



# RISK MANAGEMENT SECTION

"A JOINT SECTION OF SOCIETY OF ACTUARIES, CASUALTY ACTUARIAL SOCIETY AND CANADIAN INSTITUTE OF ACTUARIES"

# Risk

Canadian Institute of Actuaries  Institut canadien des actuaires

# Management

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Actuaries

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# Looking Ahead

by Ronald J. Harasym

**T**his is truly an exciting time to be actively engaged in risk management. As we look around, the world of risk management continues to evolve at a revolutionary pace. People need to continuously think outside of the box when dealing with risk. The key drivers of risk are ever-changing and probing, in search of critical weaknesses in our living and operating environment. The consequence, whether it be global terrorism, a pandemic or changes in risk appetite, requires that risk assessments and contingency plans need to be frequently reviewed, tested, validated and refreshed. With the increasingly complex and fast-changing business environment, organizations are seeking risk management professionals to join their teams.

The requirement to develop effective and efficient risk policies, procedures and practices in concert with these winds of change has become mission critical to many companies. Many key risk drivers have now taken on dynamic properties and are being modeled using advanced stochastic and analytical techniques. Given the nature of the situation and the experience and training that actuaries bring to the table, who better is suited to the role of risk management than actuaries?

The purpose of the Joint Risk Management Section is to further education and research in the area of risk management and to establish leading risk management techniques. These efforts should help to increase the exposure and profile of the actuarial profession as being leaders in the risk management field.

Doug Brooks has been the chair of the Joint Risk Management Section for the past year. Doug showed excellence in dedication and great initiative to help make the new Chartered

Enterprise Risk Analyst (CERA) designation a reality, as well as creating a partnership with the Canadian Institute of Actuaries (CIA) as a sponsor of the section. I personally appreciate the leadership and vision he has brought to the section. While Doug is leaving the section council, I am very happy that he will continue to actively participate in the work of the section. This continues the trend of prior council members who continue to serve as active participants of the section council.

Last but not least, I would like to also thank Tony Dardis, Ken Seng Tan and Fred Tavan for their years of dedicated years of service as council members. I would also like to take this opportunity to welcome our new council members – Steve Craighead, Matt Clark, Don Mango and John Nigh. ♦



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# Chairperson Farewell Article

by Doug Brooks

Another year begins for the Joint Risk Management Section in an environment where risks continue to dominate business news. Events in 2007 demonstrated that even institutions with significant risk-management capabilities are not immune to significant losses if those capabilities are not directed broadly enough, and if the decision-making culture of organizations does not take risk into account when making business decisions, and instead puts weight on short-term gains and rewards. This emphasizes what ERM is all about—integrating comprehensive risk management into the culture of an organization. However, it takes discipline to stay away from opportunities that the market appears to be rewarding. As actuaries, we must bring our own specific expertise to bear in the risk management field, but also ensure that the product of our efforts become part of the organization's culture and not just data that is reported for governance purposes. This requires effective communication on the business implications of the information we produce.

Over the past year, the actuarial profession has continued to push forward in the area of risk management. The Society of Actuaries has implemented a new designation—the Chartered Enterprise Risk Analyst (CERA)—that will provide more visibility to actuaries as trained risk management professionals. Internationally, the actuarial profession is considering development and recognition of a global ERM designation, as well as providing support for many other ERM-related initiatives. We remain a relatively small profession, and in order to compete as a profession and gain a reputation as experts in the broad field of risk management, we must continue to combine efforts as broadly as possible. This collaboration is evident as our section sponsored jointly by the Casualty Actuarial Society, the Canadian Institute of Actuaries and the Society of Actuaries. As

well, the section has encouraged international communication among actuaries with the creation of an international sub-committee that led to the creation of the International Network of Actuarial Risk Managers (INARM) an international network of actuaries interested in risk management. Dave Ingram was the lead force behind this initiative.

The section continued in its important roles of encouraging and sponsoring research, as well as supporting educational efforts through actuarial and other conferences—the ERM Symposium in particular. This newsletter is also a very important aspect of the section's work.

I would like to thank all of those who have contributed to the work of the section over the past year. In particular, Ken Seng Tan has spearheaded the newsletter for several years. Fred Tavan has similarly led the research initiative. Their terms on the section council have now ended. As well, thanks to Tony Dardis and Bob Wolf, whose terms have also ended. Particular thanks to Ron Harasym, who has taken on the responsibility of chairing the section for the next year.

The actuarial profession has much to offer the field of risk management. We are true professionals in this field, a field where many are attempting to stake out their territory. We must continue to develop and promote our expertise in this field. We must do this by combining the efforts of actuaries across various areas of practice and national boundaries. I look forward to seeing the section continue to help actuaries achieve these goals! ♦



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# Performance Measurement within an Economic Capital Framework

by Mark J. Scanlon

## Introduction

**W**ith the increasing number of insurers around the world implementing economic capital (EC), improved performance measurement is often cited as a key expected benefit from such implementations. This article discusses how this improvement in performance measurement can be achieved through the use of a framework that explicitly links risk, capital and value.

The article begins by describing the framework in broad terms. A brief discussion about how measures based on shareholder value are more useful than other commonly used measures when looking at insurance company performance follows. Next, there is a more detailed review of how the economic balance sheet and related measures of EC and economic value can be used to target and measure performance. Some implications for the U.S. insurance market are then discussed. Finally, a high level overview is given of an EC implementation approach that uses the economic balance sheet and that can be executed relatively quickly.

While the focus of the article is on publicly listed life insurance companies, the concepts can equally be applied to property-casualty insurers and non-listed insurers such as mutuals.

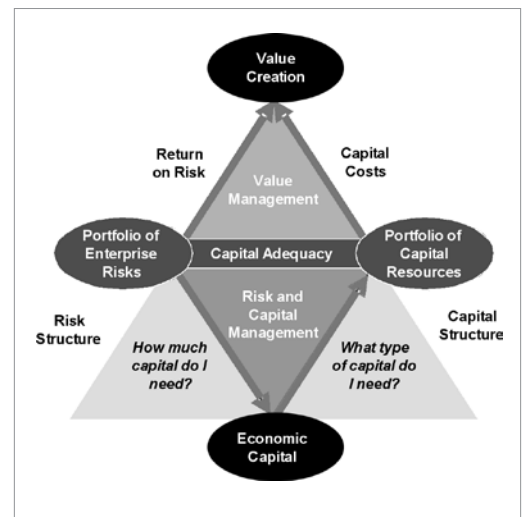
## The Risk-Capital-Value Framework

Among the many reasons given by companies for wanting to calculate EC, most relate to management wanting to make better informed decisions. Improved performance measurement through the use of EC is an important tool in this decision making process. However, by itself, EC does not give any real measure of business performance, but rather gives a measure of the

risk in the business. Thus, in order to use EC to measure performance, some related measure of return is also required.

The Risk-Capital-Value (RCV) framework provides the required link between economic capital and performance measurement. This framework—which shows that risk, capital and value are inextricably linked—can be used to set targets and measure performance in a manner that is aligned with management’s primary objective of creating shareholder value. Figure 1 shows a graphical representation of the RCV framework.

**FIGURE 1: THE RISK-CAPITAL-VALUE FRAMEWORK**



The RCV framework begins with the understanding that a company’s management must focus on two fundamental “portfolios” when striving for value creation, namely its portfolio of businesses and related risks and its portfolio of capital used to finance its businesses. EC is a true measure of the risk in the company (i.e., one that is not distorted by accounting or



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regulatory regimes) – this tells management how much capital they need. A next step, not explored further in this article, is to decide on what type of capital is needed. Management expects to earn a return relative to the risk it has retained—this drives shareholder value creation. However, holding capital against those risks has costs associated with it costs that which reduce value creation. Using this framework, management can aim to maximize shareholder value by relating decisions about the risks it takes to decisions on the capital it uses.

### Value-Based Performance Measures

The RCV framework focuses on value-based metrics for measuring performance. Historically, value-based metrics, such as embedded value (EV), have not been as widely used in the United States compared to many other countries. GAAP Return on Equity (ROE) continues to be the most popular measure used in pricing and performance measurement in the United States. The 2006 Tillinghast Pricing Methodology Survey (which examines the pricing practices of U.S. life insurers) indicates that less than 30 percent of life insurers in the United States use EV measures in pricing. This percentage would be even lower if adjusted for companies that have a European parent and are required to calculate EV. The continued dominance of GAAP ROE is somewhat surprising given its widely recognized shortcomings in measuring the performance of life insurers.

For many industries, ROE is a good indicator of shareholder value created or destroyed over the period. However, for life insurers, GAAP reserving and reporting requirements result in GAAP equity being a poor representation of the value of the business attributable to sharehold-

ers. Similarly, GAAP earnings are often a poor measure of shareholder value created or destroyed over the period. Some specific aspects of GAAP reporting that result in ROE often misrepresenting the performance of insurance companies include:

- Under GAAP reporting, life insurers are required to include prudent margins in the calculation of their liabilities. This results in GAAP equity no longer representing the true value of shareholder interest in the company.
- Asymmetry in rules around how and when assumptions can be changed is another aspect of GAAP reporting that makes GAAP ROE a weak performance measure. In the event of a loss, assumptions are “unlocked” and all expected future losses recognized immediately. But in the event of higher than expected profits emerging, assumptions are not adjusted accordingly and the increase in value is not reflected immediately, but continues to emerge over time.
- In an attempt to report normalized earnings, GAAP reporting requirements can lead to economically similar items being treated differently. For example, some items are capitalized and amortized over time, while others flow through earnings in that period. Similarly, some items are reported “below the line” and impact equity with no direct impact on earnings. While there may be logic to these allocation rules from the perspective of normalizing earnings, they can be distorting from the perspective of measuring the true performance of shareholder interest over the period resulting in GAAP ROE being a poor indicator of increases or decreases in shareholder value.

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Using this framework, management can aim to maximize shareholder value by relating decisions about the risks it takes to decisions on the capital it uses.

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**Performance Measurement ...**

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- GAAP reporting—and hence GAAP ROE—makes no explicit allowance for the risks inherent in the business. This makes setting ROE targets for different products (or businesses) and comparing actual performance for these products (or businesses) challenging.

In isolation, some of these distortions can be easily identified and allowed for, but in practice, with insurers selling multiple products across different markets and geographies and the level and mix of business constantly changing, it can be virtually impossible to monitor and adjust for all the distortions.

Now let us look briefly at EV. EV is broadly defined as the net worth (NW) plus the value of in force (VIF) less a cost of capital (COC). In practice, the EV is driven off the regulatory balance sheet, with the VIF representing the shareholder value contained within the assets backing the regulatory liabilities. It is valued on a free cash flow basis, using best-estimate assumptions, and allows explicitly for the risks within the cash flows. The exact manner in which risk is allowed for depends on the EV approach used (e.g., “traditional” EV or market-consistent EV). The COC recognizes the costs of holding risk capital, and similarly, the manner in which this is calculated and interpreted depends on the EV approach used.

By focusing on the economic fundamentals and “looking through” distortions related to regulatory accounting requirements, EV effectively gives us a better measure of the true shareholder value of the business. The change in EV over time (commonly referred to as EV earnings) represents the change in shareholder value over time. As such, EV and related measures are superior measures of shareholder value creation than the more commonly used GAAP ROE.

Irrespective of the exact methodology used, it is important that this value-based approach make proper allowance for the risk in the business. Shareholder value is only created when the return on EV exceeds the return required by shareholders, consistent with their degree of risk aversion (which in a market-consistent world, is assumed to be the market’s view of risk). In practice, the use of market-consistent EV (MCEV) has increased considerably over recent years, with insurance companies looking to target and measure performance using a framework that measures risk in a manner consistent with that implied by the market. This is the basis for the economic balance sheet approach discussed in the next section.

Note also that the EV of an insurance company represents the “book value” attributable to shareholders, calculated on an economic basis. As such it excludes any consideration of franchise value associated with expected future new business. In practice, shareholders are interested in the total return on their investment (i.e., the change in the value of the company plus any dividends received) and so franchise value also needs to be considered when targeting performance. This is considered further in the next section.

**Economic Balance Sheet Approach**

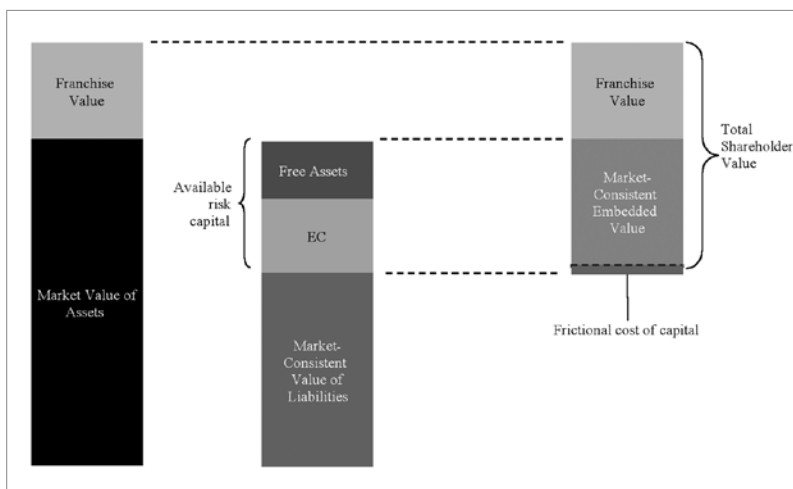
Expanding on the above, let us examine at a high level the type of framework being used by a number of insurers to manage their businesses. This will provide insight into how the concepts and relationships embodied by the RCV framework are being applied in practice. An increasing number of insurers, particularly in Europe, are using frameworks based on an economic (i.e., market-consistent) view of the balance sheet with assets and liabilities

reflected at market values. The value of liabilities is thus derived using best-estimate assumptions, with all margins removed, using discount rates consistent with the market risk inherent in the projected cash flows. Consequently, no distortions are introduced into the balance sheet by accounting or regulatory valuation requirements (e.g., through prescribed valuation margins that are amortized over the duration of the business). Also, since the economic assumptions are those implied by the market rather than based on the views of management, this approach is more objective than a traditional EV approach.

Under this approach, we define available risk capital as the difference between the assets and liabilities on the economic balance sheet. Required risk capital is defined by EC, which can be calculated by stressing the economic balance sheet for significant risks, to quantify the business exposure to those risks. Excess or free assets are then the amount, if any, by which available risk capital exceeds EC. We can see that available risk capital effectively represents the economic value of the business before any adjustment for the cost of capital. Under a market-consistent approach, all costs associated with holding capital are frictional (e.g., agency costs, the cost of double taxation). Reducing for these gives the MCEV. The other component of shareholder value is franchise value, which is driven by the expected level and profitability of future new business. This value is the difference between the company's market capitalization and its MCEV.

Together, these elements form a framework that incorporates risk, capital and value on a consistent basis and provides a logical basis for setting targets and measuring performance. The economic balance sheet and related components of value are shown in Figure 2.

**FIGURE 2: THE ECONOMIC BALANCE SHEET INCORPORATING FRANCHISE VALUE**



Under this framework, the actual and required performance of in-force and new business can be measured in a consistent manner.

In valuing the in-force business, investment risk is automatically allowed for (because cash flows are valued in line with their market price) and insurance risk (which is diversifiable) is valued on a best-estimate basis. Performance targets should thus be linked to the investment risk accepted, allowing for the frictional costs of capital.

Since the business is valued using assumptions that reflect the risks taken, the business is not expected to generate any additional value. However, as the business takes off, actual results will differ from expected. An important aspect of measuring performance is to determine what is driving these deviations. For example, are they the result of random fluctuations or a consequence of conscious management action? Using a replicating portfolio approach, the economic balance sheet can be broken down to distinguish between insurance results and investment re-

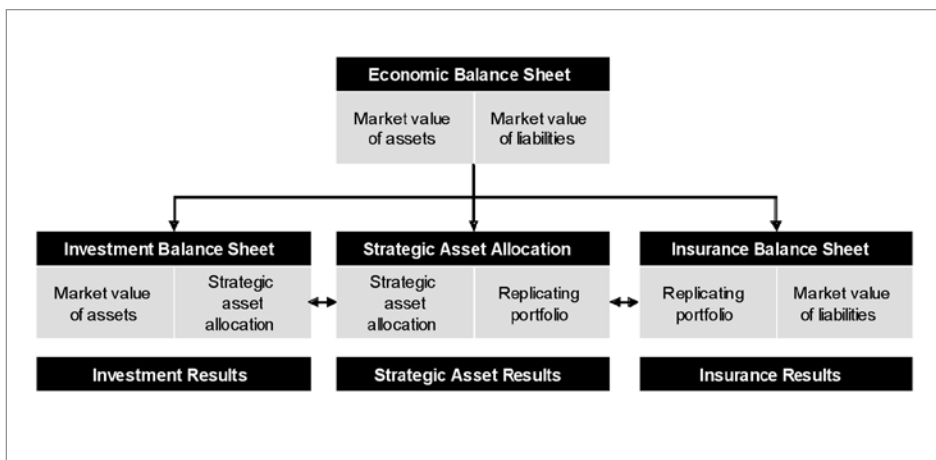
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sults. Investment results can be further analyzed between those decisions related to strategic asset allocation decisions and tactical investment decisions. This type of analysis, illustrated in Figure 3, is analogous to that used frequently in the evaluation and attribution of asset management results. See Figure 3.

**FIGURE 3: ANALYSIS OF IN FORCE PERFORMANCE UNDER AN ECONOMIC BALANCE SHEET APPROACH**



New business performance targets need to be linked to franchise value. Franchise value reflects shareholders' expectation of new business profitability. So to the extent new business value generated is lower than expected, franchise value (and hence shareholder value) will be destroyed. Since policyholders are risk averse, they will not be expected to invest their money with a business that does not hold sufficient capital. We can again see the connection between risk, capital and value: a company needs to hold sufficient capital to maintain its franchise value, but holding more capital increases frictional costs and hence reduces value. In practice, back-solving for implied shareholder expectations for future new business value from the franchise value requires considerable judgment, but the results can provide valuable insight to management.

## Implications for the United States

The framework described in this article is increasingly being adopted by European insurers. This is related to the fact that the above framework is consistent with the new capital requirements being introduced by a number of regulators. It also relates to with the direction in which Solvency II requirements are heading as well.

In the United States, an increasing number of companies are implementing EC frameworks. Unlike Europe, the main external driving force in the United States so far appears to have been the rating agencies, which have been paying much more attention to EC when reviewing an insurer's overall risk management process. The introduction of risk-based principles into U. S. insurance regulations has also had an impact. In the United States, there does not yet appear to be one particular EC calculation approach that is dominating others. A number of U.S. companies are using approaches that begin with the statutory balance sheet and project the portfolio until runoff, while others are using approaches that are based off the economic balance sheet over a one-year time horizon (along the lines described in this article).

Historically, economic value measures, such as EV, have not been that widely used in the United States, with the main exception being the U.S. subsidiaries of European multinationals. With companies moving towards using EC frameworks as part of the risk and capital management process, we will likely see an increased use of value-based measures, irrespective of the specific approach to EC chosen. Companies that aim to use EC for managing risk and capital, but continue to use GAAP ROE or similar measures to target and measure performance, may struggle to optimize decision making in the face of conflicting measures.



It is unlikely that U.S. insurance companies and their shareholders will suddenly stop being interested in GAAP ROE, but we may see ROE targets being adjusted to attempt to allow for aspects of risk captured by the EC calculations. Use of several measures simultaneously is also a feasible approach. Another practical issue is that developing an RCV framework is not an overnight exercise. It should only be used as the main driver of business decisions and performance measurement once it is stable and has been rigorously tested. Additionally, a move to managing the business using this risk-based approach can be a politically sensitive and culturally challenging exercise. Buy-in at all levels of the organization is important for it to succeed. Communication with external stakeholders is another critical success factor.

### Fast Track EC Implementation

One of the reasons for the popularity of the economic balance sheet approach in the United States is that usually it can be implemented relatively quickly. By following a few key steps focused on producing fast and efficient results companies can produce robust EC results in a short period of time. These results can facilitate substantive discussion with external parties such as rating agencies and regulators. In addition, they provide a strong platform from which longer term, more sophisticated EC implementation can be developed. The four major steps of this approach are:

- Develop the economic balance sheet itself, which companies are usually able to do without the need for further construction and implementation of complex models.
- Identify the key risks to be tested and determine appropriate stress test(s) for each of those risks.
- Run each of the stress tests and recalculate the economic balance sheet, giving the required EC for that particular risk.

- Aggregate the results from the different stress tests using a correlation matrix to give the total company EC.

### Conclusion

This article has shown that an RCV framework—combining consistent measures of EC and EV—can be used to set performance targets and measure actual performance of insurance companies in a manner that is consistent with management's primary objective of shareholder value creation.

In particular, the economic balance sheet approach provides a framework with capital and value being measured using a market-consistent approach. This approach is increasingly being used by insurers in Europe and the United States to calculate EC and manage their business. The relatively short implementation times that can be achieved with this approach contribute to its popularity, especially with companies that operate under time constraints. ♦

# Enterprise Risk Management—A Brazilian Market Perspective

by David Sommer



**P**riorities in overseas insurance markets are not the same as in the United States. Enterprise Risk Management (ERM) is no exception.

While various forms of dynamic financial analysis and risk modelling have been discussed and practiced for some time in more technically advanced insurance markets, the advent of Solvency II has brought these concepts and the framework of Enterprise Risk Management to the attention of developing markets. In many instances, this awareness is created via the regulatory authority, which wishes to implement a risk-based approach to capital adequacy. This was the case in the Brazilian market, where new regulations anticipate capital requirements for underwriting, credit, market, operational and legal risks. While these will be phased in over time, this completely new approach toward insurance company management is forcing the market to reeducate itself.

While there has been much written about ERM, it has typically been written from a developed-market (U.S. or European) point of view. Many

sources of insurance risk in other markets are different and even those that are similar have different levels of relevance. The goal of this article is to look at ERM from the point of view of the Brazilian Insurance Market and comment on some of the specific challenges there.

## **Underwriting (and Reserve) Risk**

Brazil is a market with a much less aggressive court system than other more developed markets and almost no natural catastrophe risk. While there is significant price competition and related underwriting cycles here, the tails are much shorter and as a result, the corrections typically occur much more quickly. Further, companies with diversified books of business do a fairly good job of not being aggressive across-the-board. In addition, the market is focussed on personal lines products with lower limits. Even where there are higher limits exposed (property premiums make up less than 15 percent of market premium), company retentions are relatively low due to regulatory restrictions, limiting the insurer's underwriting risk due to large losses.

Underwriting risk in Brazil typically comes from what we would call parameter risk, that is the incorrect pricing of business (or poor acceptance criteria) due to the lack of familiarity by the underwriting department. While there is a movement toward more technically-based pricing in the market, this is limited to a only a few products and much of this analysis tends to be subverted by commercial concerns with only a few brave souls willing to maintain discipline in face of market pressures. With regards to life insurance, there is still significant debate over which mortality tables are appropriate for the Brazilian insured population (which is significantly different than the overall population) and the impact of improvements in mortality in general.



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As far as reserving risk is concerned, the market for the most part calculates reserves mechanically without considering changes in portfolio or environment. As a result, there is a significant probability that a company's reserves are not properly stated. With the relative shortness of tail, this magnitude of this risk is likely to be less than in more developed markets.

### Market Risk

Market risk is characterized by volatility in interest rates and their effects on asset values and returns. Due to the governments concerns of inflation, Brazil has one of the highest real interest rates in the world despite consistently improving indicators. However, interest rates are falling and will continue to do so, with forecasts of nominal interest rates close to 10 percent at the end of the year. This sustained fall in investment returns (interest rates were 18 percent in January 2006, compared to 11.5 percent in July 2007), is particularly concerning as there are few options for long-term investments that could allow for companies to immunize their portfolios against the impact this will have on their investment returns. And for multinationals with Brazilian operations, the weakening of the U.S. Dollar against the Brazilian Real (18 percent since the beginning of 2006) has only increased these concerns. Integrating a well-built asset module into an insurer's dynamic financial model can provide the basis necessary to evaluate which investment strategies would be the most appropriate for this new environment.

In addition to these more obvious issues, there are the underwriting risk implications for products with interest-sensitive components. During periods of high returns, many insurers

provide guarantees for their products that are unsustainable in today's environment. In these instances, market and underwriting risks are difficult to separate, especially when effects on lapse rates are also considered.

### Credit Risk

Until the beginning of the year, the Brazilian reinsurance market has been a monopoly. Although legislation has been passed opening the market, regulation defining the new environment will likely not be released before the end of the year. As such, traditional credit risk concerns of reinsurance recoverables have not yet come to Brazil, although they will be here shortly. While there is the default risk on investments, insurers typically do not invest in stocks and most commercial paper held, if any, is in larger banks.

### Legal Risk

This is Brazil's contribution to the international discussion of what risks insurers face. The initial definition put forth by the regulator to the working group in 2005 was that legal risk consisted of "the level of uncertainty to the returns of an institution due to the lack of a completely legal basis for its operations. An example of this is the risk that its contracts are not legally protected against bad faith by its associates, insufficient documentation, or insolvency." The regulator, perhaps seeing that the market was having difficulties understanding the distinctions between legal and operational risk (and some aspects of underwriting risk) has recently defined this to be "the risk in view of the peculiarities of the Brazilian legal system." It is clear that the market will continue to await further definition of this and operational risk prior to undertaking any modelling.

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**Integrating a well-built asset module into an insurer's dynamic financial model can provide the basis necessary to evaluate which investment strategies would be the most appropriate for this new environment.**

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**Operational Risk**

As in other contexts, operational risk remains defined in complementary terms or “all other risks.” The market, due to regulatory initiative, has begun to focus more on internal controls and it is hoped that this will be the first step towards identifying (and subsequently quantifying) sources of operational risk.

While insurers do not tend to have large sums of money riding on the successful execution of the number of transactions that banks have, they do recognize that there is significant risk due to bad faith, E&O and other operational shortcomings. And as the legal system in Brazil is particularly paternalistic, the “people” risk due to employee lawsuit (not covered by legal risk) is a significant reality here.

**ERM for Insurers in Brazil in the Near-Term**

As previously mentioned, insurers are facing new risk-based capital requirements that carry

strong incentives (approximately 15 percent of required capital) for them to develop dynamic financial models for these risks, starting with underwriting risk. As the market is relatively unsophisticated from a modelling perspective, companies are scrambling to hire consultants and/or develop internal expertise in designing, building, parameterizing and calibrating these types of models, as well as finding a platform sufficiently transparent and flexible to adapt to future regulations as well as integrate into the company’s newly-developed risk management processes. While it is important for these modelling efforts to be focussed on Brazilian issues, it is equally important to understand how the Brazilian market is changing and understand which methods and approaches will be appropriate for a given company during this period of transition. ♦

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# A Toy Copula<sup>1</sup> ERM Model in R<sup>2</sup>

by Steve Craighead

A simple ERM model entails setting up various risk sub-models and creating a dependency relationship between these risks. After this is accomplished all one needs to do is to simulate for a given number of trials (say 1,000) and aggregate the dependent risk values. From these aggregated results one can then either determine VaR or conditional tail expectation (CTE) at a specific percentile. Later in this article, we will construct our ERM toy model, which will demonstrate how to link statistical sub-models with copula dependency models using the R copula package.

The R copula package models the Frank, Gumbel and Clayton copulas within the Archimedean family, as well as, the multivariate normal and Student-t copulas. The Archimedean copulas are limited to dimensions less than seven since the resultant multivariate probability density function (PDF) is not available due to difficulty in symbolically differentiating the associated multivariate cumulative distribution function (CDF).

In brief, the steps that the reader needs to follow are:

- A. Specify the copula that will model the dependence.
- B. Specify the multivariate distribution using the copula defined in step A by using the



`mvdc()` function. You must also define the marginal distributions associated with each risk. You will also specify the marginal parameters which will be discussed below.

- C. Supply the marginal data associated with each risk.
- D. Fit the model.
- E. Examine the results.

Before we actually create the toy ERM model, we need to discuss some basics in R.

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<sup>1</sup> This entire article assumes that the reader is acquainted with both the concept of copulas in the modeling of dependence in ERM modeling and how to use the R language with statistical modeling. However, for further information on copulas, you may read the excellent survey article "Understanding Relationships Using Copulas" by Frees and Valdez in the *NAAJ* Volume 2, Number 1 of 1998. If you prefer to experiment with copulas in Excel instead of R, please refer to the workbook and articles created by Sam Cox and Don Behan on <http://www.behan.ws>.

<sup>2</sup> The R language is very popular open source statistical modeling environment, which you can obtain from the Web Page <http://cran.r-project.org>. If you are interested in building the toy model in this article, you will need to download the base R Binary for the operating system of your choice (Windows, Linux or MAC). Also, you will need to download the contributed copula package. You can do this initially when you download the base system, or you can use the package installation facility when you start R.



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## A Toy Copula<sup>1</sup> ERM Model in R<sup>2</sup>

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The R language has many different univariate distributions available for modeling the marginals. A statistical distribution in R uses three separate functions for modeling (with the possibility of a fourth). For example, if you wanted to model a univariate normal distribution, you would use either the `dnorm`, `pnorm`, `qnorm` (and `rnorm`) functions. The `dnorm` function models the density, the `pnorm` models the distribution (CDF) and the `qnorm` is the quantile function, which is the inverse function of the CDF. The fourth function is `rnorm`, which can be used to generate random normal variates. Other example distributions functions are `dt`, `pt`, `qt` and `rt` for the Student-t, and `dexp`, `pexp`, `qexp` and `rexp` for the exponential distribution. Each of these functions requires specific model parameters. The normal distribution has the model parameters `mean` and `sd` for the mean and standard deviation. The Student-t distribution requires the parameter `df` for the degrees of freedom. The exponential distribution uses the `rate` parameter.

One must also load the `copula` package after starting R. This is done in Windows by choosing the `copula` package when using the Load Package option under the Packages option on the command list at the top of R.

When carrying out step B (see page 13), the `mvdc()` function creates a multivariate distribution object in R. This function has three major

inputs. The first is the copula. The second is a list of the specific marginals and the third is a list containing lists of associated marginal parameters.

For instance, say you want to model a bivariate CDF using the Gumbel copula (with parameter of three) and the first marginal is a normal distribution with a mean of 10 and a standard deviation of two and the second marginal is an exponential with a rate of two.

A. First, You need to use the command

```
gmb<-gumbelCopula(3, dim = 2)
```

to create the copula object. The symbol “<-” is used as the assignment operator. The “`dim=2`” assures that we are creating a bivariate CDF. You can specify up to six dimensions within the R Copula library.

B. Next you specify the bivariate distribution by using the command:

```
myCDF<- mvdc(gmb, c("norm","exp"), list(list(mean=10,sd=2),list(rate=2)))
```

Notice the first parameter in `mvdc` is the `gmb` object defined in step A. The second parameter is a generic list of the two marginal distributions (produced using the `c()` function). The third parameter is much more complex, where the `list()` function is used three times. Here we have a list made of two separate lists. The first of these two separate lists are the parameters that model the normal marginal as discussed above. The second of these lists contains the parameter required to model the exponential marginal. The `list()` function is not as generic as the `c()` function, but the `mvdc`

function expects the marginal parameter defined in this fashion.

C. Next you need to supply the risk data associated with each marginal. Since this is a toy, we will actually use the myCDF multivariate distribution as defined to generate the data (a bit incestuous, but okay for this demonstration). Here you will use the rmvdc() function which will generate random variates from myCDF. Use the command

```
x <- rmvdc(myCDF,1000)
```

to generate 1000 samples from your bivariate CDF. You could also supply your own data x as in an R matrix with 1000 rows and two columns. For instance, if you were able to use identical scenarios and produce separate various risk values based on these scenarios, and collect these together into an R matrix, you could then design your copula multivariate distribution and use the fitting algorithm to fit your actual data.

D. Next, take the data in the matrix x and determine the best parameters in myCDF by using the fitting function fitMvdc() (which uses maximum likelihood). This function requires the x matrix, the myCDF object and a generic c() list of initial guesses to the parameters. Note that the first parameter in this list will be the parameter associated with the Gumbel copula model (which we assumed as 3). The remaining values are associated with the parameters of the marginals. Suppose that you use the command:

```
Fitted<-fitMvdc(x, myCDF, c(3,9,1,1))
```

Here the 3 is the Gumbel parameter, the 9 is the initial guess for the normal mean, 1 for the normal sd parameter and 1 for the exponential rate parameter. Here starting values were different than the original model, so that in Step E, we

can see the goodness of fit. Note: you may get a warning message stating that there are so many separate warnings and that you should enter the command “warnings()” to display these. These warnings arise when the fitting algorithm moves the parameter estimates outside the acceptable values. At this time, you may disregard these.

E. Once the model fitting has completed, you can examine the results of the fit by just issuing the command “Fitted.” This will display to the screen the results. For instance the following is the results obtained by the author. Your results may vary due to the random values that were generated in matrix x.

```
> Fitted
The ML estimation is based on
1000 observations.
Margin 1:
      Estimate  Std. Error
m1.mean  10.157765  0.05885397
m1.sd    1.984802  0.03243711
Margin 2:
      Estimate  Std. Error
m2.rate   1.893372  0.05849316
Copula:
      Estimate  Std. Error
param     2.819898  0.08826639
The maximized loglikelihood is -1787.369
The convergence code is 0
>
```

Observe both the relative parameters and their standard error, and how close the estimates are to the original parameters originally set up.

Also, one can examine the contour plot of the bivariate density function by using the following commands:

continued on page 16 ▶

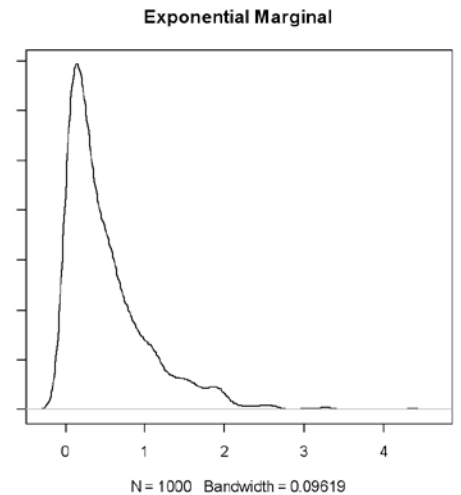
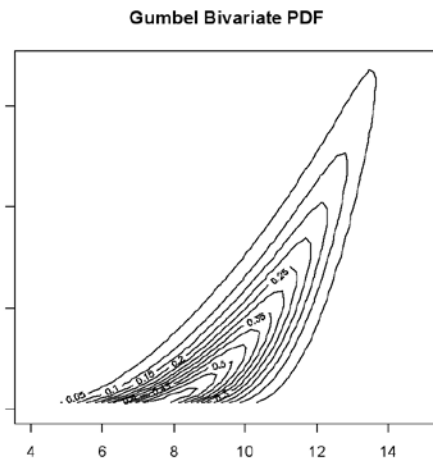
**A Toy Copula<sup>1</sup> ERM Model in R<sup>2</sup>**

▶ continued from page 15

```
contour(myCDF,dmvd,c,xlim=c(4,15),
ylim=c(0,1.7))
title("Gumbel Multivariate PDF")
```

```
K <- density(x[,2]) #x[,2] obtains risk 2
K$Call <- "Exponential Marginal"
plot(K)
```

These produce the following graph:

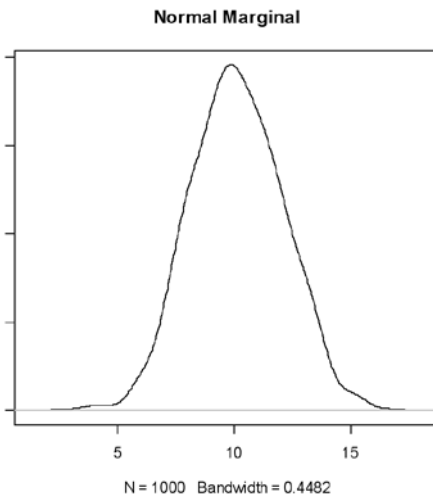


One obtains the graph of the normal marginal by using these commands:

```
K <- density(x[,1]) #x[,1] gets risk 1 results
K$Call <- "Normal Marginal"
plot(K)
```

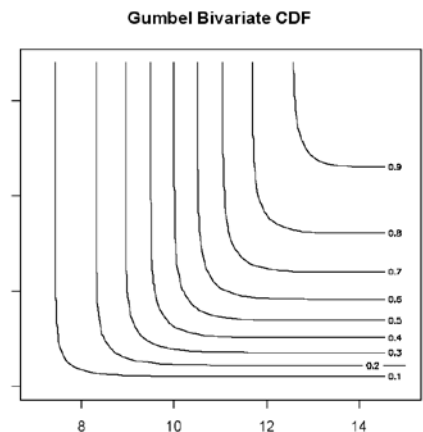
Note how that the PDF is not symmetric, which is a characteristic of the Gumbel Copula since it is only defined in the right tail.

Also, one can examine the contour plot of the bivariate cumulative function by using the following commands:



```
contour(myCDF,pmvdc,xlim=c(7,15),ylim=
c(0,1.7))
title("Gumbel Bivariate CDF")
```

This produces the following graph:

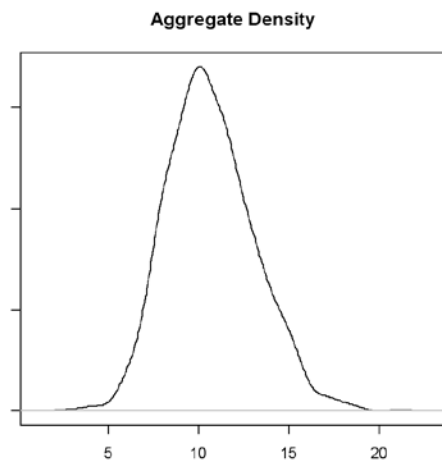


To obtain the exponential marginal, use these commands:



Of course, if you add up the random samples, you will have the total dependent risks! By using these following commands, R will display the density of the total risks:

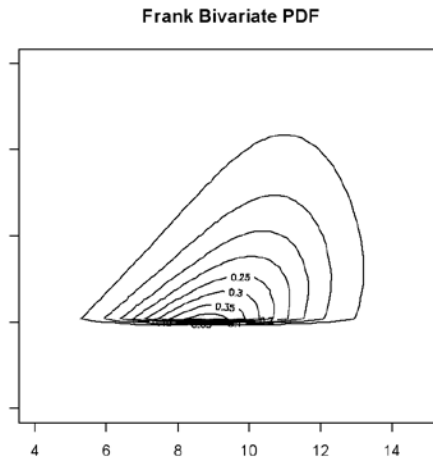
```
Y<- apply(x,1,"sum") #sum across columns
of x
K<-density(Y)
K$Call <- "Aggregate Risks"
plot(K)
```



With just the above commands you may examine other copulas such as the Frank copula using the commands:

```
frank <- frankCopula(param=2,dim=2)
myCDF<-mvdc(frank,c("norm","exp"),list
(list(mean=10,sd=2),list(rate=2)))
contour(myCDF,dmvdc,xlim=c(4,15),ylim=
c(-0.5,1.5))
title("Frank Bivariate PDF")
```

You will obtain the following density contour:



Other things that you can do, is to increase the number of dimensions and use other marginals. Also, you can use the `rmvdc()` command as we did in step C above and simulate your dependency multivariate distribution.

Though this toy model only uses two risks, you can use up to six risks, by changing the definition of the copula as well as specifying the different sub-models. Hopefully, the examples above are explicit enough to let you do various what-ifs on your own data. ♦

### Bibliography

R Development Core Team (2006). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, <http://www.R-project.org>.

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Though this toy model only uses two risks, you can use up to six risks, by changing the definition of the copula as well as specifying the different sub-models.

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# Research Report: Linkage of Risk, Capital and Financial Management

by Aaron Halpert and Leslie Marlo

**T**he functions of risk management, capital management and financial management are three vital areas of an insurance company. Each of these functions individually is critical for the ongoing viability of an organization, and each has often existed in a vacuum. Increasingly, the concept of linking such functions has gained traction, with the recognition that such integration may add value to a company.

Some of the impetus for insurers to demonstrate linkage stems from regulatory and rating agency sources. Regulatory compliance often drives actions in the financial services industry, and the banking industry is already measuring and managing risks to comply with Basel II. For European insurers, the advent of Solvency II—loosed fashioned after Basel II—is not far away, and the International Associations of Insurance Supervisors also has a solvency project underway. Meanwhile, rating agencies are asking pointed and detailed questions about companies' risk management practices, and going on record that they will consider internal capital models when evaluating capital adequacy.

Beyond compliance, however, are a number of benefits that will result from linkage; in theory, certainly a more integrated environment should lead to better decision making, and therefore, better key performance indicators. It is possible that a company could point to a strategic capital decision made in a risk-aware environment that directly improves financial results. But less tangible benefits are equally valid, from an improved understanding of risks and their true costs to the ability to measure individual business units' contribution to the overall organization to greater transparency in results.

How do the functions connect with one another? Full linkage involves recognition of the risks

facing an organization and their impacts both individually and in the aggregate on capital needs. Through quantification of risks and capital impact, well-defined strategic decisions can be made. Linkage occurs as a risk-aware culture considers risk metrics in conjunction with performance measures throughout all decision points of the organization. Ideally, this is a process that is truly ingrained throughout the organization.

The CAS-CIA-SOA Joint Risk Management Section commissioned KPMG LLP to explore the processes and infrastructure that would allow a company to properly coordinate risk, capital and financial management in a manner that is efficient and effective. Based on our research, including interviews with a number of insurance companies of varying size, product distribution and corporate configuration, several effective practices have emerged relative to implementation of a linked environment. These include:

1. Development of a corporate oversight committee, representing senior management commitment to implementation of an integrated environment. For linkage to be successful, a cultural shift must occur wherein senior management "buys in" to the value added from the process.
2. Development of a framework, specifying how the goal of linkage will be accomplished. This includes decisions regarding consistent terminology and definitions, risk appetite, hurdle rate and performance measures to be used throughout the organization.
3. Risk identification and assessment, key to the understanding of the organization's risk profile. This should emphasize material risks at the individual business unit as well as at an aggregate level, both before and after risk mitigation activities.



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4. Actual linkage of risk, capital and financial management through the use of economic capital modeling and performance measurement on a risk-adjusted basis.
5. Education and communication throughout the organization and including the Board of Directors and Audit Committee. This allows for an environment wherein different areas become cognizant of how their actions impact others.

In theory, the implementation of a linked environment may sound more attainable than it does in practice. Any number of challenges goes along with the benefits, and often they may seem insurmountable. These include resource constraints from both monetary and personnel perspectives, the difficulty in effecting a cultural shift to a new way of considering risk, capital and financial management either from senior management or from risk owners at the functional level, and a myriad of technical issues that are still unresolved within the industry. Even those companies that have begun implementation—those who are technologically sophisticated—consider there to be room for improvement in modeling. There simply is not enough data or knowledge of distributions to adequately model certain risks. The list of challenges is long enough to seem overwhelming, yet our research shows that value is gained from breaking off manageable pieces within the process.

For an insurance company just starting out, the following practical suggestions are worthy of consideration:

1. Establish buy-in and direction from senior management and the Board of Directors, while allowing risk owners at the functional level to participate in shaping the process.
2. Establish a well-defined framework for linking risk, capital and financial management. As the implementation proceeds, it is important to see that strategic decisions are in fact being made on a risk-adjusted basis using the defined framework.
3. Recognize that certain components of the process are already in place. Every business unit identifies and evaluates risks in some manner; build on this rather than starting from scratch.
4. Keep it simple, at least at first. Start with the most material risks, basic financial metrics and economic modeling commensurate with the organization's resource constraints.
5. Become familiar with best practices but realize there is no one right approach and that integration of best practices can come over time.

In the real world, many companies are on their way to achieving an integrated state, while many others are just starting out. A whole spectrum of companies lies in between. Many challenging tasks exist, and numerous components must be considered. But it is possible to break down the tasks into smaller, simpler pieces. While the tasks are admittedly difficult, those who have already embarked on the process are finding the benefits worthwhile.

KPMG LLP would like to thank those who contributed to our research, including all of the company personnel who agreed to share their thoughts on the state of linkage at the companies and in the insurance industry.

We further thank the members of the Project Oversight Group which oversaw the completion of this report for the CAS-CIA-SOA Joint Risk Management Section: Linda Chase-Jenkins, John Kollar, Scott Orr, Max Rudolph, Frank Sabatini, Robert Schneider, Steve Siegel (SOA research actuary) and Jeanne Nallon (SOA research assistant).

The full report may be found at:

<http://www.soa.org/soaweb/research/risk-management/research-linkage-rm.aspx>

The views and opinions are those of the authors and do not necessarily represent the views and opinions of KPMG LLP. ♦

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**Linkage occurs as a risk-aware culture considers risk metrics in conjunction with performance measures throughout all decision points of the organization.**

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# Measuring and Managing Reputational Risk

by Daniel Diermeier

**R**eputation has moved to the top of the agenda for many CEOs and senior executives. What used to be “nice to have” is now increasingly considered as a core asset that needs to be protected and managed. Reputational damage can hurt a company in many ways. Take the example of Wal-mart. Over the last two years, Wal-mart has been the subject of negative news coverage on topics ranging from environmental and labor concerns to allegations that Wal-mart has negative net effect on local communities. These accusations (whether true or false) have already had an impact on Wal-mart’s business performance. According to a leaked internal study, about 2-8 percent of shoppers have taken their business elsewhere because they were no longer comfortable shopping at Wal-mart stores. Perhaps more importantly, Wal-mart has encountered increased resistance to opening new stores, especially on the West Coast and the North Eastern region of the United States. As a consequence Wal-mart’s stock price has been depressed over the last two years.

An important lesson from the Wal-mart case and related cases is that a company’s reputation (even among customers) is only partially shaped by direct experiences with the company. In other words, perfect execution at the typical “touch points” with customers is not sufficient for building and maintaining an excellent reputation. Third parties, especially the media, play an important role in shaping customer perception. In particular, there are three core difficulties in managing corporate reputations:

- Lack of **control**.
- Limited **credibility**.
- Overwhelming **complexity**.

**Control.** Companies cannot directly control the messages received by third parties. Consider the example of a credit card company. If a customer is unhappy with a late-charge, a customer services representative can directly engage with the customer on a one-on-one basis and rectify the situation, e.g. by waiving the fee or at least explaining its rationale. In contrast, if the *New York Times* runs an article detailing the alleged abuse of late fees among credit card companies the company cannot reach all the readers of this article, certainly not among potential customers.



**Complexity.** Customers usually do not understand the complexity underlying certain business decisions. As a consequence they will form their own beliefs on whether the company’s behavior was appropriate or not. In many cases they will rely on heuristics and rules of thumb when forming an opinion about a company. Social and cognitive psychologists have demonstrated that risk perception is subject to various biases and so-called “framing effects.” For example, customers will overestimate the risk to themselves if they empathize with the reported victim of allegedly improper business practices. Food safety concerns are a prime example of such processes. Adult female customers, for example, will be measurably more concerned



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for their own well-being if they read an article about a child being injured than, for example, a middle-aged male.

**Credibility.** When third parties (e.g., journalists or scientific experts) play a role in shaping a company's reputation, companies need to realize that in many cases their own credibility is much lower than that of the experts. In the competition over a company's reputation, companies are at a disadvantage compared to scientists, doctors, even non-governmental organizations and many government actors. Moreover, which third parties have the high credibility varies from country to country. In Northern Europe, non-governmental organizations have some of the highest credibility scores. This is not true in Japan or the United States where some government agencies (e.g., the FDA) have more credibility with customers. Companies need to understand that what works in one market may not work in another. During the introduction of genetically modified food, Monsanto successfully used the FDA to overcome customer concerns about food safety in the U.S. market. A similar strategy in the European market, however, dramatically back-fired because the Ministry's reputation had previously been damaged after it mismanaged the occurrence of Mad Cow Disease in the United Kingdom.

These few examples point out that reputation management not only can be extremely challenging, but can affect the core assets of a company, especially if maintaining high levels of trust among customers, regulators, investors, or other stakeholders is necessary for sustained business success. It follows that reputation management should not be relegated to functional specialists such as the legal or PR department. In many cases reputational challenges have their origin in ordinary business decisions such as market entry (Monsanto), marketing (credit cards) or product design (sub-prime lending). Once reputational challenges have

reached the desk of the corporate counsel they frequently have reached crisis proportions. It is therefore much better to integrate reputational considerations into the day-to-day business decisions of the managers that run the business.

To successfully manage reputational challenges companies need to develop three core capabilities:

- A functioning **early warning system**.
- Ongoing **measurement** of the reputation of the company, its markets and products
- Rapid **situational assessment** by issue, product, and market.

**Early Warning System.** In many cases reputational challenges have their origin in areas not frequently monitored by companies. For example, a data privacy issue may first be voiced in an obscure engineering conference and not raised again until it reached main-stream media. In many cases, companies can completely avoid or at least mitigate reputational crises by changing business practices, stakeholder outreach or through detailed communication plans. But developing such responses takes time, the one thing companies do not have once an issue has reached crisis proportions. In retrospect the warning signs could have been identified but they never reached the key decision-makers. Moreover, in many cases issues that turned out to be enterprise-critical were not even identified as potential risks; they never made it onto the radar screen. As "unknown unknowns" they never could be integrated into a proper risk management framework.

This is the value proposition for investing in early warning systems. This may range from informal monitoring of various media sources over proactive stakeholder outreach to the development of an internal issue anticipation group. Of particular promise is the use of information technology in this area. Many of my clients have benefited from using tools from computational

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**Reputational Management not only can be extremely challenging, but can affect the core assets of a company ...**

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## Measuring and Managing ...

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linguistics and artificial intelligence to identify and monitor emerging issues. Conceptually, the idea is closely related to the concept of “open source intelligence” in the area of national security. The idea is that in the context of emerging issues, the shortcoming does not rest in the lack of information but in too much information. Unfortunately, much of the information is never aggregated to actionable intelligence. The “dots” were present, but not connected.

**Measurement.** What gets measured gets managed. While financial and operational risk can now be (largely) quantified, this is not the case for reputational risk. If companies engage in any measurement at all it is largely based on surveys or focus groups which make it difficult to obtain enough reliable data for a proper quantitative analysis. Two things are lacking: operational measures (similar to, customer satisfaction scores in marketing or quality measures in manufacturing) and financial measures that connect reputational with financial performance. Again, the sophisticated use of information technology provides a potential remedy.

As discussed on page 21, media coverage heavily influences the perception of customers and other stakeholders. While measuring their beliefs directly may be prohibitively costly and impractical, we can measure the opinions expressed in the media and third-party sources. This can be accomplished by using computer algorithms that are trained to identify positive or negative opinions using technologies not too dissimilar from a sophisticated spam filter. The effect of this approach is to generate quantitative data about a company’s reputation that can then be further analyzed.

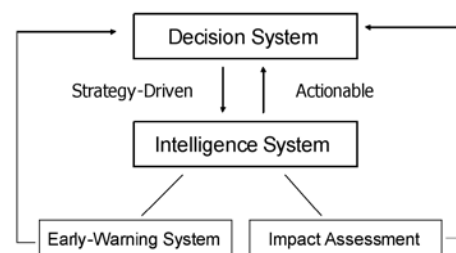
For example, companies can compare the reputations of a given product in two different markets, measure reputational challenges over time, and assess whether a particular strategy has “moved the needle.” Once such measures

have been developed, they can be connected to a company’s financial performance using standard event study methodologies. This allows an integration of reputational risk with other risk types.

**Situational Assessment.** Once critical issues have been identified and their impact measured, managing such issues requires rapid and reliable situational assessment. For example, in many cases issues are “owned” by only a few journalists. Also, journalists frequently rely on the same group of experts that are then repeatedly quoted. Companies need to understand who is an “ally” or an “opponent.” Of course, the list of opinion leaders, gate-keepers, etc. is both issue- and market-specific and therefore requires ongoing monitoring.

Given that the importance of managing reputational risk is no longer much in doubt, companies need to develop appropriate processes and capabilities. The following figure summarizes the key components of an effective reputational risk management system.

### Reputation Management System



However, even if companies develop appropriate decision systems—and many do not—there is much less appreciation of the need to create intelligence systems that allow a quantification of reputational risk. Yet, the many reputational crises suffered by corporations today make the need for such a system only too apparent. ♦

# Operational Risk Management in Local Chinese Securities Companies

by Wei Wang

With a history of less than 20 years, the operation and management of local Chinese securities companies is not yet mature. The fact remains that most of the risk lies within the companies' embezzlement of customers' funds or failure of supervising the behavior of their branches. Thus we have developed an operational risk management framework for local Chinese securities companies and a set of tools to manage their branches. This framework sets up procedures and instructions for establishing a controlled environment for the companies. The tools develop systems for collecting and monitoring information and evaluating and appraising branches accordingly. This framework and these tools have been implemented in the first IPO securities company of China and have achieved good results.

## Introduction

China's securities markets embarked on a rapid track for developments when the Shanghai Stock Exchange and Shenzhen Stock Exchange were both established in late 1990. At present, China's securities market offers several types of financial instruments, including: A shares, B shares, T-bonds, corporate bonds, convertible bonds, investment funds, warrants and so on. By the end of 2006, some market data were presented as following<sup>1</sup>:

1. There were 1,507 listed companies in China, out of which 1,398 companies issued A shares, the other 109 companies issued B shares.
2. There was an aggregate market capitalization of RMB 8, 940.4 billion<sup>2</sup>, among

- which the capitalization for tradable stocks amounted to RMB 2, 500.3 billion,
3. In the year 2006, the turnover of stocks and funds reached RMB 9, 247.2 billion,
4. About 77 million securities investment accounts were opened; most of them are retail investors. The institutional players include securities companies, insurance companies, investment fund management companies, Qualified Foreign Institutional Investors (QFII), corporate annuities and China National Social Security Fund, etc.

As the important intermediaries in China's capital market, there are over 100 securities companies in China, most of which are local.<sup>1</sup> Based on the mechanism of category regulation of the China Securities Regulatory Commission (CSRC), 19 securities companies are classified as the innovation category companies; 30 securities companies are classified as the normative companies according to their net capital, business management and so on. In the meantime, about 40 securities companies were closed by the CSRC. One or more of the followings reasons explain their closures:

1. Embezzlement of customers' funds;
2. Embezzlement of customers' bonds by repurchasing;
3. Illegal operation, for example overdraft and issuing bonds without authorization.

The overall level of quality of the securities companies is important and determinant to the health and stable operation of the securities market and country's financial system. Therefore, operational risk management becomes important and necessary to every securi-



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<sup>1</sup> Source: <http://www.wind.com.cn>

<sup>2</sup> The ratio to GDP reached about 50 percent.

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**Operational Risk Management ...**

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ties company. It is important for us to develop a suitable framework to manage the risk of loss resulting from inadequate or failed systems, people and internal processes; and especially to prevent the companies and their branches from embezzling the customers' funds. We have developed a framework for local Chinese securities companies to manage their operational risk, which covers the organization, operation, monitoring and reporting in the securities companies. Some parts of the framework seem to be platitude; however, they are extremely important for the local Chinese securities companies.

The Chinese securities companies do not have a long history and the risk management in these companies has also just started. Some principles, which are supposed to be the general knowledge or guidelines in risk management have not been properly implemented or enforced in China's securities companies. Taking that into account, some of these contents are considered in our framework. It is possible for the securities companies to design and arrange and also evaluate their own operational risk management accordingly. This framework surely provides a reference for the regulators and any others who are interested in evaluating the risk management of China's securities companies.

**Operational Risk Management Framework—Organization****1. Separation of Decision Making, Implementation and Supervision**

There should be an appropriate division of work and organization in the securities companies to guarantee that the decision making, implementation and supervision are separated.

**2. Chinese Wall System**

The decision making, information, staff and offices of the departments of broker-

age, asset management, proprietary trading and underwriting and sponsorship in each securities company should be separated to prevent insider trading and market manipulation.

**3. Segregation of Duties between the Front Offices and Back Offices**

The front offices should not take the duties of the back offices such as settlement and accounting. On the other hand, the back offices such as the department of settlement should not do trading with customers.

**4. The Vertical Management of Branches**

In China, securities companies generally own the 10 or more branches distributed in a broad range of the country. Every branch has its own staff and departments for business, finance and information & technology to support its operations. To prevent the failure of internal control, these three kinds of staff must be directly under the control of headquarters. The employment, assessment, salary and routine management of the staff must be determined independently by the three corresponding departments in the headquarters. Regular rotation, mandatory vocation and audit should be enforced. This organization arrangement is the base of the following reporting tool.

**Operational Risk Management Framework—Operation****1. Accounts**

- (a) To ensure the reality and integrity of the information of customers' accounts.
- (b) To establish the one to one relationship between security account, capital



account and bank account to prevent the embezzlement of the customers' funds,

- (c) To set up the backup documents of the important customers at the headquarters instead of only leaving them in the branches.

## 2. Clearing, Settlement and Custody

- (a) To ensure the clearing and settlement departments are independent to trade units; to check up the clearing & settlement results with trading recordings.
- (b) To deposit more than 70 percent customers' funds in the headquarters instead of branches to prevent the embezzlement by the branches,
- (c) To set up a detailed record of bonds' ownership to prevent the repurchasing without customers' authorization.

## 3. Accounting

- (a) To make sure that the accounting is standardized and timely.
- (b) To check the customers' asset records with different sources every day.
- (c) To check the accounts with banks to against unilateralism record.

## 4. Trading

- (a) To make sure a completed procedure of the key business such as the opening of securities investment accounts and depositing,
- (b) To separate the conflicting authorization in the trading system; to make sure there is an approval process for special authorities.
- (c) To make sure that the change or upgrade of the trading system or system parameters are set up by headquarters.

## Operational Risk Management Framework—Monitoring

The internal supervision organizations of a securities company should include the board of supervisors, the risk management committee under the board, the risk management department, the audit regulation department, the legal department and so on. We have also set up a Real-time Monitoring and Early-warning System (RMES) to monitor the large amounts or suspicious monetary or securities transactions and give proper warning. It is an important means to check the operation and misappropriation of customers' assets.

### 1. Data Sources Needed in the RMES

- (a) Trading System
- (b) Accounting System
- (c) Banking System
- (d) Clearing & Settlement System

The purpose of acquiring the data from different sources is to maintain a system of checks and balances. In addition, a series of monitoring indicators from these sources can detect the abnormal behaviors to determine suspicious operations.

### 2. Tools in RMES:

- (a) Real-time Monitoring and Early Warning  
To monitor each securities transaction and the deposit of funds; to compare them with a pre-determined threshold value; to give early warning information;
- (b) Account Management  
To check the legitimacy and completeness of customers' accounts; to check one-to-one relationship between the customer security account, capital account, and bank account; to check whether the trading fee is abnormal;

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**Operational Risk Management ...**

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**(c) Special Operations Watching**

To check whether there are special business operations and abnormal behaviors, such as overdraft, record correcting, manual deposit of securities and abnormal bank stock transferring.

**(d) Bond Repurchase Check**

To check whether there is any bond repurchase without customers' authorization.

**(e) Fund Balance Check**

To check in the trading system, the financial system, the settlement system and the banking system whether the funds' records meets the balance equation.

**(f) Inquiries Function**

To meet the demand of inquiries of customer information, transaction history and other information on bank accounts.

**Operational Risk Management framework—Reporting**

Each business line in a securities company has its own reporting systems. To further guard against risk in particular in cases where branches are out of rule, we have designed a reporting tool to strengthen internal control in the branches. We try to prevent the misappropriation of customer assets with this tool. This reporting tool includes what to report, who should report and reporting process.

**1. What to Report**

The contents of the report are set by the department of risk management in the headquarters of the securities company. The contents of the report are mainly the abnormal operations, such as the withdrawal of too large an amount of funds or other adjustments;

**2. Who Should Report**

The manager and staff from the departments of business, finance, information and technology in the branches should all sign the report to confirm the accuracy and integrity of the contents of the report.

**3. Reporting Process**

Daily, branches should report business status of the previous day. Staff in the department of risk management should check the accuracy and completeness using the RMES. For abnormal conditions, they should follow a tracking and follow-up process.

Due to the vertical management of these organizations mentioned above, staff can be mutually supervised. The reporting tool will help to reinforce the internal control, and to improve the operation of the staff (any operational or procedural error must be reflected in the report and seen by the manager related). In this way, the operational risk of the branches can be reduced.

**Conclusion**

In this article, we present a framework for China's local securities companies to improve their operational risk management, which includes organization, operation, monitoring and reporting. We have also developed a series of tools in monitoring and reporting that support this. It may be a source of reference to formulate system and process standards and can be adjusted according to actual situations for all securities companies to establish their own operational risk management systems. Some parts of our framework and tools are adopted by the supervision institution used to judge whether a securities company can be classified as an innovation category or other one. It has also been implemented and has proven to be effective in CITIC Securities Co. Ltd., the only securities company listed in China up to now. ♦

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Your help and participation is needed and welcomed. All articles will include a byline to give you full credit for your effort. If you would like to submit an article, please contact Valentina Isakina, editor, at [valentina\\_isakina@mckinsey.com](mailto:valentina_isakina@mckinsey.com) or Steve Craighead, co-editor, at [steven.craighead@towersperrin.com](mailto:steven.craighead@towersperrin.com).

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In order to efficiently handle articles, please use the following format when submitting articles:

Please e-mail your articles as attachments in either MS Word (.doc) or Simple Text (.txt) files. We are able to convert most PC-compatible software packages. Headlines are typed upper and lower case. Please use a 10-point Times New Roman font for the body text. Carriage returns are put in only at the end of paragraphs. The right-hand margin is not justified.

If you must submit articles in another manner, please call Kathryn Wiener, (847) 706-3501, at the Society of Actuaries for help.

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