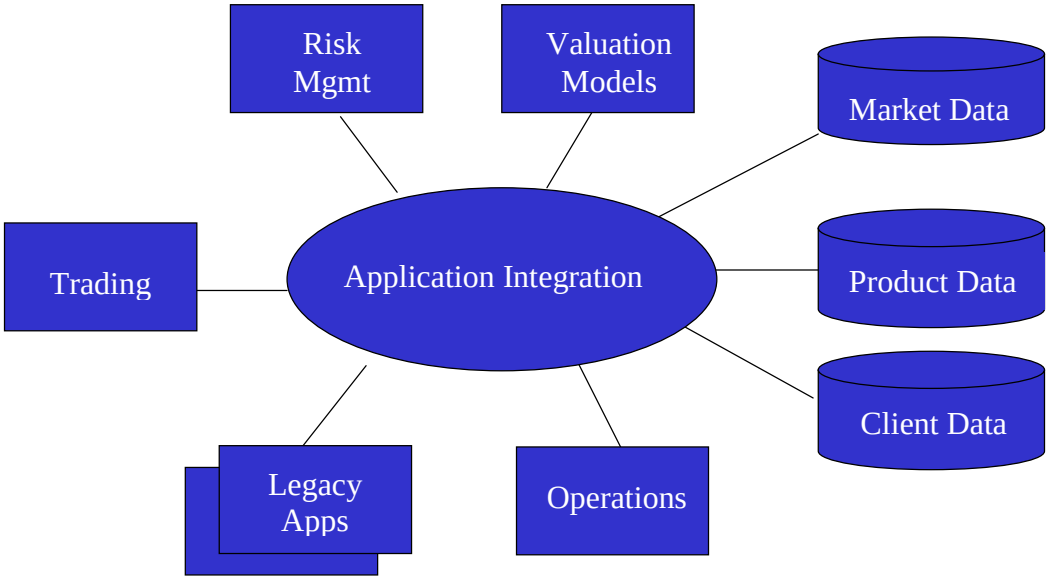
Figure 1. Hub and Spokes Model – Integration across diverse applications and platforms



Multinational or global operations require the same integrated data environment, encompassing multiple databases in major business centers: New York, London, Hong Kong and Tokyo, for example. Data networks offer the necessary bandwidth and redundancy, so that they can be reliably connected. Again, our difficulty is with the volume and time-critical nature of the data required by all locations. The solution is to *selectively replicate* only that information that really needs to be in multiple locations, at frequencies that suit the dynamic nature of the data and timeliness requirements of applications. Some categories of data, like a trade, or update of a market price, may need to be replicated instantly, while others may occur hourly or at the end of the trading day.

Finally, *data security* presents significant operational risk to the organization. While security overall is a major topic at all levels, and is generally addressed in numerous application vehicles, data security must also be addressed within the database itself, and in all data communications. Row level access controls, security level classification and access protection, change management and tracking, data encryption, and much more need to be factored into the overall data management schema.

Conclusions and vendor considerations

The Harvard Research Group spoke with numerous IT managers in the financial services industry, and asked them what they felt they needed most from their vendors. The following areas came across as particularly important:

1. Knowledgeable, dedicated people – who understand the financial services business environment and application arena, and will work as partners.

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2. Support in times of crisis: When disaster strikes, as it occasionally does, IT managers need a vendor that will do what it takes to keep the operation going. People are still talking about the aftermath of "Black Friday" in 1987, when trading volumes stressed systems literally to the breaking point. Some vendors came through; some did not.

3. Access to and partnership with leading technical talent – Financial services information technologists push the limits of data management technology. They value peer-to-peer interaction and collaboration with top vendor talent.

4. Tools and Middleware – of all the product information we discussed, development tools and middleware jumped out as areas of critical interest. Data and protocol adapters, and tools to create these and other middleware applications, were seen as critical to solving data integration and "many to many" interface needs.

5. Standards support and multi-vendor interoperability – look for a business partner that knows how to create a unified data management environment, and drive the effective flow of information, spanning diverse technologies, vendors, locations and geographies. Seek solutions that maximize the use of open standards and interfaces, maximizing future flexibility to grow and change.

Considering these factors, and the product needs discussed above, Sybase offers particular strengths that merit consideration. Like IBM and Oracle, Sybase offers a complete line of data management products. However, Sybase has uniquely chosen to bring together all of the elements necessary to achieve what it calls "Information Liquidity:" the unimpeded flow of information across diverse technologies, vendors and locations. Specific Sybase strengths include:

- *Centralization of large, growing and highly dynamic data management systems*: In reality, large and complex data environments like the ones discussed here are not practically implemented as a single database. Instead, multiple databases need to be unified under a common management structure and architecture. SybaseASE pioneered the concept of federated databases, combining central policy management and control with the performance of distributed processing across multiple databases. Sybase is extending its reach with VLDB (Very Large Database) technology, further strengthening its scalability, fault tolerance, and data security features. It is also driving operational cost reduction, utilizing SMP (Symmetric Multi-Processing) systems.

- *Effectively manage diverse arrays of data*: SybaseASE has the ability to index and search diverse data types, even across different languages and character sets. Further, Sybase has taken a strong position in its support of XML, the highly adaptable industry data envelope that is transforming multi-vendor data communication worldwide. SybaseASE is the only database vendor that can search and query XML documents or index structures stored in a database, flat files, or at a web address. Sybase plans to add XQUERY (XML Query Language) support, which should significantly strengthen its position.

- *Efficiently store and rapidly access very large historical databases*: the Sybase data warehouse solution, Adaptive Server IQ Multiplex, together with Sun, broke industry records for the world's largest verified database, with 48.2 TB of raw input data comprising 179 *billion* rows. More impressive, the Sybase schema compressed the data to 22TB, and excelled at getting it out: Sybase access times beat all others tested by a factor of 10 or more.

- *Data replication for global operations*: Sybase offers excellent data replication technology, itself the product of collaboration with Sybase' Wall Street customers. Replication Server enables near real-time,

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global data replication. It can synchronize and replicate information across heterogeneous platforms, in any number of locations, supports dynamic transaction routing, and offers a strong management system.

- *Middleware applications, adapters and tools*: Middleware is at the heart of Information Liquidity, enabling information to flow between different databases, systems and applications. The Financial Fusion Tradeforce product line offers a broad set of protocol adapters and a complete platform solution for e-Banking messaging. Leading electronic communications networks, including SWIFT, Tigerex, EuroNext and BRUT employ these solutions. Beyond these, Sybase offers a rich array of middleware and adapters that enable integration across differing applications, transports, message libraries and data formats. Its web services offering provides the critical tools needed to integrate applications across the web.

- *Expertise and support*: Sybase understands the non-stop, business critical nature of the financial services industry. It has a solid track record, with a client list that reads like the "Who's Who" of financial services: Goldman Sachs, Bear Stearns, Commerzbank, Sumitomo Mitsui, Samsung SDS, New York Mercantile Exchange, Credit Lyonnais – the list goes on. Beyond offering strong support services, Sybase partners with its customers, developing strong working relationships through its SAGE executive advisory group, user groups, and one-on-one interactions.[6]

An effective risk management system requires, at its foundation, a unified, adaptable approach to information management that allows central management and distributed operation, working across diverse technologies and vendors. Sybase brings together the necessary products and expertise to create such a foundation for serious, run-the-company applications.

Notes and Sources:

[1] In February 1995, a single trader, Nicholas Leeson, also had responsibility for overseeing back office operations. Without detection or oversight, he committed Barings Bank to positions that led to $1.5 billion in losses and the liquidation of the bank. For more on this and similar preventable disasters, see:
Culp, Christopher L., The Risk Management Process. New York: Wiley & Sons. 2001.
[2] Crouhy, Michel; Galai, Dan; Mark, Robert, Risk Management. New York: McGraw-Hill. 2001.
[3] Basel Committee on Banking Supervision, Bank for International Settlements, "Sound Practices for the Management and Supervision of Operational Risk," July 2002.
[4] McEachern, Cristina, "WS&T Forum," Wall Street and Technology, August 2002. pp. 26-27.
[5] Jorion, Philippe, "The Orange County Case: Introduction to VAR," available on the web, 1996.
[6] Sources from Sybase include:
Sybase White Paper, "Sybase Information Liquidity;"
Sybase White Paper, "Future Direction of Sybase Data Management;"
Sybase Press Release, "Sun and Sybase Reference Architecture Shatters Industry Records," April 3, 2002.

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