RiskValueInsights™
Creating Value Through Enterprise Risk Management — A Practical Approach for the Insurance Industry
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Part One

Laying the Groundwork for Strategic Enterprise Risk Management in the Insurance Industry: From Need, to Framework, to Process

We set the stage in the first four chapters by:

- Presenting an overview of the monograph and our objective in writing it (Chapter I)
- Laying out the business case for enterprise risk management in the insurance industry (Chapter II)
- Introducing RiskValueInsights™, our approach to enterprise risk management specifically designed for the insurance industry:
  — the conceptual framework (Chapter III)
  — the process (Chapter IV).

In Part Two (beginning with Chapter V), we focus on the strategy development stage of the RiskValueInsights™ process. We then provide suggestions on how to move forward in manageable increments.
I. Overview and Objective

In the face of well-publicized industry calamities, increasing pressure from regulators, rating agencies and investors — and, perhaps most importantly, for fundamental business reasons — insurance company executives are embracing the concept of enterprise risk management (ERM) in increasing numbers. ERM is generally defined as assessing and addressing risks, from all sources, that represent either material threats to business objectives or opportunities to exploit for competitive advantage.

Yet, while they embrace the general concept, insurance executives also report both dissatisfaction and frustration with actually implementing ERM. They don’t believe they have a coherent conceptual framework to guide their thinking about ERM. They are dissatisfied with the tools they believe are currently available to them to manage risk at the enterprise level. They are particularly dissatisfied with the tools to manage operational, as opposed to financial, risks. And they are not entirely clear about how to incorporate enterprise-wide risk management into their larger strategic decision-making and overarching goal for their enterprises: to create value.

To address the needs of insurance senior managers for an ERM process that is specific to the insurance industry and that explicitly links ERM to strategic planning, we have developed a new approach to ERM. We call it RiskValueInsights™. It is intended to improve insurers’ ability to create value. It does so by employing a formal process that allows senior managers to find the optimal relationship between risk and value for their enterprise, based on the risk and value preferences of those managers, which are unique to each company. RiskValueInsights™ can help senior managers achieve that goal because it:

- incorporates all material risks — financial and operational
- evaluates all relevant strategies — financial and operational
- considers all pertinent constraints (including political/social, regulatory and competitive)
- exploits the natural hedges and portfolio effects among the risks, and the financial and operational efficiencies among the strategies.

The result of applying this process is the optimal set of strategies from the perspective of both the policyholder and the owner — strategies that balance the need for capital and the need for return, growth and consistency.

ERM is multifaceted and may appear daunting to some. Indeed, we consider our RiskValueInsights™ approach as the “ideal” to strive for, gradually. We therefore conclude our monograph with ideas on pragmatic ways to implement ERM in a manageable, stepwise fashion, using the “building blocks” of RiskValueInsights™.

Because the dynamics between risk and value are quite different — and arguably more complex — for insurers than for any other financial services sector, traditional financial industry models are inadequate to produce optimal results consistently. Our approach is grounded in the realities of the insurance industry, and blends industry-specific models and methods.

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1 See Appendix A, “A Brief Recent History of the Risk of Not Managing Risks Holistically.”
4 One of the central goals of ERM is consistent financial performance. While some in the industry accept the fundamental value of consistency, others argue that investors do not favorably value companies that expend time and resources attempting to minimize volatility in their results. This volatility, the argument goes, can more efficiently be diversified away within the investor’s own portfolio. Our empirical research indicates that, holding constant other key drivers of share value (such as earnings growth and return on capital), investors do indeed assign considerable value to consistency, and earnings consistency in particular. See Appendix C, “The Value of Consistency,” for a full discussion of this point.
with tailored techniques from other industries to address the industry’s key risk management problems.

We have attempted to include all sectors of the insurance industry (life, health, property/casualty and investment management) and have highlighted issues of specific relevance to individual sectors where appropriate.

We prepared this monograph in direct response to insurance executives’ declared desire for a unifying ERM framework specific to their industry. We address the concerns they expressed regarding their lack of tools, processes and time. In the following chapters we describe an approach to ERM that is:

- conceptually straightforward
- based on sound science as well as practical realities
- implemented in manageable steps.

Specifically, the monograph will help insurance executives respond in a coherent way to strategic, financial and operational questions such as:

- How can we identify the key or emerging risks that deserve senior management attention? (Chapter V)
- How do we measure and manage our operational risks with the same level of sophistication as we do for financial risks? (Chapter V)
- How do we relate risk management activities to the business’s bottom line? (Chapter VI)
- How much capital do we need? And how do we convince the rating agencies? (Chapter VII)
- How should we evaluate business segment performance, given the differing levels of risk each segment contributes to the enterprise? (Chapter VII)
- How do we select our growth strategies, given our risk environment? (Chapter VIII)
- How can we maximize our return on capital, given our risk appetite? (Chapter VIII)
- How do we best invest our assets, given the structure of our liabilities? (Chapter VIII)
- How much, and on what terms, should we reinsure/hedge? (Chapter VIII)
- What must be done to implement a sound, comprehensive risk management framework and process throughout the organization? (Chapters IV, IX, X)
- How can we continually evaluate our risk management program? (Chapters IV, IX, X)
- How should we communicate our risk management programs to outside audiences? (Chapter IV)
- How does all this relate to value creation? (Chapter III)
- How do we get to full ERM in manageable steps? (Chapter XI)

RiskValueInsights™ recognizes that the answers to these questions are fundamentally related. In the pages that follow, we outline how to exploit these fundamental relationships to unlock value.

We intend to continually update and enhance this monograph. We are sincerely interested in, and invite you to share with us, your comments and suggestions.
II. The Case for an Insurance Industry-Specific Approach to Enterprise Risk Management

A. The Promise of ERM for the Insurance Industry

There are very sound business reasons that insurance companies and other financial services organizations have begun to embrace ERM.

These organizations believe ERM can help increase the value of their companies. This belief is founded upon ERM’s potential to:

- avoid “land mines” and other surprises
- improve the stability and quality of earnings
- enhance growth and return by more knowledgeably exploiting risk opportunities and managing/allocating capital
- identify specific opportunities such as natural synergies and risk arbitrage
- reassure their many stakeholders that the business is well managed — stakeholders that include investors, analysts, rating agencies, regulators and the press.

The confidence of another group of stakeholders — depositors and policyholders — represents a very important asset to banks and insurance companies. Protecting the interests of these parties, properly recognizing the risks they present and balancing their interests against those of the owners of the enterprise are distinct motivating factors for financial services companies to adopt the rigor of ERM.

Also, financial services companies have a distinct competitive reason to get ERM right. Organizations in all industries are looking to the financial services industry, particularly insurance companies, to help them meet their own ERM challenges. Whether the need is sophisticated risk assessment, risk modeling, risk mitigation or risk financing, the financial services industry is assumed to be ahead of the game. A financial institution that can demonstrate that it has, in fact, mastered ERM internally will make itself more credible in the marketplace and, as a result, more likely to attract and retain increasingly sophisticated customers.

Moreover, the insurance industry is now experiencing strategic and operational problems that lend themselves to ERM solutions. Insurers today face decreasing margins, increasing competition from unconventional sources, more demanding stakeholders and — for many lines — too much capital pursuing too little business. The industry is also in the midst of fundamental changes in technology, distribution systems and customer expectations that create new risks and challenge high performance. Convergence of the banking and insurance sectors brings additional uncertainties and greater levels of scrutiny.

In this more complex environment, insurers need to wring maximum value from the business by making sound decisions about:

- products/markets
- distribution
- investments/assets
- operations
- human resources
- capital
- hedging/reinsurance.

*Based on our client experiences, discussions with industry executives, and specific results of our insurance industry ERM surveys and interviews cited later in this chapter.

*An empirical study exploring the explicit linkage between stability of earnings and enterprise value is summarized in Appendix C, “The Value of Consistency.”
Although these decisions — and their attendant risks — are usually treated by managers as separate and distinct, they are, in fact, an interrelated mix of financial and operational judgments. A classic example of this for industrial companies generally is: foreign exchange fluctuation (a financial risk) is mitigated by buying source goods and services closer to the point of sale of one’s own products and services (an operational strategy), reducing the need for currency hedging (a financial strategy). While this particular example may be of only limited use to many insurance companies, consider the following insurance-specific interplay of strategies/risks:

- Moving from high front-end commissions to higher renewal commissions brings agents’ interests and policyholders’ interests into closer alignment and mitigates the risk of market conduct problems.
- Involving asset managers in product development decisions reduces asset-liability mismatch risk.
- Selling products over the Internet may require simplified product features, options and pricing. This should improve administrative efficiency, increase product transparency and reduce the risk of product misrepresentation. However, there may be loss of brand awareness as customers price shop. Also, claim costs may increase if there is less opportunity to gather and verify applicant data for risk rating.

The promise of ERM for insurers is that it can help them integrate the evaluation of these financial and operational decisions by demonstrating their impact on both financial and operational risks. Moreover, the promise of ERM is that this integrated evaluation can actually change, and improve, business decisions.

**Figure 1**: Respondents believe that ERM will help them address their top business issues, shown above in order of importance (Source: Enterprise Risk Management in the Insurance Industry: 2000 Benchmarking Survey Report, cited among the references on pages 88 and 89).

Clearly, insurance industry senior managers hope that ERM will live up to its promise. We saw that in a worldwide survey of industry Chief Financial Officers, Chief Actuaries and Chief Risk Officers conducted in 2000 by Tillinghast – Towers Perrin. (Enterprise Risk Management in the Insurance Industry: 2000 Benchmarking Survey Report, our full report on the results of the survey and related interviews, is listed among the references on pages 88 and 89.)
Among the key findings of the survey was that these industry executives believe ERM will help them address their key business issues. Eighty percent of respondents feel that ERM will help with earnings growth, which they identified as their number one business issue. Ninety-seven percent believe that ERM will help improve return on capital, their number three business issue. Almost half (47%) believe that ERM will even help with top-line revenue growth, their number two issue. The majority of respondents, and in some cases 100% of them, feel that ERM will help with each of the remaining business issues on their top 10 list (see Figure 1).

B. The Doubts That Industry Leaders Have About the Current State of ERM in Insurance

While insurance senior managers see the potential value of using ERM strategically to help them build value, they also report significant frustration and dissatisfaction with the current state of ERM in the industry today. In particular, insurance executives cite several barriers in their path to an industry-specific ERM. In our benchmarking survey, the barriers most often cited were, in descending order across all respondents: tools, organizational turf, processes and time (see Figure 2).

The concern about tools was especially clear for those tools intended to assess, measure, mitigate and finance operational risks. Across all categories of operational risk (including, for example, reputation/rating, distribution channel and people/intellectual capital), only 55% of respondents, on average, said they were satisfied with these tools; for financial risks (including interest rate, credit and currency) the average was 70% (see Figure 3).

With respect to risk management processes, survey respondents were most dissatisfied with their current ability to:

- include operational risk in the determination of economic capital
- stochastically model the important operational and financial risks
- prioritize risks from disparate sources using a common metric
- optimize financial and operational risk management strategies in light of the organization’s risk/return requirements
- accurately model the impact of risks and strategies on financial results.
Figure 3: Respondents believe that ERM will help them address their top business issues (Source: Enterprise Risk Management in the Insurance Industry: 2000 Benchmarking Survey Report, cited among the references on pages 88 and 89).
Finally, they were not convinced that they had a coherent framework to guide their risk management activities — and they felt they needed one.

C. Temptation: Borrow From Banking

Given the dissatisfaction with the current state of ERM in the insurance sector — particularly for managing operational risks — it’s not surprising that some managers believe they can speed the implementation of ERM in this industry by simply borrowing and “tweaking” concepts and tools from the banking sector. The temptation may be particularly strong because it looks like the banking sector has made significant progress organizationally with the creation of the senior-level Chief Risk Officer function. But, while this approach has fostered consistency of measurement and oversight of financial risks, the treatment of operational risks in banking remains largely qualitative and ad hoc.7 (See the discussion of Modeling Operational Risks in Chapter V.)

That’s one of the reasons we believe it would be a mistake to try to simply adopt the methodologies and measures prevalent in banking to the insurance industry. More fundamentally, the operations of these sectors, and their attendant risks, differ in important ways, and for the insurance industry these risks are, arguably, more complex. These fundamental differences are explored in Section III.C.

The ERM framework for insurers must recognize the unique nature of insurance operations — this is particularly important in this era of industry convergence. Bank assurance groups, for example, must be careful not to simplistically apply to insurance businesses the tools and techniques that were developed to manage banking businesses.

D. RiskValueInsights™: The Strategic Enterprise Risk Management Approach for the Insurance Industry

It is abundantly clear, then, that the insurance industry wants and needs its own approach to ERM. We believe RiskValueInsights™ meets that need. Our approach, detailed in the chapters that follow, directly addresses the desire of insurance executives for a unifying framework, as well as their concerns regarding tools, processes and time.

7 Though the New Basel Capital Accord attempts to impose some conformity.
III. RiskValueInsights™: Beginning With the Right ERM Conceptual Framework

RiskValueInsights™ takes as its foundation a conceptual definition and framework for ERM that is specific to the insurance industry. Our definition is grounded in the fact that insurers’ core business is creating value by assuming risk.

A. Definition of ERM for Insurers

We define ERM for insurers as the optimization of the dynamic relationship between risk and value throughout the insurance enterprise.

It comprises: the development, implementation and monitoring of financial and operational strategies for assessing, mitigating, financing and exploiting financial and operational risk for the purpose of increasing enterprise value.

In this definition, **financial risks** refer to asset and liability risks (e.g., investment, currency, inflation, underwriting); **operational risks** comprise business and event risks (e.g., technology failure, natural catastrophes and new competition). **Financial strategies** refer, for example, to capital structure, asset allocation, product mix, reinsurance and financial hedg-
ing; operational strategies include internal controls, hiring/training/incentive plans, distribution systems, culture change and process engineering.

This definition informs both the RiskValueInsights™ framework — a way to think about ERM for insurers — and the process — how to accomplish it.

B. RiskValueInsights™: Creating a Framework to Increase Enterprise Value

Managers of an insurance enterprise need to be concerned with myriad separate but related activities, ranging from product and distribution, to investments, to financing, to organizational issues. The overall objective of these activities is to increase the value of the enterprise.

The best way for insurance managers to achieve this objective is to:

- **Understand** the full external and internal environments within which they operate. These environments create the financial and operational risks unique to each enterprise (see Figure 4).

- **Investigate** the complete set of financial and operational strategies available, any of which may be applicable to both financial and operational risks (see Figure 5).

- **Apply** this knowledge in a holistic risk management framework, exploiting financial and operational efficiencies among the strategies, and portfolio effects and natural hedges among the risks.

- **Increase** value by:
  - providing an appropriate level, structure and attribution of capital — which optimizes capital use and establishes the proper business performance measurement framework
  - enhancing growth opportunities — by identifying the growth strategies that best exploit the organization’s risk condition and appetite
  - increasing return on capital — by rigorously analyzing and selecting strategies that optimize the risk/return profile for the overall enterprise
  - improving the consistency of results — by identifying the primary sources of performance volatility, and pursuing strategies, including risk pooling and natural hedges, that address them (see Figure 6).

Figuratively speaking, insurance managers attempt to build a sturdy edifice in a very hazardous climate. The risk environment is the climate they must operate within. The value edifice is built on a foundation of capital and is
supported by the three pillars of growth, return and consistency. The relationship between risk and value is complex and dynamic. RiskValueInsights™ is the approach by which managers optimize this relationship (see Figure 7).

C. What’s Different About This?
ERM versus Traditional Risk Management. ERM, as we have defined it within RiskValueInsights™, embraces financial and operational risks and financial and operational strategies. The goal is to manage both types of strategies and risks within a coherent framework that recognizes and exploits their rich interplay. This goes beyond traditional industry approaches — such as dynamic financial analysis (DFA), asset/liability management (ALM), risk and capital management (RCM), dynamic capital adequacy testing (DCAT) and dynamic solvency testing (DST) — that tend to focus exclusively on financial strategies to manage financial risks (see Figure 8). Moreover, RiskValueInsights™ provides the logical integration of risk management activities, such as risk assessment, financial risk modeling, operational risk modeling, capital management, asset/liability management and reinsurance/hedging strategy.

ERM for Insurers versus Other Financial Institutions. ERM for insurers and for other institutions...
financial services companies have some similarities — but also some fundamental differences. The major differences between insurance and banking from a risk management perspective are:

- Insurance liabilities are not known with certainty. They are evolving estimates of payments to claimants and can thus display significant volatility. In addition, these liabilities are subject to claims being contested (often involving litigation) and the impact of public policy (governmental or court activism) that significantly increase their variability. Bank liabilities, primarily deposits, generally are known with certainty.

- Insurance liabilities cannot be traded easily or efficiently in open markets. They are comparatively illiquid and cannot be easily “marked to market.” In banking, it is assets that cannot easily be marked to market, while liabilities, especially money market instruments, are traded in highly efficient markets and are therefore easily marked to market.

- Insurance liabilities can have long remaining term to maturity and duration.

- Insurance company balance sheets, especially in the property/casualty industry, can include significant amounts of assets and liabilities that are related to contracts that have expired. For banking products, in general, assets and liabilities are extinguished when contracts expire.

- Insurance companies are much less exposed to liquidity risk than are banks, because their liabilities are not payable on demand. This difference explains why a run on a bank can cause failure in a matter of hours, while it takes months or longer for policy lapses to force an insurance company to reorganize or cause it to fail.

- Insurers and banks have different views of operational risks:
  - Insurance companies have not been subjected to as much regulatory pressure as banks in connection with the avoidance or mitigation of operational risks because, unlike banks, they cannot cause directly a malfunction of the national or international payment and settlement systems. Banks, as a result, are primarily concerned with event risks, such as technology failures.
  - Insurance companies are concerned about business risks, especially reputation risks, such as those resulting from their relative lack of control over people selling their products (e.g., independent insurance agents).

- Insurance risk, resulting from underwriting activities, is primarily associated with insurance liabilities. Credit risk, one of the main risks that banks have, is related to their assets. So, insurance companies expend much energy managing liability risk, and banks expend much energy managing asset risk.

- Insurance products have high acquisition costs resulting in long break-even periods, but savings products are generally profitable from day one.

- In insurance, there has been little uncoupling so far between the generation of assets and liabilities — they both originate from the same contracts. This makes it more difficult for insurance companies to understand and manage the performance impact of linkages between assets and liabilities (the sharp distinction between deposit taking and lending activities and their uncoupling makes this task easier in most banks).

RiskValueInsights™ explicitly recognizes the unique nature of insurance operations.
A conceptual framework, however sound, is meaningful only if it can help improve the management of the enterprise. In this chapter, we outline a systematic process that helps management make well-informed decisions in key strategic areas and thus “operationalizes” the RiskValueInsights™ framework. The process involves the development, implementation and monitoring of strategies, executed in a continual loop (see Figure 9).

We provide an overview of each of these three stages in this chapter. In the five chapters that follow (V through IX), we will focus on the details underlying the strategy development stage. In each of those chapters we outline each of the five steps in the strategy development process that represent the “ideal” to be striven for. Although it would be the rare company that could immediately jump to this ideal process for developing strategy, clearly defining and communicating the ultimate goal is helpful in constructing a transition path toward the ideal. However, even for some very progressive companies, the path has been blocked with the baggage of legacy information technology, “silo based” organizational structure and lack of tools. In Chapter XI, therefore, we propose how companies could move incrementally toward this ideal process in manageable steps.

A. The Process Begins With Strategy Development

Strategy development is the critical first stage — investing in a rigorous effort at this point will pay dividends by making the subsequent stages, and the entire process, more disciplined and effective. In this monograph, strategy development refers to the process of making annual decisions with respect to issues such as distribution channel, capital deployment, investments and technology. It does not refer to long-term business planning decisions related, for example, to business model (e.g., manufacturing versus distribution) and branding. The goal of strategy development in this context is to optimize management’s response to the following types of questions:

- What should our product mix be?
- What channels should we distribute the products through, and to which markets?
- What set of agency ratings should the company target? And how do we most efficiently achieve our target rating(s)?
- How much capital should we hold and how should we attribute it to each product/business line to properly gauge performance?
- How much and on what terms should we reinsure/hedge?
- How should we invest our assets?
- How much should we invest in technology, and which technologies?
How should resources be assigned to sales versus service, and how should they be deployed across products and regions?

How much should we spend on recruiting, training and retention?

These questions should be answered with the objective of maximizing economic value over the long term while minimizing the risks of large deviations from expected performance. While each management team for each enterprise may have different preferences for maximizing value versus averting risk and while the circumstances under which each must develop its strategy will also differ, the process for answering these questions is the same regardless of the risk-value preferences. The strategy development stage consists of five steps (see Figure 10).

1. Assess the current internal and external risk environments. This includes assessment of both financial and operational risks, using both qualitative and quantitative methods.

2. Articulate alternative financial and operational strategies for maximizing value within the current risk environment. In addition, create a stochastic financial model of the business to express the interaction of the financial and operational risks and strategies in terms of the organization’s bottom-line financials.

3. Evaluate strategies using the stochastic financial model in this step and the next by considering both policyholders’ concerns and owners’ interests, respectively. Specifically, in this step policyholders’ concerns about solvency are reflected in the determination of capital requirements.

4. Consider owners’ interests by analyzing a combination of financial metrics focused on the drivers of value: growth, return and consistency. Strategies will differ in their impact on each of these drivers. This step will require optimizing the trade-offs among the value drivers based on management’s objectives and constraints.

5. In practice, the process is typically not as straightforward as depicted. Decomposition of the results of steps 3 and 4 will likely suggest ways to fine-tune the strategies through minor modifications. However, these refined strategies must go through the evaluation process with respect to policyholder’s concerns and owners’ interests by repeating these two steps. We have formalized this decomposition analysis and described it as a final, optimization step of the strategy development process.

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**FIGURE 10**
The RiskValueInsights™ strategy development stage has five steps.
Before discussing each of these steps in the five chapters that follow, it is useful to consider what must happen once management has agreed on a set of financial and operational strategies. The remaining two sections of this chapter present an overview of the strategy implementation and ongoing monitoring stages.

**B. The Second Major Stage Is Strategy Implementation**

The optimal set of strategies for a particular organization will be drawn from a mix of possible strategies, from the straightforward and quickly implemented to the complex and multi-year. These latter strategies often involve substantial people-oriented activities that may require broad-scale behavior modification.

A financial strategy such as changing the organization’s outward reinsurance program is an example of straightforward activity, and is relatively easy to implement. In fact, all that’s required is to obtain the necessary senior management approval of the program design, pricing and counterparties, and to secure coverage.

Much of the groundwork for these activities will have been laid in the strategy development stage. A reinsurance program change does not require broad-based buy-in of the organization as a whole.

At the other extreme, an operational strategy such as adopting the Internet as a primary distribution channel, or deciding to compete exclusively on the basis of customer service, requires substantial change of behavior among a significant number of employees. At a minimum, extensive training/retraining of affected staff and redesign of employee incentive plans are required.

For all but the most straightforward strategies, implementation should follow a well-planned change management process (see Figure 11). Of course, the level of necessary detail within this process will vary depending upon the strategy. (See Appendix F, “An Overview of Change Management,” for more on this topic.)

**C. The Third Major Stage Is Monitoring Strategy Performance and Risk Environment**

Once the financial and operational strategies have been implemented, their performance must be monitored to make sure they are achieving their goals. Similarly, the risk environment must be continually monitored to make certain that key assumptions have not changed. These assumptions include financial and operational variables such as interest rates, productivity, sales, claims, persistency, employee turnover and investment return. Significant deviation
from assumptions could undermine the rationale for the chosen set of strategies and jeopardize financial performance.

The specific operational and financial measures that are captured in the monitoring process will vary, depending on the selected strategy and its objectives. (Examples of measures are shown in Figure 12.) However, some common guiding principles are:

- include both leading indicators and outcomes
- include actual levels, expected or “planned” levels, and benchmarks for each measure
- include measures pertaining to all stakeholders — customers, shareholders, distributors, employees and vendors
- organize measures to clarify “line of sight” or value chain
- limit number of measures to enable management focus
match frequency of reporting (e.g., daily, monthly, quarterly) to the volatility and importance of the measure.

The selected measures can be presented in a visual “risk dashboard” that clearly identifies unacceptable deviations from expectations (see Figure 13).

Significant deviations from performance require a quick reassessment of, and possible revisions to, the strategy. The dashboard can be used to determine the root cause(s) of the deviation. These can be classified into three categories:

- error in assumptions
- change in the risk environment
- poor execution of strategy.

The first two require either repeating the strategy development process or fine-tuning a limited number of “substrategies” by reflecting the new information. Typically, the weakest link in the process is executing strategy. Mitigating poor execution can also involve redevelopment of the strategy in cases where the strategy development did not reflect deep-seated cultural constraints that may be difficult to overcome. Indeed, strategy development should properly reflect implementation constraints. And often it involves a greater focus on change management efforts.
Because strategy development is both the most critical and the most complex stage in the RiskValueInsights™ process, we devote the next five chapters to a full discussion of each step in strategy development:

- Assess Risks (Chapter V)
- Articulate Strategies (Chapter VI)
- Evaluate Strategies Based on Policyholders’ Interests (Chapter VII)
- Evaluate Strategies Based on Owners’ Interests (Chapter VIII)
- Refine Strategies (Chapter IX).

The five-step process is recapped in Chapter X.

In Chapter XI, we provide suggestions on how to proceed incrementally in introducing strategic enterprise risk management into an organization, using the concepts and tools of the RiskValueInsights™ process.
The strategy development process begins with risk assessment, the first step. Risk assessment can easily bog down the process because there are literally hundreds of risks that an organization faces depending on how they are defined and classified. It’s vital that the risk assessment focus only on risks that can have a material impact on financial performance and strategy development. Thus, before embarking on an enterprise-wide risk assessment process, it is important to understand management’s objectives, broadly stated, and the financial and operational performance metrics that are used to evaluate the performance of the business.

A. Risk Assessment Begins With Risk Identification

Given this context, managers begin the risk assessment step by identifying risks from all sources, both financial and operational, that can prevent an organization from meeting its objectives or represent a distinct potential opportunity for competitive advantage. Examples of financial risks include credit, interest rate, currency, underwriting, investment and reinvestment risks. Operational risks include risks that fall into broad categories such as people, technology, distribution, and political and regulatory risks.

Materiality is generally determined qualitatively at this stage, based on company experts’ views of the potential impact of each risk on key performance indicators (KPIs). KPIs might include financial measures such as market share and profitability, and externally focused measures such as public perception and customer satisfaction.
Risks that pass the materiality threshold should be described as fully as possible including, where appropriate:

- an identification of causal factors and consequences
- timing (e.g., short term versus long term, seasonal)
- correlation with other risks, including whether it could trigger or be triggered by other risks
- current risk mitigation strategy and its effectiveness to date
- either historical data on, or expert assessment of, its impact on relevant KPIs.

This process involves gathering historical data, reviewing documents and conducting interviews to gather information on business processes, organization, technology, people and culture. Thus, it provides valuable insight into how the business operates as well as its capacity and readiness for change.

There are several ways to document the output of the risk identification process. A simple method is to create tables where each row represents a unique risk and each column is used to organize information gathered for each risk (e.g., likelihood, predictability, severity of impact, quality of controls). The table may be used later to help prioritize risks.

An alternative method is to develop risk maps that graphically illustrate both the causes and consequences of each risk. For example, *Figure 14* illustrates a risk map of a computer virus infection.

The advantage of the graphical method of documentation over the tabular method is that it’s a more natural way to present the risk dynamics when it comes time to develop risk mitigation strategies. It’s clear from the map that risk mitigation strategies must block either the effect of causal factors or mitigate the consequences. The disadvantage of this method is that it requires more work. A combination of the two methods of documentation may be most appropriate (i.e., a table supported by risk maps for certain complicated risks that require a better understanding of the underlying dynamics). That is especially the case if the risk table is used to prioritize risks in the next phase of risk assessment.

*Figure 14*

A risk map of cause-effect relationships can be used to document the output of the risk identification process.
B. The Next Phase of Risk Assessment Is Risk Classification and Prioritization

The risk identification process will likely generate more information than management can digest unless it is properly organized. There may be 100+ risks identified across the organization. They will vary significantly in their scope and impact on the ability of the organization to meet its objectives. A practical approach to organizing the information is to classify the risks in a way that suggests how management should address them.

Classification

One useful classification method separates risks into strategic risks versus manageable risks. Strategic risks are those that can be addressed only through substantial expenditures and/or a change in strategic direction. Many financial risks fall into this category because of the substantial impact they pose. Strategic operational risks can arise, for example, when an organization enters unfamiliar business territory due to a major acquisition, a new competitor emerges or customers’ buying preferences change. As a group, they pose difficult decisions and complex trade-offs because of their interaction and relative impact on strategic objectives. For these reasons, strategic risks require a more thorough analysis than conducted thus far in the process — they need to be modeled and incorporated directly into strategy development. Modeling the portfolio of financial and operational risks is described later in this section on the first step in strategy development.

Manageable risks, on the other hand, are those that the organization can address with existing capabilities without substantial expenditures. These risks might include weak contingency planning in critical functions or employee dissatisfaction with opportunities for advancement. The proper response to manageable risks is to use existing organizational capabilities to mitigate them. They do not need to be modeled, nor do they directly influence strategy development.

Prioritization

Manageable risks should be prioritized and allocated to each managerial level in consideration of their priority and scope (i.e., the highest priority risks are reviewed by the board and senior management, the middle level by business unit management and the lowest level by line management). Where the line is drawn

---

**FIGURE 15**

A risk table can provide a relatively simple way to prioritize risks

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Quality of Controls</th>
<th>Composite Score (1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative government, legal and media actions</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>5</td>
</tr>
<tr>
<td>Uncompetitive administrative costs, including costs of personnel practices</td>
<td>H</td>
<td>L</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>Leadership inability to overcome cultural resistance to necessary changes</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>3</td>
</tr>
<tr>
<td>Competition from new entities with more efficient business models</td>
<td>M</td>
<td>H</td>
<td>L</td>
<td>4</td>
</tr>
<tr>
<td>Possibly incorrect IT strategy, architecture and direction</td>
<td>L</td>
<td>H</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>Poor positioning to compete by ourselves in the new e-business world</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>Poor strategic focus, direction and execution through our people</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>Poor market knowledge and research</td>
<td>L</td>
<td>L</td>
<td>M</td>
<td>2</td>
</tr>
</tbody>
</table>
between each level depends on the number of risks, the number of management levels and the capacity of management at each level to address risks. Some risks may be low priority but may require review at a high organizational level because of their wide scope. Regardless of how the risks are allocated, it’s important to prevent risks from slipping through the cracks. Just because a risk is not considered strategic does not mean that it should not be managed somewhere in the organization, else it may grow unattended to become a major risk.

In prioritizing manageable and strategic risks, once again, there is no need to bog down the process by developing sophisticated and precise scoring and ranking methods. After all, the objective is simply to organize risks into broad categories of importance for management review. What is important, however, is general agreement on the prioritization. The simplest way to accomplish this is to establish a cross-functional team that reviews the information documented in the prior risk identification step and assigns a score to each risk, on a scale of 0-5, for example (see Figure 15), using the table created as the output of the risk identification process. In order to establish a consistent scoring system, the team should be briefed on management objectives, financial and operational performance metrics, and the risk attributes that should be considered, e.g., likelihood, severity, timing, controllability and correlation.

Another prioritization method is illustrated in Figure 16, where each risk factor (“A” through “M”) is placed on a grid based on both the “depth of concern” throughout the organization (as measured by the frequency of its mention by knowledgeable internal interviewees) and the perceived degree of impact on identified business metrics. (Two such metrics are illustrated in the figure: a financial metric and a customer satisfaction metric.) In this example, the risk factors in the upper right-hand sector of the grid are given the highest priority.
Our final example of a classification/prioritization scheme is a “heat map,” shown in Figure 17. In this example, risk factors are first classified according to whether they represent external conditions or internal capabilities. Within each of these categories, risk factors are color-coded based on their priority (established via a process similar to that shown in Figure 16). Certain of these capabilities are needed to respond to certain of these conditions. Cases that represent an interaction of a high-priority (i.e., weak) capability and a high-priority condition are areas worthy of immediate senior management attention.

### C. Risk Modeling Follows Risk Classification and Prioritization

Once risks have been identified, classified and prioritized, the strategic risks need to be modeled. As discussed, strategic risks are those that require considerable investment and/or a significant change in strategic direction. Risk modeling means developing a probability distribution on outcomes that represents the uncertainty associated with a specific risk factor. A risk model of interest rates, for example, will generate a probability distribution of each point on the yield curve. Modeling the risk associated with the productivity of a distribution channel would generate, for instance, a probability distribution of sales volume associated with that channel.

<table>
<thead>
<tr>
<th>Organizational Capabilities</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A Gov’t, Legal, Media Action</td>
</tr>
<tr>
<td></td>
<td>B Inadequate Capital</td>
</tr>
<tr>
<td></td>
<td>C Administrative efficiency/nimbleness</td>
</tr>
<tr>
<td></td>
<td>D Leadership to overcome cultural resistance to change</td>
</tr>
<tr>
<td></td>
<td>E New, More Efficient Competition</td>
</tr>
<tr>
<td></td>
<td>F IT strategy, architecture/direction</td>
</tr>
<tr>
<td></td>
<td>G e-Business</td>
</tr>
<tr>
<td></td>
<td>H Strategic focus, direction/execution through our people</td>
</tr>
<tr>
<td></td>
<td>I Systematic customer needs satisfaction</td>
</tr>
<tr>
<td></td>
<td>J Business segmentation</td>
</tr>
<tr>
<td></td>
<td>K Medical expense control</td>
</tr>
<tr>
<td></td>
<td>L Membership and billing systems/processes</td>
</tr>
<tr>
<td></td>
<td>M Market knowledge and research</td>
</tr>
<tr>
<td></td>
<td>N Freedom of Choice/Open Access</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions</th>
<th>A Gov’t, Legal, Media Action</th>
</tr>
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<td></td>
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<td>K Medical expense control</td>
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<td></td>
<td>L Membership and billing systems/processes</td>
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<tr>
<td></td>
<td>M Market knowledge and research</td>
</tr>
<tr>
<td></td>
<td>N Freedom of Choice/Open Access</td>
</tr>
</tbody>
</table>

**FIGURE 17**

A “heat map” classification/prioritization scheme identifies areas in need of immediate senior management attention
There is a wide variety of risk modeling methods that can be applied to a specific risk. They can be thought of as lying on a continuum that is based on the extent to which they rely on historical data versus expert input (see Figure 18 and glossary in Appendix E). Along the continuum of sources of information, the methods listed on the left are ones that rely primarily on the availability of historical data. They include, for example, empirical distributions, parametric methods to fit theoretical probability density functions, regression, stochastic differential equations and extreme value theory. These methods have been used extensively by financial institutions to model financial risks (see box for discussion of modeling financial risks).

**FIGURE 18**

There is a continuum of methods for modeling risks. Each method has advantages/disadvantages over others, so it's important to select the best method based on facts and circumstances.
Financial risks are, for the most part, risks that are exogenous to the organization and beyond its direct control. These include: macroeconomic risks such as interest rates, exchange rates and asset performance, and insurable risks such as mortality and property/casualty claims. A combination of financial and operational strategies is used to protect against the adverse financial effects of these risks.

Since there usually are extensive historical data associated with financial risks, the methods listed on the left side of Figure 18 are most often used to model financial risks. Many financial institutions, particularly banks, build models of each financial risk separately, and then combine the risks using a statistical approach. For example, if the risks were interest rates, equity returns and liability volatility, financial institutions would strive to build statistical distributions representing each of the three risks — and then combine them by convoluting (mathematically combining) the distributions. This requires the specification of the form and parameters of each of the three distributions, and the nature of the linkages between them. If the probability distribution for each risk is part of a family of distributions with special mathematical characteristics (e.g., symmetric distribution with constant covariance structure), the aggregate distribution can be obtained analytically by doing the math (rather than simulation). Analytical representation of risks in this way has the benefit of ease of implementation and speed of calculation.

Einstein once said, “Solutions should be simple, but not too simple.” We believe that the analytical representation described above oversimplifies the reality. This doesn’t mean we don’t use distributions, but it does mean that we don’t think they can be combined as conveniently as some might suggest. That’s because reducing the interrelationship between two risks to a single number (i.e., their correlation) is much too restrictive to capture the nature of most risks in the real world. For example, consider the behavior of equity markets around the world. At most times the behavior of the stock markets in New York, London and

**FIGURE 19**
Global CAP:Link employs a cascade structure for modeling macroeconomic risks. The arrows indicate the direction of the causal relationship among the variables.
Now let us turn to the aspect of risk modeling most troubling to insurance industry managers: modeling operational risks. The general reliance on historical data to model financial risk has somewhat biased financial institutions to considering the same methods for modeling operational risk. However, operational risks are not like financial risks. For one reason, they vary significantly based on a company’s unique operational processes, technology, resources, culture and organization. Since most of these factors are dynamic, typically there are limited, representative historical data on which to base the modeling.

A structural model represents the interaction among risk variables explicitly using stochastic differential equations (SDEs) and other techniques rather than one number. For example, our Global CAP:Link scenario generator represents the interaction among financial risks as a cascade structure (see Figure 19). Each variable in the cascade is dependent on the variables “above” it. The SDE for each variable is stated as a function of the other variables to which it is related. The specific form of the equation and parameter values are calibrated to properly represent the relationship based on historical data representing many different economic environments. In Global CAP:Link, the correlation between variables is an emergent property, not a constant input parameter.

In addition, the structural approach is better in a multi-period context. A stochastic scenario generator like Global CAP:Link can generate internally consistent paths for interest rates, inflation, equity markets, currencies, etc., over multiple time horizons. Through the use of structured equations, appropriate levels of mean reversion, spread reversion, etc., can be induced. This is vastly superior to assuming these variables behave in some kind of a “random walk” over time.

Generating scenarios using a structural model eliminates constraints on risk modeling such as limitations on the form of probability distributions and constant correlation associated with statistical models. Thus it provides a much more reliable representation of the nature of financial risks and their interaction. As we will see, structural approaches also provide similar advantages in modeling operational risks.

Tokyo is only partially correlated. While they react to one another, they also react to local conditions. However, the level of correlation changes when one of the markets declines precipitously. In those scenarios the markets move down in virtual lockstep. This type of behavior (varying levels of correlation) can be captured more directly and easily by using a structural model to simulate scenarios rather than a statistical model.

Now let us turn to the aspect of risk modeling most troubling to insurance industry managers: modeling operational risks. The general reliance on historical data to model financial risk has somewhat biased financial institutions to considering the same methods for modeling operational risk. However, operational risks are not like financial risks. For one reason, they vary significantly based on a company’s unique operational processes, technology, resources, culture and organization. Since most of these factors are dynamic, typically there are limited, representative historical data on which to base the modeling.

The methods listed on the right in Figure 18 rely primarily on expert input, including for example, Delphi method, preference among bets or lotteries, and influence diagrams. These have been used successfully for several decades by decision and risk analysts to model operational risks in support of management decision-making in manufacturing, particularly in the oil and gas industry, and in the medical sector. The methods listed in the middle of the continuum rely on data, to the extent that it is available, and expert judgment to supplement the missing data. In these methods, expert judgment is used to develop the model logic indicating the interactions among key variables and to quantify cause-effect relationships based on experience and ancillary or sparse data. Methods such as system dynamics simulation, Bayesian belief networks and fuzzy logic in particular are ideally suited for quantifying operational risks. These methods offer the greatest potential for modeling operational risks for financial institutions (see box for discussion of modeling operational risks) until the industry matures in its gathering and maintenance of data for operational risks.
Unlike financial risks, operational risks arise due to factors that are, for the most part, internal to the organization. Efforts to date for modeling operational risks (primarily in the banking sector) have focused on extending the use of statistical (or "parametric") methods commonly used for modeling financial risks. Such attempts have been limited by the lack of historical data on operational risks. Some financial institutions, industry associations and others have reacted to this deficiency by beginning to compile databases of operational risks. However, operational risks differ from financial risks in several important ways that limit the use of statistical methods based on historical data.

1. Operational risks vary significantly based on how a company manages its internal operations. Thus the data needed to apply standard statistical approaches must be company specific. In fact, the data should also be representative of the current operations environment. To the extent that operations are dynamic due to changes in the business model, technology and processes, it will be difficult to gather sufficient representative data. Relying solely on industry-wide data could be seriously misleading.

2. Operational risks are managed through changes in processes, technology, people, organization and culture — not through hedging in the capital markets. Managers need a risk modeling approach that can provide them information on how the operational risk would change if they were to implement alternative operational decisions. For example, by how much is technology risk reduced by implementing redundancy in the technology infrastructure? Again, it’s highly unlikely that the historical data will be segmented by alternative operational decisions such that a distribution fitting approach will answer these questions.

3. Operational risks can be loosely classified into event risks and business risks. Event risks refer to isolated occurrences that generate losses (e.g., technology failure, fraud, mis-selling). Business risks are those created by business decisions (e.g., changes in distribution strategy, launching a new product). Although it may be possible to gather historical data on losses due to event risks, finding data to assess the frequency and severity of losses stemming from business decisions seems unlikely.

These differences have implications on how operational risks should be modeled. Operational risk modeling methods must be flexible and robust enough to fill in data gaps, presumably by tapping the knowledge of experienced operations managers who are “closest” to specific risks. As with financial risks, we believe that structural (i.e., causal) models of operational risk are more robust than statistical models. Structural methods differ from statistical methods in that they simulate the dynamics of a specific system by developing cause-effect relationships between all the variables of that system. Figure 18 illustrates a continuum of methods for modeling risk. Of these, the methods in the middle of the continuum, such as system dynamics simulation, fuzzy logic and Bayesian belief networks (BBNs), are examples of causal methods that best suit the unique requirements of operational risk modeling.
Technology. The major steps in applying system dynamics simulation are as follows:

1. Rely on expert input from seasoned managers to develop a graphical system map of the cause-effect relationships among the key variables to represent the dynamics of a specific risk. Figure 14 is an example of a system map for the risk of the failure of information systems. A system map for the risk associated with the decision to use the Internet as a distribution channel to launch a new product, for example, would capture the impact of variables such as brand name, marketing and advertising expenditures, complexity of product features, use of a financial services portal, process cycle times, availability of online support, etc.

2. Quantify each cause-effect relationship using a combination of historical data and expert input. Again, expert input is used to fill data gaps and adjust for data that may not be representative. To the extent that expert input is uncertain, the cause-effect relationship is represented stochastically, i.e., the effect is represented as a probability distribution around a point estimate (see Figure 20).

3. Run simulations to develop a range of outcomes for key operational and financial variables. The output across the simulation runs is summarized as a probability distribution for financial variables. The probability distributions represent the operational risk given the current operating environment.

4. Perform “what-if” analysis by modifying decision variables representing changes in operations and rerunning the simulations. With little effort, an operational risk simulation model can be converted to a “business flight simulator” that allows managers to evaluate the impact of alternative decisions on operational risk (see Figure 21).

Bayesian belief networks are similar to system dynamics simulation. The network consists of:

- nodes representing decision variables, outputs and intermediate causal variables
- arcs which are directional arrows connecting nodes indicating the logical causal relationship
- node probabilities indicating the probabilities for each possible value at a node conditioned on the values of the nodes on which it logically depends.

As with system dynamics simulation, expert input is used to develop the logical relationship among nodes and to assess the node probabilities (using Bayes’ Rule) to the extent that data is not complete. Once the network is specified, the network is solved analytically to develop a probability distribution for each output node. BBNs thus are an “analytical cousin” to system dynamics simulation.
Advantages of Causal Models

In addition to avoiding the drawbacks of parametric methods, causal modeling methods offer several significant advantages:

- As businesses become more complex, knowledge of their underlying dynamics becomes fragmented and localized. Although many managers have a good understanding of their own functional areas, few have a solid grasp of the dynamics of the entire organization. Obtaining a complete picture of the sources of operational risks and how they may affect the business through intermediate cause-effect relationships requires the combined knowledge of managers across functional areas. The causal approaches facilitate interaction among managers through a structured, interactive and participative modeling and decision-making process.

- A causal approach helps focus data-gathering efforts. A model can be built quickly with expert testimony and readily available data. By performing sensitivity analysis on the assumptions underlying the model, one can identify the assumptions or relationships that contribute most to the results. This helps an organization deploy resources to gather specific data needed to tighten key assumptions. Such an approach is more cost effective than are unfocused, hasty efforts to build massive databases.

- Most importantly, operational risk models based on these principles will give managers a better understanding of the dynamics of their own functional areas and of the organization. The operational risk simulation models can be easily converted to “business flight simulators” that let users try out strategies or change assumptions and observe their effects. These gaming exercises, conducted individually or in group sessions, inevitably produce unexpected or counter-intuitive results. By observing individual cause-and-effect relationships, managers can more easily discover where prior assumptions were flawed. This learning can be applied to better decision-making, which in itself is a key objective of enterprise risk management.
Throughout the risk assessment process, those performing the analysis must pay careful attention to the correlation among risks. In the identification process, we noted that for each risk, the relationship to other risks should be identified. This process can be used to ferret out natural hedges. Natural hedges are two risks that have a negative correlation. For example, the risk of increasing cost of production could partially offset the risk of a new competitor entering the market by raising the competitor’s barrier to entry. In some cases, one risk has both positive and negative effects; for example, impact of interest rate risk can increase/decrease both liabilities and assets. Insurers and pension funds take advantage of this dynamic by modeling assets and liabilities together. In other cases, risks may be positively correlated. To the extent that risks are not 100% correlated, it is important to capture the diversification benefits to paint an accurate picture of total risk. One of the primary benefits of an enterprise-wide risk assessment is to reduce the cost of risk management by properly reflecting natural hedges and risk diversification. (See box on modeling financial risks for description of methods for modeling correlation.)

Having completed the Risk Assessment step, the logical next step is to determine how to mitigate them. At this stage, manageable risks have been addressed by the appropriate managerial levels using existing organizational capabilities. Strategic risks have been quantified using a combination of risk modeling methods that reflected the relative availability of data and expert input. So, at this point, we have a reasonably complete statement of the risk environment under which the business is operating. The next step is to develop strategies that will navigate the business through the risk environment to meet management objectives.
A. The Strategy Articulation Step Begins With Strategy Definition

Strategies are decisions regarding core business activities. For an insurer, such decisions include product mix, distribution channel, reinsurance, asset allocation, business processes, technology and incentive compensation. Strategies also include decisions about activities meant explicitly to transfer or hedge risks, such as foreign exchange trading to hedge currency risk.

For example, a high-level combination of financial and operational strategies could be:

- Change the product mix as follows:
  - Personal auto  X%
  - Home  X%
  - Personal liability  X%

- Allocate assets to the following classes in the proportions specified:
  - Universal life  X%
  - Annuity  X%
  - Term life  X%
  - Cash instruments  X%
  - Fixed income  X%
    - Short-term  X%
    - Mid-term  X%
    - Long-term  X%
  - Equity  X%
    - Domestic  X%
    - International  X%
    - Real estate  X%
Invest $X million in the Internet distribution channel for personal property/casualty product lines

Increase compliance resources by X%

Change the form of commissions and incentive compensation from X to Y

Increase incentive compensation pool by X%.

The above combination represents one set of strategies. The objective of the articulating strategies step in the strategy development process is to propose alternative financial and operational strategies and to develop a financial model used in later steps to evaluate these strategies.

Strategies are developed to maximize value in consideration of the risk environment. Value drivers such as earnings growth, return on capital and consistency of financial performance are often in conflict with one another. Some decisions may grow earnings at the expense of return on capital while others may increase return in the long term but create short-term instability. Thus, financial and operational strategies must be carefully coordinated to optimize the trade-offs and maximize overall value based on management objectives.

Coordination of financial and operational decisions requires input from a broad array of managers, each of whom may currently “own” one or more of the decisions. Complicating matters is the fact that operating managers may change strategies midterm if their results are not “on plan.” The idea of coordinating all strategic financial and operational decisions is likely to be new to most financial institutions. At best, only financial decisions, such as product mix, reinsurance and asset allocation are coordinated now. The interaction of the strategic risks highlighted in the risk assessment step should provide some justification for coordinating with other operational strategies related to distribution channel, technology and people, for example. However, the ability to coordinate strategy will depend primarily on leadership’s ability to convey the merits of an enterprise-wide approach to maximizing value/minimizing risk over more parochial, silo-based approaches.

B. After Defining Strategies, Develop a Financial Model to Express Their Impact on Key Performance Indicators

Having modeled strategic risks and articulated potential financial and operational strategies, the logical next step is to measure the impact of the strategies on the organization’s key performance indicators, given the risk environment. A stochastic financial model is constructed for this purpose. This model is designed to generate pro forma financial statements. It is constructed by breaking down each item on the financial statements into its operational and financial components. Each risk and strategy affects one or more of these components, which are then rolled up into the financial statement.

Risks affect elements of the financial statements or their constituent variables by making their value uncertain. These variables are replaced by the probability distributions for the corresponding risks that were developed in the risk assessment step. For example, the number of policies sold in a given period is a constituent variable in calculating revenue. Risk of competition makes the number of policies sold uncertain. Risk of competition can be modeled in the risk assessment step as a probability distribution on the number of policies sold. This distribution is used to represent the uncertainty associated with the number of policies sold in the financial model. In this manner, all strategic risks modeled in the risk assessment step, and their correlation, are reflected in the financial model — making this a stochastic financial model. The model is used to run simulations that generate alternative scenarios of financial performance. Therefore, the output of this stochastic financial model is a probability distribution on key financial metrics such as net income.

Capturing the impact of all financial and operational strategies as well as financial and
operational risks in one holistic financial model creates an extraordinarily powerful tool in the RiskValueInsights™ process of strategy development:

1. The model links disparate risk measures into a common metric. So far, each risk has been modeled using its own unit of measurement. For example, interest rates at various durations for interest rate risk, annual returns for asset risk, perhaps market share percentage for competitor risk, and local currency denomination for underwriting risk. These disparate measures must be combined into a common measure in order to measure the aggregate impact of all risks. By using one model, the aggregate impact of all financial and operational risks is expressed as a probability distribution on a financial metric like net income.

2. Similarly, the model expresses the impact of all financial and operational strategies in terms of common metrics like capital required, net income or any other metric that management uses to run the business.

3. The model can be used to measure the relative impact of each risk or each strategy. By successively turning “on” and “off” a risk variable in the model, it’s possible to decompose overall risk on net income, for example, into its constituents. Similarly, each strategy can be turned “on” and “off” to determine its relative impact on maximizing value and minimizing risk. Decomposing risk and value into its constituents provides helpful information in developing optimal strategies that balance risk and value (see Figure 22).

**FIGURE 22**
Risks and strategies are linked to key performance indicators through a stochastic pro forma financial model of the enterprise
Fortunately, financial institutions already use sophisticated stochastic financial models to develop pro forma financials. However, they generally only reflect some financial risks and some financial strategies. They need to be enhanced to reflect operational risks and operational strategies. Reflecting operational risks involves converting deterministic variables to stochastic variables by representing the variable as a probability distribution (as described above). Technically, the current models reflect operational strategies implicitly in the model assumptions. These strategies need to be made explicit in order to model the interaction of changes to operational strategies with financial strategies and risks. Enhancement of current models could face serious performance obstacles such as an increase in the number of simulations needed to develop stable distributions of outcomes. However, there has been a steady and impressive trend in computing power, which is expected to continue and may offset performance issues. Greater difficulties may arise because of the resources needed to revise and validate large sections of complex financial programs. Therefore, a plan of incremental enhancements to current models is advised to minimize model risk and to maintain credibility of the model.

C. Match the Model to the Appropriate Time Horizon

Time is an important consideration in this analysis. Strategy development is generally based on projecting financial performance three to five years into the future. Thus, the assessment and modeling of strategic risks must consider changes to the risk environment over the same period. The financial model must also generate probability distributions for financial metrics as a function of time — typically annually. However, given the long-term commitments inherent in the products sold by insurers, the performance of the financial products must be modeled over a much longer period.

D. Summing Up Steps One and Two of Strategy Development

Capturing the impact of all financial and operational strategies, as well as financial and operational risks, in one holistic financial model creates an extraordinarily powerful tool in the RiskValueInsights™ process of strategy development.

The first two steps in the strategy development process, assessing risk and articulating strategies, constitute the bulk of the analytical effort. The remaining steps will continually use the risk models and the stochastic financial model to evaluate strategies.
Strategies are evaluated in consideration of interests of both customers (i.e., policyholders, through their proxies, the regulators and rating agencies) and owners of the enterprise. Ultimately, policyholders are concerned with the solvency of the business, whereas owners are concerned with returns on their investment. This section is focused on the interests of policyholders while the next section shifts emphasis to owners.

Policyholders’ interests are reflected in the amount of capital the company holds against adverse performance. The greater the level of capital, the lower the risk of insolvency, all else equal. However, too high a level of capital may increase owners’ demand for earnings to the point that the price paid by policyholders is pushed unreasonably or uncompetitively high. Therefore, the objective is to establish the minimum level of capital that will achieve the desired level of policyholder protection.

Figuratively speaking, capital is the foundation upon which the value edifice is built.

A. Begin by Defining the Types of Capital Requirement Used in the Evaluation

Evaluating strategies by how they satisfy policyholders’ concerns essentially means determining the level of capital required by these strategies. And that means, first of all, deciding which type of capital requirement to use in the evaluation.
In practice, there are several important types of capital requirements, including regulatory, rating agency, competitive and economic capital.

- Regulatory capital requirements are minimums established explicitly by the regulatory agencies that hold jurisdiction where the company has major operations.

- Rating agency capital requirements are those that, in large part, determine the company ratings assigned by such organizations as A.M. Best, Moody’s and Standard & Poor’s.

- Competitive capital requirements are implicit constraints imposed by the competitive environment within which each company operates. They reflect both the upward pressure on capital represented by very secure, highly rated competitors, and the downward pressure represented by high-return, efficiently capitalized competitors.

- Economic capital requirements are those derived from explicitly stated financial objectives or constraints, such as “the amount of capital needed to reduce the technical ‘probability of ruin’ to an acceptable level.”

These various capital requirements are not completely independent; competitors’ capital levels are, of course, influenced by regulatory and rating agency considerations. And importantly, all capital requirements can be converted to an economic capital equivalent by imputing their probability-of-ruin implications, for example. The utility and relevance of this conversion is discussed in the following two sections.

Companies that favor using economic capital cite several reasons, including:

1. Economic capital reflects the underlying economics of the business as opposed to political and rating agency conservatism.

2. Regulatory and rating agency capital may actually not allow for some of the risks a company faces, such as interest rate guarantees, guaranteed surrender values and a whole range of operational risks.

3. Since regulatory capital varies by political jurisdiction, if a large institution working across many jurisdictions were to make decisions based on regulatory capital requirements, it may have different strategies for each region. This would amount to running a number of smaller independent institutions and result in a forfeiture of gains from economies of scale.

4. There are opportunities to hedge the difference between regulatory and economic capital. This is accomplished through “rule arbitrage,” i.e., by shifting risks into different jurisdictions with different capital requirements through the use of reinsurance, captives, etc.

5. Economic capital can more directly be compared across lines of business, e.g., banking products versus insurance products.

Each insurance company differs in terms of which definition of capital it uses to suit its management needs. For the purposes of illustration, we will use economic capital to evaluate a set of strategies, recognizing that the other types of capital requirements can also be expressed in economic capital-equivalent terms.

**B. Next Determine the Enterprise-Wide Economic Capital Requirement to Satisfy Policyholders**

There are two primary methods for determining economic capital. One is based on the probability of ruin while the other is based on the economic cost of ruin. We will discuss...
both here and compare them to Value-at-Risk (VAR). Probability of ruin is relatively easy to conceptualize. This is the probability that liabilities will exceed assets on a present value basis at a given valuation date, resulting in technical insolvency. It can be calculated from the probability density function by measuring the area under the curve corresponding to the section where liabilities exceed assets. This is shown in Figure 23 as the shaded area. Alternatively, it can be calculated from the cumulative distribution function by determining the probability point (on the y-axis) where liabilities equal assets (on the x-axis), as shown in Figure 24. These probability plots are generated by running computer simulations of liabilities and assets using the stochastic financial model in the prior step.

Economic capital based on the probability of ruin is determined by calculating the amount of additional assets needed to reduce the probability of ruin to the target specified by management. Addition of capital shifts the curves in both figures to the right by the amount of additional assets, thereby reducing the shaded area in Figure 23 and lowering the probability point on the y-axis in Figure 24. The target probability of ruin is set by management in consideration of several factors, primary among them the solvency concerns of policyholders — usually expressed in terms of the minimum rating that management desires from the rating agencies. (See further discussion below.)

The probability-of-ruin approach is conceptually similar to the VAR approach used in banking for determining capital for market risk. The VAR of a bank’s portfolio exposed to market risk is “the maximum loss over a target horizon within a confidence interval” (Jorion, 1997). The target horizon generally corresponds to the time needed to liquidate the entire portfolio in an orderly fashion (typically measured in days for most bank portfolios). The confidence interval is expressed as a quantile of a cumulative distribution function, e.g., 99%. It is set by implicitly reflecting the cost of a loss exceeding the VAR amount, the bank’s risk aversion and
some practical considerations associated with back testing. For example, if the VAR for a 99% confidence interval over 10 days is $1 million, it means that there is less than 1% probability of total losses on the portfolio exceeding $1 million over the next 10 days. Therefore, the capital cushion to cover losses at the 99% confidence level is equal to VAR, i.e., $1 million. This also means that $1 million in capital is needed for a 1% probability of losses exceeding capital.

Although there are technical computational differences between how insurers use probability of ruin and banks use VAR to determine capital, conceptually the two are linked. VAR is the monetary amount on the x-axis corresponding to the probability of ruin on the y-axis of the cumulative distribution function plot illustrated in Figure 24.

Both the probability-of-ruin and VAR methods have the advantage of being risk measures that are easy to understand and communicate. This no doubt is the reason that they are widely accepted in insurance and banking respectively. However, both risk measures fail to consider the severity of ruin events, i.e., the expected loss to policyholders.

Economic cost of ruin is an enhancement to the ruin probability concept, though one that is more prevalent in the property/casualty arena. In the event of ruin, the policyholders expect to get some, but not all, of the benefits to which they are contractually entitled. The difference between what policyholders are promised and the expected value of their post-ruin benefits represents an expected shortfall to policyholders — this is called the economic cost of ruin. (It is sometimes called “expected policyholder deficit,” but there may be insurance or prudential obligations in place to protect policyholders from this loss; we therefore prefer the term “economic cost of ruin.”) Economic cost of ruin (or ECOR) thus considers not only the probability of ruin, but also the expected loss to policyholders in the event of ruin. It is represented by the “shaded area under the
curve” in Figure 24. (An analogy may be useful here: think of a bond rating that considers both the probability of default and the salvage value of the bond in the event of default.) In practice, ECOR is often expressed as a percentage of policyholder reserves.

ECOR has important advantages over probability of ruin and VAR. Two companies with the same ruin probability would typically have different, perhaps very different, ECORS. The company with the higher ECOR would have fewer funds remaining after liquidation to distribute to policyholders. Arguably, this policyholder payment capability captures the essence of the need for capital. For some companies, the conceptual advantages of ECOR are outweighed by practicalities, such as the fact that probability of ruin is computationally simpler. Advances in computational efficiency are overcoming these practical constraints.

How are ruin probability or ECOR standards established for an insurance company? In some cases, senior management or Boards of Directors are able to express their preferences in terms easily convertible to these metrics. In other cases, ruin probability or ECOR standards are imputed from the rating (e.g., S&P rating) desired by the company. Whatever the source of the standards, expressing these objectives/constraints in ruin probability or ECOR terms is important for two reasons. First, it facilitates the appropriate attribution of capital, as discussed in the following section. Second, it provides essential information, in the right language, to the strategy optimization exercise outlined in the following chapter.

The overall economic capital for the enterprise is determined for each combination or set of financial and operational strategies that were proposed in the prior step. Recent surveys conducted by Tillinghast of insurance companies indicate their strong desire to reflect major operational risks and strategies in determining the capital requirement. Since both financial and operational risks are incorporated in the financial model used to calculate cumulative earnings, operational risks would be automatically reflected in establishing the capital requirement.

C. After Determining the Total Capital Requirement, Attribute Capital to Business Segments

Having determined the appropriate capital requirement at the enterprise level to satisfy policyholders’ interests, it is necessary to fairly attribute capital to each segment in a way that reflects its contribution to the enterprise-wide capital requirement. This attribution allows the proper evaluation of the performance of each business segment.

There are several methods for attributing capital to each business unit. These methods differ primarily by the choice of risk measure used to estimate the capital requirement of each segment in relation to risk.

One such method is to attribute capital across business segments in proportion to the present value of expected customer payments. Under this method, each product is assumed to contribute to the risk of insolvency in proportion to the economic value of commitments to customers — and thus all products are assumed to involve the same degree of risk. Since this is not the case in most situations, less risky products provide a capital subsidy to the more risky products. The resulting unfairness may result in business decisions that destroy economic value.
To attribute capital fairly across segments, capital requirements must be determined in relation to the riskiness of each segment. Since, at the most intuitive level, policyholders, regulators and insurance executives can see that the level of risk is directly related to the probability of ruin of the company, it is often suggested that probability-of-ruin constraints be used to drive the capital attribution process. However, both probability of ruin and VAR have a serious drawback if they are used to attribute capital to business segments or to determine the capital of merged or combined operations. For example, when two or more risky portfolios are combined, the capital based on these measures for the combined portfolio may turn out to be more than the sum of the capital for each portfolio determined separately. (See Appendix G and references on coherent risk measures for numerical examples.) Combining risky portfolios should, however, decrease total risk, and therefore capital, due to risk diversification. Under certain conditions then, these risk measures may suggest incorrectly that combining portfolios increases the level of risk.

This drawback of probability of ruin and VAR arises when loss distributions of business segments are asymmetric and not correlated uniformly across the range of outcomes. This is prevalent in insurance where, unlike banking, most risks exhibit “fat tailed” probability distributions that cannot be fully represented simply by their mean-variance characteristics.

A refinement to this method is to use the “ECOR ratio” (i.e., the ratio of ECOR to the present value of expected customer payments) to drive the attribution process.

ECOR does not suffer from the drawback described above for probability of ruin and VAR. Determining capital using ECOR correctly produces this result: Combining risky portfolios reduces the capital requirement for the same level of risk tolerance, and produces sensible results when used to attribute capital to business segments.

In any case, the attribution process requires completion of two steps.

1. Calculation of stand-alone capital requirements:
   The objective of this step is to determine the minimum amount of capital that is needed by each individual segment to meet the corporate level risk constraint, expressed as a probability of default or ECOR ratio, for example. Note that adding up the stand-alone capital requirements calculated above will result in a capital requirement that is greater than the aggregate capital requirement of the enterprise. The difference between the two amounts represents the capital saving achieved by diversification. This benefit needs to be allocated to business segments.

2. Allocation of the diversification benefit to segments:
   The allocation of the diversification benefit to segments needs to reflect the contribution of each segment to aggregate enterprise risk. It involves calculation of the marginal capital requirement of each segment, i.e., the amount of capital needed by the enterprise to add the segment to the enterprise. The difference between this marginal capital requirement and the stand-alone capital requirement calculated in the preceding step represents the maximum amount of diversification credit associated with any segment. The actual amount of credit given to any segment will be less than this maximum. It will be derived by use of any one of several possible algorithms that are designed to make the resulting allocation fair across segments.
It is important to note that capital attribution results can be highly sensitive to the risk measure and risk constraints that are selected. In particular, as described in the prior section and in Appendix G, there are situations in which using a probability-of-ruin constraint can lead to severely erroneous conclusions about capital requirements and to inappropriate attribution of capital across business segments (especially in property/casualty insurance companies). These difficulties can be avoided by using the ECOR ratio as a measure of risk and selecting an ECOR ratio target as a risk constraint.

One noteworthy feature of capital attribution is that, even if the enterprise-wide capital requirement is established on the basis of regulatory, rating agency or competitive capital considerations, it can be fairly attributed to business segment by first converting the enterprise-wide requirements into an implied risk constraint (e.g., ECOR ratio). The imputed financial constraint at the enterprise level can then be applied at the business unit level, and business unit capital requirements can be derived therefrom. After applying any necessary diversification benefits, this results in an economically fair capital attribution. Indeed, given the practical difficulties in assigning regulatory, rating agency or competitive capital at the business unit level, this may represent the most realistic and meaningful way to attribute such capital.

It is important to attribute capital to business segments to determine which segments, and which financial and operational strategies within a segment, are creating or destroying value. This is explored in the next chapter.

Having evaluated each combination of financial and operational strategies in terms of its capital requirements — which is what matters most to policyholders — the next step is to evaluate them on the basis of returns to owners.
The focus in this step is to evaluate strategies by considering the interests of enterprise owners. This group is primarily focused on growth of the business, return on their investment and consistency of financial performance — the three pillars of the value edifice. Strategies will distinguish themselves based on their relative impact on each of these value drivers. Some strategies are meant to focus primarily on growing the business, while others focus on return. Still others focus on reducing variability. A combination of financial and operational strategies will likely affect all three objectives in positive and negative ways. Therefore, evaluating strategies will require optimizing the trade-offs among the objectives based on the preferences of managers acting as agents for the owners.

A. Begin This Step by Defining the Risk and Value Measures

In order to evaluate strategies against management preferences, each objective must be defined in terms of measures that are generated by the stochastic financial model developed earlier. Note that the financial model generates projections of financial statements — specifically, it generates probability distributions on each major element of the financial statement. Growth is typically measured as the expected value of the average percent change in revenue or earnings over the time horizon. The return for a business segment can be measured as the expected value of average net earnings over the time horizon as a percent of attributed economic capital. Earnings in this case should be determined on an economic value or cash flow basis, rather than statutory, to ensure that the numerator is consistent with the economic cap-
ital in the denominator. Consistency, however, can be measured in several ways.

Consistency typically refers to net earnings but can also apply to return on capital, revenue growth, growth in embedded value or any other financial metric that the owners consider important. In all cases, a measure of consistency for any financial variable can be represented by any of the illustrative risk metrics in the following table.

The target levels in the formulas for each risk metric are based on owner expectations. The target level for return on capital is ostensibly the return that the owner expects given the capital market investment opportunities that are available.

These risk metrics are not the same as those discussed in the previous chapter because the respective phenomena they describe (risk for policyholders and risk for owners) are fundamentally different. This difference is discussed in Appendix D.

### B. Next, Select the Methods for Evaluating Strategies

Once the measures are selected, there are several options for evaluating strategies. They range from those that are computationally easy but involve extensive discussion among decision-makers to those that rely more on computational sophistication to capture management objectives.

<table>
<thead>
<tr>
<th>Risk Metric</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>$\sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$ where $n$ is the number of simulation iterations and $\bar{x}$ is the average value over all iterations. This is a commonly used measure of risk by academics and capital markets. It is interpreted as the extent to which the financial variable could deviate either above or below the expected value. Note that equal weight is given to deviations of the same magnitude regardless of whether the deviation is favorable or unfavorable. (There are different schools of thought on whether standard deviation in this context should measure total volatility or only the non-diversifiable volatility.)</td>
</tr>
<tr>
<td><strong>Shortfall Risk</strong></td>
<td>$\frac{1}{n} \sum [\text{if } (x_i &lt; T) \text{ then } 1, \text{ else } 0]$ * 100% where $T$ is the target value for the financial variable and $n$ is the number of simulation iterations. This is an improvement over standard deviation because it reflects the fact that most people are risk averse, i.e., they are more concerned with unfavorable deviations rather than favorable deviations. It is interpreted as the probability that the financial variable falls below a specified target level.</td>
</tr>
<tr>
<td><strong>Value at Risk (VAR)</strong></td>
<td>In VAR-type measures, the equation is reversed: the shortfall risk is specified first, and the corresponding value at risk ($T$) is solved for.</td>
</tr>
<tr>
<td><strong>Downside Standard Deviation</strong></td>
<td>$\sqrt{\frac{\sum \min[0, (x_i - T)]^2}{n}}$ where $T$ is the target value for the financial variable and $n$ is the number of simulation iterations. This is a further improvement over the other metrics because it focuses not only on the probability of an unfavorable deviation in a financial variable (as with shortfall risk) but also the extent to which it is unfavorable. It is interpreted as the extent to which the financial variable could deviate below a specified target level.</td>
</tr>
<tr>
<td><strong>Below-Target-Risk (BTR)</strong></td>
<td>BTR is similar, but the argument is not squared, and there is no square root taken of the sum.</td>
</tr>
</tbody>
</table>
1. The simplest approach is to plot all combinations of strategies on a two-dimensional chart representing risk and value (Figure 25). Either growth-based or return-based measures can be used to analyze risk and value. Risk is plotted on the x-axis using any one of the risk metrics in the above table. Value is plotted on the y-axis. In Figure 25, expected return on capital over five years is used to measure value, and BTR with a target rate of X% is used to measure risk. Each point on the plot represents a proposed set of coordinated financial and operational strategies.

Sets of strategies dominated by other sets are eliminated from consideration. For example, strategy set A dominates strategy set B because A has both a higher Value and lower Risk, i.e., A is better than B under both measures. The remaining strategy sets are evaluated through discussion among the decision-makers. Decision-makers voice their respective preference for trading off the expected return on capital against the uncertainty of attaining that level. Typically, several plots with various value and risk measures are developed to provide several perspectives to the discussion.

2. A more sophisticated approach uses mathematical optimization technology to automatically eliminate dominated strategies. Given the number of alternatives proposed in Step 2 (“Articulate Strategies,” Chapter VI) for each independent financial and operational strategy, there may be hundreds or possibly thousands of possible combinations of strategies that must be evaluated. In this case, it’s practical to subject some strategies to mathematical evaluation rather than manual evaluation as in the prior method. In particular, the asset allocation strategy can be mathematically optimized to develop an efficient frontier of dominant asset allocation strategies on a risk-value plot (Figure 26 on following page). Each point on each curve represents a specific combination of strategies. Moving from point to point along the curve represents changes in only the asset allocation strategy,
whereas moving from curve to curve represents changes in the other strategies. The thick-lined curve represents all dominant combinations of strategies. Note that as before, it is still necessary for decision-makers to discuss their relative preference for risk versus value in selecting the optimum combination of the remaining strategies. However, all the dominated asset allocation strategies have been eliminated from the discussion a priori.

As in the prior method, a value metric must be chosen for the analysis (e.g., return on capital) as well as a risk metric (e.g., below-target-risk). Also, if management objectives extend beyond either just return on capital or just below-target-risk, several plots would have to be created to represent other value and risk measures. It’s possible to summarize information from several plots with different value and risk measures into one plot with compound value and risk measures. To do this, the relative preferences among each value measure and each risk measure must be made explicit and stated in mathematical form. However, the process of simplifying preferences into a mathematical equation is fraught with difficulties. First, not all decision-makers may have similar preferences. Second, people generally have difficulty articulating their preferences precisely. Finally, preferences may change as a result of discussion with other decision-makers. Therefore, whenever possible, it’s preferable to resist collapsing multiple financial measures into a compound measure for the purposes of evaluating strategy.

A partial solution to this problem is to display the desired value and risk measures simultaneously, using visual devices. For example, an extra risk or value metric (i.e., a third dimension) can be captured in a classic two-dimensional efficient frontier graph by varying the size of the “bubble” used to represent each strategy on the graph according to the size of the metric for that strategy. An alternative
method for reflecting management objectives that extend over multiple measures is to represent some measures as constraints in the formulation of the optimization problem.

Constraints can also be used to represent objectives other than maximizing value and minimizing risk. In general, constraints are factors that preclude an enterprise from pursuing the optimal risk management strategy. They can include risk management budget limitations, unavailability of reinsurance, restrictions on use of financial hedges, cash flow requirements and undesired results under statutory and/or generally accepted accounting principles. Any of these can be structured as mathematical inequalities and added to the above formulation of the optimization problem. Naturally, adding constraints will always narrow the window of strategies that can be considered, and in the extreme, none of the strategy combinations may meet all constraints. In this case, it becomes necessary to selectively loosen the constraints and/or eliminate some constraints. However, judicious use of constraints can simplify the evaluation of strategies.

In all cases, the final evaluation and selection of the best combination of strategies is accomplished through discussion — among decision-makers armed with insight into the risks and values of each strategy.

C. Finally, Conduct Sensitivity Analysis

Regardless of the methods chosen to evaluate strategy, it is generally helpful to analyze the sensitivity of the conclusions to modeling assumptions and parameters. For example, are the conclusions very different for small changes in either the target return or the optimization constraints? Although cumbersome, sensitivity analysis is vital to ensure that the strategy evaluation approach is robust, thereby increasing credibility and buy-in among the decision-makers.
Although alternative financial and operational strategies were developed in Step 2 (“Articulate Strategies,” Chapter VI), promising new strategies often come to light in the process of discussion and analysis of strategies in Steps 3 and 4. In this case, Step 2 may have to be revisited to ensure that the financial model can model the new strategy. Steps 3 and 4 must then be repeated to evaluate the new alternatives against the best candidates from prior analysis. In this section, we present a formal method for developing new strategies by decomposing the analysis into root causes.

One of the fundamental objectives of management is to increase the consistency of results. This reflects owners’ risk aversion to negative deviations from expected performance. In Step 1 (“Assess Risks”), sources of potential deviation were identified, prioritized and classified. Each source of risk that involved either substantial expenditure or change in strategic direction — strategic risk — was modeled as a probability distribution on one of the variables in the financial model. This structure allows us to determine the relative impact each risk source has on consistency of results.

The uncertainty associated with a variable in the model can be turned “on” and “off” to assess the impact of that variable. Turning “on” a variable means converting it from a deterministic variable to a stochastic variable. As previously discussed, this is done by replacing the deterministic value with the probability distribution of the risk source that it is associated
with. Turning “off” a variable means replacing the probability distribution with the expected value of the variable, i.e., the mean of the distribution. In each case, the risk measure for a financial metric is recorded, e.g., BTR for return on capital. The difference in the values represents the contribution of that risk source to the uncertainty of return on capital. There will be no impact on value measures because in each case the value measure is based on the expected value of a stochastic variable.

Repeating this exercise with each risk source provides information that can be used to compare each source of risk. Tornado graphs or bar charts, as in Figure 27, illustrate graphically the relative impact of each risk source on a specific financial metric using a specific risk metric. This information is extremely helpful in developing strategies that “zero in” on large sources of risk.

Similarly, evaluating results based on changes to an isolated strategy, e.g., reinsurance, can be used to determine the relative impact of each strategy within the complete set of financial and operational strategies. In this case, it’s important to look at both value and risk measures because each strategy will likely impact both measures. Here also, the information is helpful in developing alternative strategies.

Decomposing risk and isolating the impact of each strategy can be an effective method for heuristically optimizing strategies. The process provides additional insight into the underlying dynamics between risk and value.
The five-step process recapped in Figure 28 represents the logical flow of activities in developing strategy. The risk assessment process establishes the complete risk environment by considering both financial and operational risks. Manageable risks are assigned to appropriate managerial levels while strategic risks are quantified and included in the financial analysis. Alternative financial and operational strategies are overlaid on the risk environment and modeled using an extension of existing financial models. Strategies are evaluated in consideration of both policyholders’ and owners’ interests.

Policyholders’ interests are reflected by establishing capital based on economic capital considerations (e.g., using Economic Cost of Ruin — ECOR, the premium needed to insure against ruin). Attribution methods consistent with the method used to establish overall capital (e.g., using the ECOR ratio) are used to attribute capital to business segments as a charge for protection against insolvency. Owners’ interests are reflected by evaluating each combination of strategies in terms of its impact on growth, return on capital and consistency of results.

The fundamental difference between policyholders’ and owners’ interests is captured by the risk metrics used (e.g., ECOR and Below-Target-Risk measures, respectively). The evaluation process can be computationally intensive.
but relies ultimately on the analysis and discussion among decision-makers who voice their relative preferences for multiple objectives. Finally, decomposition of risk can provide opportunities to develop potentially better strategies.

In practice, of course, the strategy development process is not so linear and logical due to political, logistical and computational issues. But a process such as the one we have described is very useful as an ideal — and is essential as a guide to inform the development of progressively more sophisticated practical processes along the way. In the next chapter we discuss how some companies have proceeded incrementally on this journey.

Illustrative Results

What are the tangible results from all this analysis and strategy development? Examples from client assignments range from more optimal asset allocation to more cost-effective reinsurance and hedging; from more risk-based internal audits to more “risk-informed” strategic decision-making. Some specific results are illustrated in the following figures.

Figure 29 shows how, using the methods described in Chapter V, a System Dynamics “flight simulator” informed management’s decisions on distribution channel strategy. By simulating the impact of certain key decisions on the probability distributions of market share and profitability, management was able to evaluate a sizable number of alternative strategy choices.

These key decisions included:
- Pricing
- Size of the independent and captive agency forces
- Commission rates
- Investments in technology
- Expenditures in building e-commerce capability.

The impact of each of these decisions on the company’s risk/reward targets was therefore directly measured, and a
small number of preferred options were presented to senior management for their review.

Figures 30 through 33 show how, using the methods described in Chapter VII, capital management was used to create value. First, the company’s overall economic capital requirement was attributed to business segment (Figure 30). The capital requirement of a segment was considered from three points of view:

1. On a stand-alone basis, that is, as if the business segment did not receive any “diversification credit”

2. On a marginal basis, whereby the capital attributed is the incremental amount required when the segment is added to the company’s overall portfolio of segments (Note: points 1 and 2 define the upper and lower boundaries, respectively, of the capital attributable to the segment.)

3. The “diversified portfolio” amount, arrived at by subtracting from the stand-alone requirement a diversification credit — the sum of such credits over all segments equals the capital saving realized by the company through diversification of its business portfolio.

Then, underperforming business segments were identified based on their risk/return characteristics. That is, once capital had been attributed to segment, the distribution of operating outcomes of each segment could be transformed into distributions of return on capital. These distributions, in turn, were assessed relative to the risk/return benchmark established by investors in the capital market. Figure 31 plots the result of this analysis for two segments. Segment A exceeded the return standard for its risk level and was cresting value, while Segment B failed to meet the standard and was destroying values.
By comparing the risk/return characteristics of different business segments against alternative investments of capital, underperformers were identified.

**Modified Capital Market Line**

The modified capital market line represents the investor’s benchmark rate of return.

**Figure 31**

Different business segments consume different amounts of capital, and some do not return more than the cost of their capital.

**Figure 32**

Through redeployment and more efficient use of capital, returns — and value — were greatly enhanced.

**Figure 33**
Next, once capital had been attributed to each segment and the required rate of return of each segment determined in relation to risk, the company was able to measure and calibrate the value creation/destruction associated with each segment. Figure 32 shows the result of this “value creation audit” for a company with five major business segments arranged from left to right in declining order of value creation. In this company, segments A and B create value while C is at value break even, and D and E destroy value. Also note the value destruction associated with excess capital.

Finally, a capital redeployment plan was developed (Figure 33). Segment D was “fixed” and is projected to now create value. Segment E was sold off. Excess capital has been earmarked to be returned to shareholders or to be used for a “strategic acquisition.” (Many companies believe that they ought to return capital to investors rather than be viewed...
as poor managers of capital productivity on behalf of their investors. A company that has credibility in the capital market can raise money very quickly on attractive terms, while a company that does not manage capital well is strategically vulnerable. 

*Figure 34* shows how, using the methods described in Chapter VIII, an asset/liability efficient frontier (ALEF™) analysis was used to improve upon a suboptimal investment strategy. Based on an asset-only efficient frontier, a workers compensation carrier would have been led to invest mostly in bonds to satisfy its risk/return constraints. But given the nature of medical claim liabilities within workers compensation, the ALEF™ analysis correctly showed that investing heavily on stocks was the better strategy. The long-term nature of these liabilities and the fact that they are very inflation-sensitive made stocks the ideal “hedge” for this carrier.

*Figures 35 through 37* show how, using the methods described in Chapters VI through VIII, a reinsurance program was redesigned to enhance enterprise value. First, each reinsurance program component was evaluated based on its contribution to reducing the risk of insolvency—this was then translated into a reduction in required capital (Figure 35, page 54). (Note that single-period statistical analysis cannot capture the impact of reinsurance programs on capital.) Relating capital reduction to the cost of each reinsurance program component allowed meaningful comparisons of components on the basis of value creation (Figure 36). The reinsurance program was redesigned, by subjecting each program component to the criteria captured in Figure 37, page 56, that is, whether its cost (which reduces *expected* return) was justified by its risk-reduction performance (which reduces *required* return).

Finally, *Figure 38*, page 56, shows how, using the methods...
described in Chapters V through IX, an integrated approach to investment and reinsurance strategy evaluation was employed to considerable beneficial effect. First, since alternative reinsurance programs change the nature of the company’s liabilities, different asset/liability efficient frontiers were generated. (The alternative reinsurance programs were selected as described above.) These efficient frontiers show the set of efficient investment strategies under each reinsurance scenario. By successively optimizing and refining the reinsurance and investment strategies, substantial improvements were achieved in terms of both risk reduction and return enhancement.
XI. Proceeding Incrementally

While, in principle, it would be possible to introduce the kind of strategic enterprise risk management that we call RiskValueInsights™ all at once, most organizations prefer an incremental approach in order to overcome the potential hurdles to implementation uncovered in our survey of industry executives. The early activities are often designed to deliver “quick wins” that help garner senior and operational management buy-in, and/or produce financial gains that help fund the next wave of activity. That kind of incrementalism can be effective, as long as senior managers keep a firm eye on the RiskValueInsights™ framework and ultimate goal of creating a fully integrated, strategic enterprise risk management system for their organization.

Many companies have started quite modestly by employing certain ERM-generated techniques in smaller-scale contexts. Examples include using a “heat map” approach similar to that shown in Figure 17 (Chapter V.B) on a less-than-enterprise-wide scope of risks, and using a “flight simulator” approach similar to that shown in Figure 21 (Chapter V.C, sidebar to “Modeling Operational Risks”) to evaluate a predetermined set of candidate strategies.

Some organizations are “starting small” by piloting ERM in one, or a small number, of their business units or locations, for real-time fine-tuning and eventual rollout to the entire enterprise. Other organizations are confining the initial scope of their ERM to a subset of risk sources. This involves explicitly reflecting the interaction of these risks in strategy development. Eventually, all sources of risk would be layered in.

A. The “Building Blocks”

Many organizations are getting their feet wet by focusing on only some risk management activities. They include the following major categories:

Risk practices audit — the comprehensive, objective review of the organization’s current activities against best practices to identify where the needs are greatest.

ERM framework development — the establishment of the objectives, business case and plan by which ERM will be implemented within the organization, including the incorporation of risk considerations into strategic decision-making, capital budgeting, business planning, performance measurement, internal auditing and stakeholder relations. Also includes the determination of a “universal risk language,” i.e., a common set of risk/value metrics, tolerances and performance standards by which to evaluate strategic and tactical alternatives.

Enterprise-wide risk assessment — the qualitative identification, prioritization and classification of key risk factors, and the quantitative measurement and modeling of those risk factors that are deemed high priority and strategic. Includes analysis of the organization’s strategic plan, solicitation of expert testimony, risk factor mapping and ranking, and financial and operational risk factor modeling, using scenario generation and structural stochastic simulation as necessary.

Sales practices and compliance — assessing exposure to various forms of litigation through actuarial and business analysis of the company’s products and practices. This includes evaluating the litigation exposure of potential acquisitions, reviewing business practices to reduce the potential for litigation and evaluating potential settlement offers.

Embedded value studies — the regular, periodic calculation of an embedded value, which is the present value of future expected after-tax
distributable profits from existing business calculated at a discount rate that reflects the riskiness of the future profit flows. The change in value of this amount over time gives a measure of the change in economic value of the business to its owners. The main sources of the change, for example value added by new business activities and deviations of actual from expected experience, can be studied.

**Strategy economics** — the development and use of financial models to analyze the risk/value economics of alternative operational strategies related to, for example, distribution channels, e-business, and customer retention and attraction.

**Financial risk modeling** — the measurement and modeling of financial risks and strategies through actuarial and structural simulation models such as dynamic financial analysis. Financial risks include asset risks (e.g., interest rates, equity returns) and liability risks (e.g., claims, expenses). One example of its use is the optimization of investment strategy, given the nature of the organization’s liabilities, its risk/reward preferences, and its regulatory and other constraints.

**Operational risk modeling** — the measurement and modeling of nonfinancial risks and strategies through the use of advanced decision theoretic techniques and causal modeling approaches such as system dynamics. Operational risks include business risks (e.g., sales tactics) and event risks (e.g., natural catastrophes). An example of its use is the optimization of distribution strategy given inputs such as elasticity of demand, cost effectiveness of nontraditional channels such as the Internet, and competitor actions/reactions.

**Capital management** — the determination of the organization’s optimal capital level and structure, subject to regulatory and rating agency constraints, and the proper attribution of capital to business segments based on relative contribution to enterprise risk. This includes quantitative risk analysis, determination of capital adequacy from the policyholders’ perspective, assessment of value creation by business segment from the owners’ perspective, redeployment of capital, and negotiation with rating agencies as necessary.

**Asset/liability management** — the coordination between an organization’s asset and liability functions and the optimization of investment allocation to asset class based on the nature and structure of the organization’s liabilities. Key activities include: expanding cash flow testing models into full ALM models; risk management of guarantees in equity-oriented products; benchmarking against best practices; evaluation and optimization of strategies using efficient frontier analysis, and implementation of ALM controls, policies and procedures.

**Reinsurance/hedging strategy** — the development and execution of an optimal risk financing program, consistent with the organization’s risk/reward targets. Includes design of coverage form and structure, catastrophe-exposure management, dynamic hedging, integrated product design and modeling, and execution through coverage placement with appropriate reinsurance and capital markets.

**“Line of sight” people performance and reward systems** — the effective linkage of individual performance targets and incentives with the strategic and financial objectives of the organization as a whole.
B. Case Study Vignettes

The activities described above, from risk practice audits to people performance and reward systems, represent the individual components of RiskValueInsights™, i.e., the “building blocks.” Examples of how companies are utilizing these components include the following:

- In the past, a large health plan conducted separate and uncoordinated risk assessments through its risk management, legal and internal audit functions. It recently undertook an enterprise-wide risk assessment covering all functional and operational divisions. The objective was to prioritize all sources of risk against a common set of financial and customer metrics to enable senior management to focus the organization’s limited resources on the proper short list of critical concerns. In addition to providing a meaningful and useful calibration of risks of varied types, this exercise surfaced critical business risks that had not been identified through any previous audit or strategic planning exercise. Senior management is using the results of this assessment to set its strategic agenda.

- A life insurance group offering guarantees on its variable annuity portfolio conducted an integrated analysis of both the downside risk from the guarantees and the revenue risk from capital market volatility to quantify the risk profile of the underlying portfolio and design an optimal risk management solution. After a period of mock testing, the hedging program has gone live.

- A multinational property/casualty company with significant workers compensation and property catastrophe exposures combined sophisticated global stochastic economic scenario generation with state-of-the-art catastrophe modeling to simultaneously derive optimal asset allocation and reinsurance strategies. This ultimately resulted in a capital structure substantially more efficient than its peer companies.

- An integrated financial services company (banking, investment management, P/C and life insurance) intended to add a new site-based delivery channel — a comprehensive risk management program was a key element of the implementation plan. The program integrated both financial risk (e.g., the economics of the new channel, and the ability to penetrate a new customer group efficiently) and operational risk (e.g., the business risk associated with bringing four lines of business to the sales desktops in remote locations, and the regulatory risk of creating a new distribution approach consistent with the regulatory requirements of each of the individual businesses).

- A large multinational financial services group undertook an assessment of the relative levels of economic capital required by each of its life and nonlife insurance subsidiaries. This involved identifying the major sources of risk in each line of business and modeling the impact of these risk areas on the projected cash flows. The results were used to determine an appropriate level of capital at individual product level, subsidiary level, product group level (across subsidiaries) and finally at group level. Global CAP:Link (a proprietary economic scenario generation model of Tillinghast—Towers Perrin) was used to produce consistent economic scenarios to allow cross-currency aggregation. The resulting attribution of capital is used as the foundation for a performance measurement system relating shareholder risk to return on capital and total shareholder return. Actual return on capital is compared to the hurdle rate implied by the shareholder risk, and differences are analyzed into above- and below-the-line effects.

- Several U.K. life assurance companies with “orphan” assets in their with-profits funds have used asset/liability modeling to determine the amount of these assets that can be
allocated and distributed between policyholders and shareholders without subjecting the fund to too high a level of risk. The impact on the fund was assessed for varying forms of allocation and distribution of assets, on both an open- and closed-fund basis, under a large number of stochastic economic scenarios, allowing for the interaction of economic conditions and management decisions on bonuses. This has been used as the basis for an allocation of these orphan assets between policyholders and shareholders, thus allowing part of the value to be unlocked.

A medium-sized life insurer was looking to improve the product design features of its flagship universal life product — specifically, incorporating a market value adjustment to protect against having to credit high interest in times of falling asset market values. The market value adjustment could have been a serious detriment to potential policyholders and might not have received regulatory approval. Working together, senior management, the actuarial team and the investment fund manager determined that an ALM model be developed using a set of stochastically generated interest rate scenarios. Various investment strategies were considered, covering a varying mix of mortgages, high-quality corporate bonds and CMOs. The ALM model then made projections based on the modeled relationship between the yield on these asset classes and the yield curve for treasuries as produced by the stochastic interest rate generator. Appropriate assumptions were made for defaults and prepayment risk. The yield relationships and other asset assumptions were reviewed by the fund management team, which also appraised the actuaries’ assumptions underlying the model that was used to create the stochastically generated interest rate scenarios. Duration and convexity of both assets and liabilities were then analyzed, and the product design and the planned investment strategy fine-tuned to bring the assets and liabilities into balance. At this point, senior management analyzed various profit metrics for different investment strategies, looking at extreme scenarios for special review. Based on this analysis, the product appeared to hold up well even under the most extreme interest rate scenarios without any market value adjustment. The ALM analysis was effectively used to establish the product design and set the investment policy, and the product was filed without any market value adjustment.

A property/casualty insurance company’s conservative asset mix resulted in performance returns that were not competitive. They evaluated alternative asset allocation strategies, along with an integrated financial reinsurance program, to enhance the returns from investments and manage the risk of their business. However, the company did not want its rating from A.M. Best to be affected as a result of implementing a more aggressive investment strategy. They developed a comprehensive model of the company and evaluated multiple scenarios of economic value in relation to risk. The model allowed them to develop a strategy to alter their asset allocation. A financial integrated stop-loss reinsurance program was designed with an investment hedge to mitigate the possibility that the investment portfolio may underperform a target return. The result: enhanced expected returns of the investment portfolio and lowered downside risk on operating income. The executive team’s understanding of their return opportunities in relation to the risks of the business was deepened. This insight was used to focus the work of line managers, and also used in discussions with outside parties regarding overall risk management.
A medium-sized German life insurance company wanted to analyze the viability of their current dividend strategy for traditional business. The German market has provided stable long-term dividend rates at a high level, even while market interest rates have declined, by smoothing book yields via accrual and realization of “hidden” reserves (unrealized capital gains on assets) and unallocated bonus reserves. In the prevailing low interest rate environment, the key competitive issue had become how long companies could finance their current dividend rates from existing buffers as compared to the market. In order to analyze the company’s competitive position, ALM models were built for the company and a representative market company, reflecting the company’s specific portfolio structure and strategies. On the basis of stochastic economic scenarios generation, the estimated time until ruin (i.e., until buffers have been exhausted) was determined for a range of potential ALM strategies for the company and compared to the results for the market. By varying the investment strategy, the company improved its risk/return positioning. As a result of the benchmark study, the life insurer received an indication of its current competitive position and a quantification of alternative ALM strategies, which led the company to reassess its dividend-setting strategy for the entire traditional life portfolio.

A medium-sized life insurance company wanted to reconsider their distribution strategy in light of plans to demutualize the following year. The bulk of their production came from a network of career agencies, and the company wanted to investigate not only other distribution channels but also the possibility of becoming a wholesaler to other financial institutions. They decided to analyze the risk/value economics of alternative operational strategies by developing a financial model of the underlying business dynamics. The process of model development and assumption setting forced the management team to articulate the alternative strategies more clearly and with greater specificity than they had thus far. The model was used iteratively to evaluate further variations in strategy suggested by a review of the projected financials at each prior iteration. Modeling the economics provided the management team with valuable information on the risks and opportunities underlying alternative strategies. As a result, the team was able to reach consensus on a distribution strategy that was better understood and provided the best prospects of success.

While such examples abound, we believe that no single best approach to ERM implementation is appropriate for all organizations. Some leading companies successfully employ a number of different phased approaches by starting with only some risks, only some strategies or only some business units. The nature and sequence of these phases depend on the culture, strategic imperatives and management style of the organization. However, it is certain that for every organization a phased approach of some sort will be more successful than attempting to do too much, too soon.

However you choose to proceed, and however fast you decide to go, it is critically important in the current environment to be on the journey and to have a clear road map — a complete conceptual framework and a coherent process — to guide your way. We believe RiskValueInsights™ provides that framework and process.
Appendices

- A Brief Recent History of the Risk of Not Managing Risks Holistically (Appendix A)
- Worldwide External Pressures (Appendix B)
- The Value of Consistency (Appendix C)
- Risk Measurement — for Policyholders and for Enterprise Owners (Appendix D)
- Glossary of Risk Modeling Methods (Appendix E)
- An Overview of Change Management (Appendix F)
- Use of Appropriate Risk Measures in Determining Capital (Appendix G)
Appendix A

A Brief Recent History of the Risk of Not Managing Risks Holistically

Over the last several years, there have been many well-publicized events at financial institutions that have led to significant financial/reputational damage and, in some cases, bankruptcies.

Several large life insurance companies accused of misleading customers through their agency sales forces face hundreds of millions of dollars in fines, billions of dollars in policyholder restitution and significant damage to their image and reputation. Findings against these companies have included:

— failure to obtain required licenses
— failure to submit sales literature for regulatory review
— failure to take disciplinary actions against sales representatives
— failure of agents to properly explain the policies or the impact of non-guaranteed elements on these policies.

A centuries-old world-class bank collapsed due to the actions of a single rogue trader who violated the bank’s trading policy, falsified records and engaged in large unauthorized trades. The bank’s control systems failed to identify any of these activities.

Lack of appreciation of the exposure to a single natural catastrophe across multiple business units resulted in severe aggregation of losses and substantial loss of capital for a large multiline carrier. This led to the carrier’s premature exit from a previously, and subsequently, profitable business segment.

A highly rated life insurer required state regulatory protection to prevent a “run on the bank” scenario that would have depleted the insurer’s surplus. The cause of the run was a ratings downgrade from one of the major rating agencies. The downgrade was due to the insurer’s failure to adequately manage its exposure to credit risk. In part, these problems were brought on by the insurer’s failure to fully appreciate the financial risks associated with a major reinsurance treaty. Ultimately, the insurer had no choice but to allow itself to be acquired by a much larger insurance organization.

A syndicate that managed a pool of reinsured workers compensation business on behalf of a number of large life insurance companies has cost these companies, their retrocessionaires and the “fronting” companies more than $1 billion in after-tax charges and settlements, as the companies have claimed they were misled into assuming more business than they expected. This caused substantial disruptions in the workers compensation marketplace and was a major factor in the collapse of a large property/casualty company that fronted for the syndicate.

The recent demise of a large Japanese property/casualty writer was related to the overall economic climate in Japan, but was heightened by an apparent poor regard for the financial risk trade-off inherent in its balance sheet. Japanese P/C insurers’ range of products includes a distinctive “Savings” policy that is essentially a combination of property insurance coverage and a life insurance endowment element. Most insurers include a significant proportion of such business in their portfolios, but this particular company had a disproportionately high share. Thus the crippling high level of interest rate guarantees, which are a recent feature of Savings business, were more acutely felt by this company and ultimately led to its demise.
Leading health insurers in the U.S. are experiencing severe medical cost trends, system problems, class-action lawsuits, adverse legal and regulatory actions, significant reserve strengthening, missed earnings targets and plummeting stock prices. This is in the midst of the e-business revolution, new and nontraditional competition, increasing customer demands and ongoing business transformation.

In Canada, there have been recent, highly publicized cases involving companies that have not had adequate control procedures in place. As a result, these companies have had their own employees take advantage of arbitrage opportunities on segregated fund products at the expense of the policyholders, have been accused of secret billing practices and are facing class-action lawsuits from their own ex-employees. Although none of these threatened the solvency of the companies involved, the reputations of these companies have been tarnished by the bad press received. There has also been a resultant increase in scrutiny by the regulators.

The U.K. life insurance industry has been required by regulators to carry out a review of millions of pension policies sold in the late 1980s and early 1990s and to compensate policyholders who are deemed to have suffered losses as a consequence of mis-selling. This review already has taken five years and is expected to last at least another two years. Total costs to the industry are widely expected to reach £13.5 billion.

A medium-sized, highly rated mortgage company never anticipated ratings agency and pension plan clients’/investors’ reactions to a planned recapture of a previously reinsured interest rate risk. The end result: a forced merger.

One of the oldest and, until recently, most respected life insurance companies in the U.K. was forced to close to new business after losing a court case on its treatment of guaranteed annuity rates. These allow policyholders the option to convert cash policy proceeds to a pension at a guaranteed rate. These guarantees appeared to be of little value when granted, but increasing longevity and falling interest rates have made them very valuable. The company, which is a mutual, had a policy of full distribution of profits to policyholders and so had no reserves to meet these guarantees without reducing policy benefits. It tried to deal with this failure in financial risk management by reducing benefits for those policyholders who exercised the option, thus rendering the guarantee worthless. It failed to manage the adverse public reaction to this course of action or to anticipate an unfavorable outcome of the legal challenge to its actions.

In most of these situations, problems stemmed from either a lack of understanding by managers of the dynamics of their business or lack of sufficient influence over the activities of individual or groups of employees or agents. It is important to note that none have been the result of a calculated risk taken by informed decision-makers. In addition to these well-noted events, financial institutions experience frequent unpiblized losses due to financial and operational risks that in the aggregate can significantly affect financial performance and organizational stability.
Worldwide External Pressures

Failures in holistic risk management have led to efforts by regulators, rating agencies, stock exchanges, institutional investors and corporate governance oversight bodies to insist that company senior management take greater responsibility for managing risks on an enterprise-wide scale. These efforts span virtually all the developed countries, from the United Kingdom, to Western Europe, to Australasia, to Canada and the United States, and they encompass virtually all industries.

Publicly traded companies, in particular, know the keen and increasing desire of their investors for stable earnings.

Broad Corporate Governance Initiatives

- In Canada, the Dey report, commissioned by the Toronto Stock Exchange and released in December 1994, requires companies to report on the adequacy of internal control. Following that, the clarifying report produced by the Canadian Institute of Chartered Accountants, “Guidance on Control” (CoCo report, November 1995) specifies that internal control should include the process of risk assessment and risk management. While these reports have not forced Canadian-listed companies to initiate an ERM process, they do create public pressure and a strong moral obligation to do so. In actuality, many companies have responded by initiating ERM processes.

- In the United Kingdom, the London Stock Exchange has adopted a set of principles — the Combined Code — that consolidates previous reports on corporate governance by the Cadbury, Greenbury and Hampel Committees. This code, effective for all accounting periods ending on or after December 23, 2000 (and with a lesser requirement for accounting periods ending on or after December 23, 1999), makes directors responsible for establishing a sound system of internal control and reviewing its effectiveness, and reporting their findings to shareholders. This review should cover all controls, including operational and compliance controls, and risk management. The Turnbull Committee issued guidelines in September 1999 regarding the reporting requirement for nonfinancial controls.

- Australia and New Zealand have a common set of risk management standards. Their 1995 standards call for a formalized system of risk management and for reporting to the organization’s management on the performance of the risk management system. While not binding, these standards create a benchmark for sound management practices that includes an ERM system.

- In Germany, a mandatory bill — the KonTraG — became law in 1998. Aimed at giving shareholders more information and control and increasing the duty of care of the directors, it includes a requirement that the management board establish supervisory systems for risk management and internal revision. In addition, it calls for reporting on these systems to the supervisory board. Further, auditors appointed by the supervisory board must examine implementation of risk management and internal revision.

- In the Netherlands, the Peters report in 1997 made 40 recommendations on corporate governance, including a recommendation that the management board submit an annual report to the supervisory board on a corporation’s objectives, strategy, related risks and control systems. At present, these recommendations are not mandatory.

- In the U.S., the SEC requires a statement on opportunities and risks for mergers, divestitures and acquisitions. It also requires that companies describe distinctive characteristics
that may have a material impact on future financial performance within 10-K and 10-Q statements. Several factors broaden the requirement to report on the risks to the organization, leading to setting an enterprise-wide approach to risk management in place:

— The report “Internal Control — An Integrated Framework,” produced by the Committee of the Sponsoring Organizations of the Treadway Commission (COSO), favors a broad approach to internal control to provide reasonable assurance of the achievement of an entity’s objectives. Issued in September 1992, it was amended May 1994. While COSO does not require corporations to report on their process of internal control, it does set out a framework for ERM within an organization.

— In September 1994, the American Institute of Certified Public Accountants (AICPA) produced its analysis, “Improving Business Reporting — A Customer Focus” (also known as the Jenkins Report), in which it recommends that reporting on opportunities and risks be improved to include discussion of all risks/opportunities that:
  — are current
  — of serious concern
  — have an impact on earnings or cash flow
  — are specific or unique
  — have been identified and considered by management.

The report also recommends moving toward consistent international reporting standards, which may include disclosures on risk as is required in other countries.

Institutional investors such as Calpers have begun to push for stronger corporate governance and to question companies about their corporate governance procedures — including their management of risk.

**Insurance-Specific Initiatives**

There are additional external pressures unique to the insurance industry that are specifically motivating insurers to take an enterprise-wide view of risk — and to integrate such risk management activities as risk assessment, capital management, asset/liability management, operational risk measurement, distribution channel optimization and reinsurance/hedging into a consistent, comprehensive framework.

— In Canada, the Office of the Superintendent of Financial Institutions (OSFI), in its *Supervisory Framework: 1999 and Beyond*, defines “inherent risk” to include credit risk, market risk, insurance risk, operational risk, liquidity risk, legal and regulatory risk and strategic risk. It states that, “Where independent reviews of operational management and controls have not been carried out or where independent risk management control functions are lacking, OSFI will, under normal circumstances, make appropriate recommendations or direct that appropriate work be done.”

— The International Actuarial Association, in its *Insurance Liabilities — Valuation & Capital Requirements: General Overview of a Possible Approach*, May 31, 2000, divides risk into eight types (credit, transfer, market, business, operational, mortality, morbidity, and property and casualty) and states:
  — “…the calculation of economic capital should be based on the expected ruin probabilities or default rates, taking into account all the risks to which the company is subject.”
  — “The portion of the risks that has not been included in the fair value of liabilities (and assets) is taken into account in the calculation of economic capital. This reflects uncertainties in the model and process risk, setting assumptions, uncertainties with respect to the distribution functions of the risk factors and the volatility in the risks.”
— “While similar in objective, the tools required to measure and to analyze them, not only are different, but also need to be supplemented with a decomposition of risk into the various (sub) risk types to make it measurable, transparent and manageable.”

In Australia, a feature of ongoing reforms to the regulation of general insurers is a layer of four standards covering the subjects of capital adequacy, liability valuation, reinsurance arrangements and operational risk. The Australian Prudential Regulation Authority (APRA) is implementing an approach based on development of, and compliance with, a range of risk management strategies. These strategies will need to deal with the myriad interlocking risks involved in managing a general insurance company. Each company will need to have its strategy agreed upon by APRA and will then be responsible for managing compliance. APRA has made it clear that an internal enterprise risk model with appropriate specifications will go a long way toward meeting compliance objectives.

In the U.K., the Financial Services Authority (FSA — the recently created regulator of all U.K. financial services businesses) is introducing a system of risk-based supervision that will create a single set of prudential requirements organized by risk rather than by type of business. Regulated businesses will have to demonstrate that they have identified all material risks and have adequate systems and financial resources to manage and finance such risks, including market risk, credit risk, operational risk and insurance risk. There is also likely to be a requirement for formal documentation of the whole process in a format that is readily accessible to the FSA.

The National Association of Insurance Commissioners (NAIC) Life Risk-Based Capital Working Group, in conjunction with the American Academy of Actuaries Life Risk-Based Capital Task Force, has finalized the development of an improved method for measuring a company’s interest rate risk. The method, which is effective for the year-end 2000 statements, “incorporates a cash flow testing requirement for annuity and single-premium life products and makes the RBC C-3a calculation more consistent with recent industry advances in dynamic cash flow testing…The task force has recognized the need to accurately incorporate these additional risks into the RBC formula. They have stated that equity-indexed annuities (EIAs) and variable products with secondary guarantees will be incorporated in a future C-3a update. This would be consistent with the task force’s goal of upgrading C-3a from a measure of interest rate risk to a more complete measure of asset/liability risk.”

Moody’s Investors Service, in its One Step in the Right Direction: The New C-3a Risk-Based Capital Component, June 2000, states that it will use the new method devised by the NAIC and the American Academy of Actuaries for measuring a company’s C-3a (interest rate) risk, as it incorporates a cash flow testing requirement for annuity and single-premium life products and is more consistent with industry advances in dynamic cash flow testing: “…the revised calculation is a more accurate barometer of the amount of capital required to support an insurer’s interest-sensitive business, as it explicitly incorporates asset-liability mismatches in determining the appropriate amount of required regulatory capital for a company. Consequently, the new calculation should help discourage companies from taking unwarranted asset-liability risk.”
A.M. Best, in its “Enterprise Risk Model: A Holistic Approach to Measuring Capital Adequacy,” describes their VAR-based method for determining the adequacy of capital for rating purposes. Their report states: “The Enterprise Risk Model is a modular system designed to capture all risks, including noninsurance and non-U.S. related risks. VAR methodologies are somewhat controversial in insurance circles, but they are the standard for other financial services organizations. More importantly, A.M. Best believes that VAR-based methodologies provide a more accurate assessment of risk and required capital, since they use observable market metrics. Beyond its application in the rating process, the model can also be a useful tool for financial managers, since the VAR framework provides a natural springboard to other applications, including risk-adjusted return on capital (RAROC) and dynamic financial analysis (DFA). The Enterprise Risk Model quantifies the risk to the future surplus — net worth — of an organization arising from a change in underlying risk variables, such as credit risk, insurance risk, interest rate risk, market risk and foreign exchange risk. The model also quantifies the benefits of diversification as it takes a macro view of the correlations among risks within an organization... Like other VAR-based models, it is calibrated to measure the risks over a defined holding period — one year — for a given level of statistical confidence — 99%.”

Standard & Poor’s Insurance Capital Markets Group has developed a new, risk-based capital adequacy model to analyze the credit, financial market and operational risks of companies that are offering products or are using sophisticated risk management techniques that are not considered under the existing Rating Group’s capital models. The model will also determine these companies’ capital adequacy. The primary application of the model will be to analyze specialized financial product companies... The model may also be applied to portions of insurance companies that control or mitigate their risks to a greater extent than is implied by the capital charges applied in the standard life/health capital adequacy model, which bases charges for interest rate risk and credit risk on industry averages and liability types rather than company-specific exposure.”

The Basel Committee on Banking Supervision has proposed a capital charge for operational risk as part of the capital framework in the New Basel Capital Accord. The charge reflects the Committee’s “realization that risks other than market and credit” can be substantial. Operational risk is defined as “the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events.” The new capital adequacy framework applies to insurance subsidiaries of banks and may well soon apply to insurance companies as insurance and banking activities converge.
Appendix C

The Value of Consistency

One of the central goals of ERM is consistent financial performance. While some industry observers accept the fundamental value of consistency, others argue that investors do not favorably value companies that expend time and resources attempting to minimize volatility in their results. This volatility, the argument goes, can more efficiently be diversified away within the investor’s own portfolio — if, indeed, that is the investor’s desire.

Our empirical research indicates that, holding constant other key drivers of share value (such as earnings growth and return on capital), investors do, in fact, assign considerable value to consistency, and earnings consistency in particular. (The sources of this value are more difficult to identify. It may be that the more consistent companies are less exposed to “systematic” volatility. Alternatively, investors may simply place more confidence in their assessment of the underlying profitability of the company with more consistent results. The premiums that investors demand for systematic versus nonsystematic risk are not easily determined, but will be the subject of further research.)

The analysis was performed on 111 publicly traded financial services companies. Similar results were found for every other industry group we sampled as well. The bottom line: consistency does indeed matter.

The primary objective of enterprise owners is to increase the value of the enterprise. The key driver of enterprise value is earnings performance. Higher returns on capital, greater earnings growth — and less volatile earnings — all generate higher enterprise value (see Figure 39).

Minimizing earnings volatility has a significant impact on enterprise value. The effect of volatility can be seen more clearly by first stratifying the industry according to return and growth, thereby normalizing those effects (see Figure 40).

FIGURE 39
Investors assign substantial additional value to companies that achieve greater consistency of results than their peers

<table>
<thead>
<tr>
<th>Market Value Added</th>
<th>Market Value Added</th>
<th>Market Value Added</th>
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<tr>
<td>Low return on capital companies</td>
<td>High return on capital companies</td>
<td>Low earnings growth companies</td>
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<tr>
<td>.69</td>
<td>1.86</td>
<td>.94</td>
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Source: Tillinghast – Towers Perrin research into 1992-1999 performance of 111 publicly traded companies in the financial services industry, based on data from COMPUSTAT and Value Line. Details available on request.
Background Information on Tillinghast—Towers Perrin Consistency Analysis

1. Overview

Consistency analysis empirically estimates whether companies with more consistent earnings receive a premium market valuation relative to peers. Since many other factors — in addition to earnings consistency — shape market valuations, we use a series of basic analytic steps to control for the influence of other factors (e.g., earnings growth and return on capital) and isolate a consistency premium or discount. We use a relatively simple control process since (1) we find that more complicated methods introduce other sources of “noise” into the process and (2) consistency premiums are fairly robust across many industry groups and emerge readily with relatively simple control techniques.

A general description of the control process is provided below. For specific definitions and data sources used in the analysis, please see the methodology section that follows.
2. Basic methodology
In performing consistency analysis, Tillinghast–Towers Perrin’s first step is to identify a relevant industry peer sample for a given company. Using an industry peer group helps filter out the effect of common industry factors (e.g., commodity price movements, regulatory risk) on market valuations. We typically use published industry groupings provided by ValueLine or Standard & Poor’s.

Next, we create a data set including a market premium measure, earnings growth rate, return on capital and earnings consistency for each peer. We employ historical growth rates and returns as surrogates for the future growth rates and returns that drive valuations. We calculate growth rates, using a least-squares (regression) approach to avoid biases caused by point-to-point methodology, and average returns on capital over the measurement window. To measure the market premium, we employ a standardized market value-added metric since it properly distinguishes between the capital that investors have placed in the business and the market value added to this capital.

Unlike market-to-book ratios, standardized market value added also captures the dollar growth in the value premium over time. Since the measure is standardized (indexed), it can be meaningfully compared across companies. Finally, ValueLine’s earnings predictability score (0%-100%) is used as the measure of earnings consistency.

We then calculate a median growth rate and return on capital for the peers and break the sample into “high growth” (growth ≥ median) and “low growth” (growth < median) and high-return (return ≥ median) and low-return (return < median) subsets.

The process is repeated one more time by calculating the median earnings predictability score for each of the four subsets and then further breaking each subset into a high-earnings consistency (earnings predictability ≥ subset median) and low-earnings consistency (earnings predictability < subset median). A total of eight subsets results from both steps.

Finally, an average market premium (standardized market value added) is calculated for each of the eight subsets, and the results are summarized in bar chart form.
B. “Earnings growth”

**Definition**

**Formula**
- Regress log-adjusted operating income after depreciation against time to determine growth rate.

**Comment**
- Growth rate based on regression is more accurate than CAGR (which is biased by endpoints).

C. “Earnings consistency”

**Definition**
- ValueLine Earnings Predictability score as reported in ValueLine Investment Survey.

**Formula**
- ValueLine earnings predictability scoring based on stability of year-to-year comparisons, with recent years being weighted more heavily than earlier ones. The earnings stability is derived from the standard deviation of percentage changes in quarterly earnings over an eight-year period. Special adjustments are made for comparisons around zero and from plus to minus.

D. “Market premium”

**Definition**
- 1999 Standardized Market Value Added (MVA) based on 1992 ending invested capital base.

**Formula**
- Std MVA = MVA % Capital x Indexed Capital
  - M/C = (Stock price x Common shares outstanding + Preferred stock + Total debt)/(Shareholders’ equity + Total debt).

**Comment**
- All data reflect year-end 1999
- MVA captures value of growth (unlike M/B ratio) since it is measured in dollars. Standardizing MVA (by indexing every company’s capital to same base year) corrects size bias of measure (so big companies with lots of capital — but low M/C — don’t dominate smaller companies with higher M/C).
Appendix D

Risk Measurement — for Policyholders and for Enterprise Owners

One of the salient features of our RiskValueInsights™ approach is the explicit recognition of the fact that risk has different faces for policyholders and for enterprise owners. This difference manifests itself directly in the measures of risk we adopt in Steps 3 and 4 of our Strategy Development process stage (Chapters VII and VIII, respectively).

Step 3 is concerned with determining capital requirements for the enterprise, which is driven by the security needs of the policyholders, or their proxies, the regulators and rating agencies. These stakeholders are concerned with what happens at the extreme adverse “tail” of the probability distribution of financial outcomes for the enterprise. That is, they are concerned with the “probability of ruin,” which, for banks, is often calibrated by Value at Risk measures. Conceptually, capital is added to the enterprise in sufficient amounts to reduce the probability of ruin to an acceptable level. A more robust risk measure is one that captures not only the probability of ruin, but the degree of ruin should it occur, which is how many “cents on the dollar” can ultimately be paid to policyholders once the enterprise becomes technically insolvent. There is a direct analog in the case of bond ratings, where not only the probability of default but also the expected salvage value is considered in rating the bond offering. The ECOR measure put forth in Step 3 is such a robust measure.

**FIGURE 41**
Distinction between the concerns of customers and owners can be represented by the sections of the probability distribution of earnings. Customers are concerned with extreme outcomes that affect the ability of the insurer to pay their claims, whereas owners are concerned with volatility of earnings below their target or expected return.
Step 4, on the other hand, is concerned with evaluating the returns on capital generated by alternative risk management strategies. This is a concern of the owners of the enterprise. These stakeholders are interested in a different segment of the probability distribution, namely the “middle segment” surrounding the target return level. When owners evaluate returns, they are concerned with the expected value of the return in light of the riskiness of the return, where the riskiness is represented by the range of outcomes in this middle segment. For these purposes, the Below-Target-Risk measure described in Step 4 is best suited.

The concerns of these two groups of stakeholders are fundamentally different and distinct. While owners are interested in seeing the enterprise remain solvent, once insolvency occurs, they are indifferent to how deep the insolvency runs. And, all else equal, they would prefer capital requirements to be low so as to enhance returns in relation to capital invested. While policyholders are interested in the enterprise being run successfully enough to ensure their security, once at that level, they are indifferent to how well owners do on their investment of capital. And, all else equal, they would prefer capital requirements to be high. Clearly, risk measures that fail to recognize these essentially different perspectives/needs and that try to force a single risk metric to measure both the risk of insolvency (for capital adequacy purposes) and the riskiness of returns (for strategy optimization purposes) are fundamentally flawed.

A graphical representation of these concepts is contained in Figure 41.
Appendix E

Glossary of Risk Modeling Methods

There is a continuum of methods for developing probability distributions (see Figure 42). The choice of method depends significantly on the amount and type of historical data that is available. The methods also require varying analytical skills and experience. Each method has advantages and disadvantages over the other methods, so it is important to match the method to the facts and circumstances of the particular risk type.

We have loosely organized the modeling methods into three categories:

- methods based primarily on analysis of historical data
- methods based on a combination of historical data and expert input
- methods based primarily on expert input.

Methods based primarily on analysis of historical data

These methods are the most appropriate when there is enough historical data to apply standard statistical approaches to develop probability distributions. Typically, several years of high-frequency data are necessary. These methods are most often used to model risks that are traded in the financial markets such as interest rate, foreign exchange, asset risks, claims, etc.

**Empirical distributions**

The simplest and the most direct approach is to assume that the historical data fully defines the probability distribution. Then the data can be used directly to develop a discrete probability distribution. Of course the danger is in assuming that the data is complete and the time period over which the data is gathered is long enough to have “seen” or experienced the full range of outcomes.

**Fit parameters of theoretical probability density functions**

An alternative to empirical distributions is to assume that the risk can be described by a theoretical probability density function. Then the data is used to estimate the parameters of the theoretical distribution. For example, for property/casualty claims, the frequency of claims is often assumed to follow either a Poisson or negative binomial distribution, whereas the severity of claims is often assumed to follow a lognormal or a Pareto (for conditional claim or tail distribution).
**Stochastic differential equations (SDE)**

A stochastic differential equation (SDE) expresses the difference (or change) in the value of a variable (e.g., interest rate) at time \( t \) and the value one time period later, \( t + 1 \). It’s a stochastic differential equation because the difference is expressed as a combination of a predictable change and an uncertain or random change during the time period. The random change is represented as a random variable with a specified probability distribution (typically normal distribution). Starting with an initial value, the SDE is used to iteratively determine a scenario of how the value changes over a forecast period (e.g., 10 years). Hundreds or possibly thousands of scenarios are generated in this way. The scenarios can then be summarized as probability distributions for each point in time over the forecast period. See “Scenario Generation” in the References for helpful publications that provide more detail on use of SDEs to model risk.

**Extreme Value Theory**

In risk management, often the most important part of a probability distribution is the tail representing the downside risk. The tail distribution is used to determine capital and shortfall risk constraints for optimizing strategies. However, most risk modeling methods focus on accurately representing the main body of the distribution. Extreme Value Theory (EVT) is a technique for increasing the accuracy with which to model the probability of large values in the tail distribution. EVT is devoted to the modeling and estimating the behavior of rare events. Different EVT models and techniques have been developed and applied to deal with some environmental issues like sea levels, wind speeds, pollution concentrations, etc., where there is a potential for catastrophic results, but it happens rarely. Recently, EVT has been used increasingly in finance and insurance.

The main difficulty of estimating rare events is that in most cases there is a small amount of, or even no, data available. The EVT approach develops models based on asymptotic theory. EVT models the limiting distribution of the extreme values of a random variable, which corresponds to the happening of rare events. A description of the method is beyond the scope of this monograph; however, several useful references are cited.

**Regression**

Often it’s necessary and useful to develop a model of a variable by examining its drivers or causal variables. A regression equation expresses a dependent variable as a function of one or more predictor variables. Regression equations provide managers more information on the dynamics underlying a specific risk to help manage, insure or hedge the risk.

**Methods based on a combination of historical data and expert input**

Often there is not enough data to reliably quantify risks directly through data analysis. In these cases it’s necessary to develop a model of the underlying dynamics that give rise to the data. This requires drawing on the experience and knowledge of domain experts to fill in the data gaps. The following methods attempt to model the dynamics of a system by using a combination of both historical data and expert input.

**System Dynamics simulation**

System Dynamics is a robust modeling method that explicitly simulates the cause-effect relationships underlying the dynamics of a system. The approach leverages both existing historical data and the knowledge and experience of senior managers to develop a stochastic simulation model. The model is used to run Monte Carlo simulations and develop probability distributions for the variable of interest.

The System Dynamics approach has several advantages over parametric approaches described above, particularly for modeling operational risks:

- It provides a systematic way to fill any gaps in historical data with input from experts, relying
on their knowledge and experience. This is applicable particularly for modeling operational risks, where it’s often the case that there isn’t enough representative data to apply the statistical methods described above.

- It provides a way to determine how operational risks change as a function of changes in operations. Since the approach explicitly captures the cause-effect linkages, it is easier to develop effective ways to mitigate risks, and measure their impact than with noncausal methods.

- As businesses become more complex, knowledge of their underlying dynamics becomes more fragmented and localized. Although many managers have a good understanding of their own functional areas, few have a solid grasp of the dynamics of the entire organization. Obtaining a complete picture, for example, of the sources of operational risks and how they affect financial performance requires the combined knowledge of managers across functional areas. The System Dynamics approach facilitates this interaction through a structured, participative modeling and decision-making process.

**Fuzzy logic**

In spite of its name, fuzzy logic is a well-established engineering science used successfully in control systems and expert reasoning. It is an approach to modeling complex systems, where much of the complexity comes from the ambiguous, uncertain or undecided representation of the variables of the system. Traditional quantitative models tend to interpret reality in binary terms. For example, imagine a device that identifies whether a person has a fever. Given the temperature of an individual, a quantitative model programmed in the device will use a discrete, binary rule, such as: “If the temperature is at or over 103°F then the person has a fever, else normal.” Even if it has other categories in between, such as “light fever,” it will still use a discrete binary rule to determine whether a person falls in the “light fever” category or “fever” category. However, in reality it’s clear that there is no precise cutoff for determining whether someone has a fever, and the boundary between “normal” and “fever” is fuzzy. Fuzzy set theory was developed to recognize these gray areas. According to fuzzy set theory, a person with a temperature of 101.5°F would be classified as having some membership in both categories “normal” and “fever.” Fuzzy logic is the reasoning based on fuzzy set theory.

Fuzzy logic has advantages in modeling complex business problems where linguistic variables are used to express the logic rules, the information is subjective, incomplete or unreliable, and the problem spaces are often nonlinear. A fuzzy system is closer to the way people reason and is therefore often used to build expert systems. The fuzzy nature of the rule spaces makes it easy to model multiple, often different or conflicting expert views toward the same model variables. In terms of risk modeling and assessment, fuzzy logic shows potential to be a good approach in dealing with operational risk, where the probability assessment is often based on expert opinion and the risk space is multidimensional and highly nonlinear.

**Estimating probabilities through expert testimony**

In extreme cases, there aren’t any data at all. In these cases, one must rely on the knowledge and experience of domain experts. Probability distributions for events for which there is sparse data can be estimated through expert testimony. A naive method for assessing probabilities is to ask the expert, e.g., “What is the probability that a new competitor will enter the market?” However, the expert may have difficulty answering direct questions and the answers may not be reliable. Behavioral scientists have learned from extensive research that the naive method can produce unreliable results due to heuristics and biases. For example, individuals tend to estimate higher probabilities for events that can be easily recalled or imagined. Individuals also tend to anchor their assessments on some obvious or convenient num-
ber resulting in distributions that are too narrow. (See Clemen, 1996 and von Winterfeldt & Edwards, 1986 in the list of references for further examples.) Decision and risk analysts have developed several methods for accounting for these biases. Several of these methods are described below.

**Preference among bets**

Probabilities are determined by asking the expert to choose which side she prefers on a bet on the underlying events. To avoid issues of risk aversion, the amounts wagered should not be too large. For example, a choice is offered between the following bet and its opposite:

<table>
<thead>
<tr>
<th>Bet</th>
<th>Opposite Side of Bet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Win $x if a new competitor enters the market.</td>
<td>Lose $x if a new competitor enters the market.</td>
</tr>
<tr>
<td>Lose $y if no new competition.</td>
<td>Win $y if no new competition.</td>
</tr>
</tbody>
</table>

The payoffs for the bet, amounts $x and $y, are adjusted until the expert is indifferent to taking a position on either side of the bet. At this point, the expected values for each side of the bet are equal in her mind. Therefore, $x P(C) – y [1-P(C)] = –x P(C) + y [(1-P(C)]$ where $P(C)$ is the probability of a new competitor entering the market. Solving this equality for $P(C)$: $P(C) = y / (x + y)$.

For example, if the expert is indifferent to taking a position on either side of the following bet:

- Win $900 if a competitor enters the market
- Lose $100 if no new competition

then the estimated subjective probability of a new competitor entering the market is $100/($100 + $900) = 0.10.

**Judgments of relative likelihood**

This method involves asking the expert to provide information on the likelihood of an event relative to a reference lottery. The expert is asked to indicate whether the probability of the event occurring is more likely, less likely or equally likely compared to a lottery with known probabilities. Typically, a spinning wheel (a software implementation of the betting wheels in casinos) is used on which a portion of the wheel is colored to represent the event occurring. The relative size of the colored portion is specified. The expert is asked to indicate whether the event is more, less or equally likely to occur than the pointer landing on the colored area if the wheel was spun fairly. The colored area is reduced or increased as necessary depending on the answers until the expert indicates that the two events are equally likely. This method is often used with subjects who are naive about probability assessments.

**Decomposition to aid probability assessment**

Often, decomposing an event into conditional causal events helps experts assess risk of complex systems. The structure of the conditional causal events can be represented by an influence diagram. Influence diagrams illustrate the interdependencies between known events (inputs), scenarios and uncertainties (intermediate variables) and an event of interest (output). An influence diagram model comprises risk nodes representing the uncertain conditions surrounding an event or outcome. Relationships among nodes are indicated by connecting arrows, referred to as arcs of influence. The graphical display of risks and their relationships to process components and outcomes facilitates visualization of the impacts of external uncertainties.

While this approach increases the number of probability assessments, it also allows input from multiple experts or specialists, and helps combine empirical data with subjective data. For example, a new competitor entering the market may be decomposed using an influence diagram such as this one:
The probability of a new competitor, \( P(C) \) can be estimated, using a **Bayesian approach**. The approach uses “Bayes’ Rule,” which is a formal, optimal equation for the revision of probabilities in light of new evidence contained in conditional or causal probabilities.

\[
P(C) = \sum_i P(C_i | R_i, T_i) P(R_i, T_i)
\]

where \( i \) is a product index, \( P(R_i, T_i) \) is the joint probability of an adverse change in regulation and introduction of new technology, and \( P(C_i | R_i, T_i) \) is the conditional probability of a new competitor entering a market for product \( i \). This formula is useful when assessing the conditional probabilities \( P(C_i | R_i, T_i) \) and is easier than a direct calculation of \( P(C) \).

Several different experts may be asked to assess the conditional and joint probabilities. For example, one expert (or group of experts) may assess the probability of adverse regulation for a specific product, another expert may assess probability of introduction of new technology, and yet a third may assess the probability of a new competitor given the state of new regulation and technology.

**The Delphi technique**

Scientists at the Rand Institute developed the “Delphi process” in the 1950s for forecasting future military scenarios. Since then it has been used as a generic strategy for developing consensus and making group decisions, and can be used to assess probabilities from a group of individuals. This process structures group communication and usually involves anonymity of responses, feedback to the group as collective views, and the opportunity for any respondent to modify an earlier judgment. The Delphi process leader poses a series of questions to a group; the answers are tabulated, and the results are used to form the basis for the next round. Through several iterations, the process synthesizes the responses, resulting in a consensus that reflects the participants’ combined intuition, experience and expert knowledge.

The Delphi technique can be used to explore or expose underlying assumptions or information leading to differing judgments and to correlate informed judgments on a topic spanning a wide range of disciplines. It is useful for problems that can benefit from subjective judgments on a collective basis.

**Pitfalls and biases**

Estimating subjective probabilities is never as straightforward as implied in the description of the methods above. There are several pitfalls and biases to be aware of.

None of the methods works extremely well by itself. Typically, multiple techniques must be used. To increase consistency, experts should be asked to assess both the probability of an event and separately the probability of the complement of the event. The two should always add up to 1.0; however, in practice they seldom do without repeated application of the assessment method. The events must be defined clearly to eliminate ambiguity. “What is the probability of a new competitor entering the market?” is not unambiguous. “What is the probability that a new competitor will take more than 5% market share of product A in the next two years?” more clearly defines the event. When assessing probabilities for rare events, it is generally better to assess odds. Odds of event \( E \) are \( \frac{P(E)}{P(\text{complement of } E)} \).
Appendix F

An Overview of Change Management

Regardless of the precise process undertaken, we have learned through client experience that there are four elements that must be in place if change is to take root in an organization. These are the “change enablers” (see Figure 43 below).

Leadership. Because leadership credibility is essential to motivating people, the single most important factor in building and sustaining change is the example set by the people who command respect and influence others. When leaders communicate well and engage directly in the process, they have an enormous impact. This means that leaders have to look at and acknowledge their own behavior and, in many instances, be willing to change it.

Communication. A communication-rich culture is essential to creating lasting change. Communication is the glue that holds an organization and its people together, and it creates real employee connection. In fact, effective, multimedia, multidirectional communication between an organization and its primary stakeholders is critical to a fast-paced, high-performing workplace. Creating an environment where everyone has the right information to do the right things at the right times helps to fully engage employees in their work.

Involvement. To change employees’ thinking, you must first show them the advantages of changing (or the negative consequences of failing to change). You must also give them the power to act — by expressing their point of view, giving feedback on new systems, identifying obstacles to change, and brainstorming and developing solutions. In other words, employees need to be involved, to some degree, every step of the way. The interactive, self-selective nature of Internet technology can rapidly facilitate this kind of employee involvement.

Measurement. If you don’t have the right information, you can’t make appropriate decisions about the right course of action. Accurate measurement is fundamental to effective change. Organizations can customize an array of proven research tools and establish a comprehensive “dashboard” of measures against which to determine appropriate action. This helps to gauge progress and make midcourse corrections, assess the effectiveness of various interventions and evaluate return on investments in new processes or programs.

Figure 43
Implementing some strategies requires a change management process

<table>
<thead>
<tr>
<th>Change Enablers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
</tr>
<tr>
<td>Communication</td>
</tr>
<tr>
<td>Involvement</td>
</tr>
<tr>
<td>Measurement</td>
</tr>
</tbody>
</table>
Use of Appropriate Risk Measures in Determining Capital

The following memorandum is based largely on a presentation entitled “Security Measures and Determination of Capital Requirements” by our colleague Jean-Pierre Berliet to the Forum on Global Risk Management at Fox School of Business and Management, Temple University on April 20, 2001. While the example described is greatly simplified, it is illustrative of situations that have arisen in actual client assignments.

At the most intuitive level, policyholders, regulators and insurance executives believe that the level of security (or quality of guarantee) offered by a company is directly related to the probability of the company defaulting (i.e., having insufficient financial assets) in relation to its obligations to policyholders.

This memorandum explains that:

- the probability of default is an incomplete measure of the security offered to policyholders
- another measure of security, the “Economic Cost of Ruin” (ECOR) provides superior information about the security offered by a company
- ECOR measures of security have important advantages over probability of default measures to help a company — determine its aggregate capital requirements — attribute capital to individual business segments correctly.

The example that follows demonstrates these points. It also suggests that probability of default measures can lead to erroneous conclusions about capital requirements and result in inappropriate attribution of capital across business segments.

<table>
<thead>
<tr>
<th>Company A</th>
<th>Probability</th>
<th>Claims</th>
<th>Minimum Required Assets</th>
<th>Policyholder Payments</th>
<th>Policyholder Deficit</th>
<th>ECOR Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>97%</td>
<td>8,784</td>
<td>10,000</td>
<td>8,784</td>
<td>0</td>
<td>2.0%</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>2%</td>
<td>10,000</td>
<td>28,000</td>
<td>10,000</td>
<td>0</td>
<td>18,000</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>1%</td>
<td>9,000</td>
<td>10,000</td>
<td>8,820</td>
<td>180 (=ECOR)</td>
<td>2.0%</td>
</tr>
<tr>
<td>Expected</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td>180 (=ECOR)</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company B</th>
<th>Probability</th>
<th>Claims</th>
<th>Minimum Required Assets</th>
<th>Policyholder Payments</th>
<th>Policyholder Deficit</th>
<th>ECOR Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>97%</td>
<td>8,505</td>
<td>10,000</td>
<td>8,505</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>2%</td>
<td>10,000</td>
<td>55,000</td>
<td>10,000</td>
<td>0</td>
<td>450 (=ECOR)</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>1%</td>
<td>9,000</td>
<td>10,000</td>
<td>8,550</td>
<td>450 (=ECOR)</td>
<td>5.0%</td>
</tr>
<tr>
<td>Expected</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.0%</td>
</tr>
</tbody>
</table>
Measuring Policyholder Security

The following tables compare the security offered by two insurance companies (A and B) that have the same basic financial resources, measured by total assets, expected losses and probability of default — and yet offer a different level of security to their policyholders.

Company A and Company B have the same probability of default of 1% (i.e., under Scenario 3), but offer policyholders very different levels of security. Company A exposes its policyholders to maximum losses of 18,000 (the difference between their claims of 28,000 and the 10,000 of assets available to pay these claims), while Company B exposes its policyholders to losses of 45,000. Under Scenario 3, policyholders of Company A will suffer an economic loss of 64.3% (18,000/28,000) of their claims, while policyholders of Company B will suffer an economic loss of 81.8% (45,000/55,000). The quality of the guarantee offered by Company A is clearly higher than the quality of the guarantee of Company B, even though both companies have the same probability of default.

This observation leads us to the view that an insurance company needs to assess the security offered to policyholders in relation to the expectation of economic loss that can be suffered by policyholders, i.e., the expected cost of ruin (or, equivalently, the “Economic Cost of Ruin,” or ECOR).

ECOR for Company A above is 180 (i.e., 18,000 cost of ruin with a 1% probability), while ECOR for Company B is 450. In relation to expected liabilities, Company A’s ECOR ratio is 2.0% (180/9,000) while that of company B is 5.0%. Both absolute and relative ECOR measures correctly show that company B offers less security to its policyholders than Company A at the level of assets needed to meet a 1% probability of default constraint.

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Probability</th>
<th>Claims</th>
<th>Minimum Required Assets</th>
<th>Policyholder Payments</th>
<th>Policyholder Deficit</th>
<th>ECOR Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 x B1</td>
<td>94.09%</td>
<td>17,289</td>
<td>38,000</td>
<td>17,289</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A2 x B1</td>
<td>1.94%</td>
<td>18,505</td>
<td>38,000</td>
<td>18,505</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A1 x B2</td>
<td>1.94%</td>
<td>18,784</td>
<td>38,000</td>
<td>18,784</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A2 x B2</td>
<td>0.04%</td>
<td>20,000</td>
<td>38,000</td>
<td>20,000</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A3 x B1</td>
<td>0.97%</td>
<td>36,505</td>
<td>38,000</td>
<td>36,505</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A3 x B2</td>
<td>0.02%</td>
<td>38,000</td>
<td>38,000</td>
<td>38,000</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A1 x B3</td>
<td>0.97%</td>
<td>63,784</td>
<td>38,000</td>
<td>38,000</td>
<td>25,784</td>
<td></td>
</tr>
<tr>
<td>A2 x B3</td>
<td>0.02%</td>
<td>65,000</td>
<td>38,000</td>
<td>38,000</td>
<td>27,000</td>
<td></td>
</tr>
<tr>
<td>A3 x B3</td>
<td>0.01%</td>
<td>83,000</td>
<td>38,000</td>
<td>38,000</td>
<td>45,000</td>
<td></td>
</tr>
<tr>
<td>Expected</td>
<td></td>
<td>18,000</td>
<td>38,000</td>
<td>17,740</td>
<td>260 (=ECOR)</td>
<td>1.4%</td>
</tr>
</tbody>
</table>
Assessing Capital Requirements and Attributing Capital to Business Segments

The use of probability of default risk measures and probability of default risk constraints also leads to erroneous determination of capital requirements and faulty attribution of capital across segments. This can be seen from the following example in which we look at the capital requirement of Company C, which combines the businesses of Company A and Company B discussed in the previous section.

The distribution of losses of Company C is obtained by convolution of the distributions of the results of Company A and Company B. The following table shows this distribution (with scenarios arranged in order of increasing claim), the related deficits for policyholders, and the absolute and relative ECOR measure of security, under the assumption that Company C has assets needed to meet the 1% probability of default constraints that were imposed on Company A and Company B.

Note that at the 1% probability of default constraint, Company C needs assets of 38,000, that is 18,000 more assets than Company A and Company B would need on a separate basis! The 1% probability of default measure implies a counterintuitive diversification penalty when Company A and Company B are combined to form Company C. This result is obtained because the loss distributions of Company A and Company B are not correlated uniformly across the range of outcomes of their activities. With regard to this characteristic of their business, the probability of default risk measure is “incoherent.” Expect this to be the case across many insurance businesses, especially those whose volatility cannot be simply described by their mean/variance characteristics or whose probability distributions involve heavy tails.

Using ECOR measures of risk as constraints for the determination of capital requirements and the attribution of capital across business segments produces results that are substantially different and consistent with conventional wisdom. They show that diversification reduces capital requirements at a given security level.

The following table compares the capital requirements of Companies A, B and C under:

<table>
<thead>
<tr>
<th></th>
<th>At 1% Probability of Ruin</th>
<th>At 1.4% ECOR Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum Required Assets</td>
<td>ECOR</td>
</tr>
<tr>
<td>Company A</td>
<td>10,000</td>
<td>180</td>
</tr>
<tr>
<td>Company B</td>
<td>10,000</td>
<td>450</td>
</tr>
<tr>
<td>Company C</td>
<td>38,000</td>
<td>260</td>
</tr>
<tr>
<td>Sum of A and B</td>
<td>20,000</td>
<td></td>
</tr>
<tr>
<td>Diversification</td>
<td>(18,000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum Required Assets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15,039</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>42,039</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>38,000</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>57,078</td>
<td></td>
</tr>
<tr>
<td></td>
<td>19,078</td>
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The 1.4% ECOR ratio is used to calculate the minimum assets that Company A and Company B require to offer policyholders the level of security implied by the 38,000 of assets needed by Company C to meet the 1% probability of default constraint. With a 1.4% expected ECOR ratio constraint, Company A needs 15,039 of assets, while Company B, which has been shown to be riskier, needs 42,039 of assets. The sum of the capital requirements of Company A and Company B operating on a stand-alone basis is 57,078, which is greater than the 38,000 needed by the companies’ combined operations (Company C), revealing that the combination provides a diversification benefit of 19,078, a theoretically sound and intuitively pleasing result.

### Conclusion

The choice of the measure used to assess the security of an insurance company, determine its aggregate capital requirement and drive attribution of capital to business segments has a significant impact on the outcome of the analyses performed. This memorandum suggests that the widely accepted probability of default measure can produce seriously erroneous results. It also suggests that the serious difficulties created by the use of the probability of ruin can be avoided by the use of the ECOR ratio as a measure of security and as a risk constraint for the determination of capital requirements and for capital attribution across business segments.

*See references:*
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References and Recommended Reading

There is a rapidly growing list of papers, articles and books on Enterprise Risk Management. The following list is by no means complete, and the references cited are not necessarily the definitive publications on the topics. However, these publications provide more detail and expand on the concepts introduced in this monograph and should prove useful for the reader who is interested in delving into these subjects more deeply.

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