Joint CAS-CIA-SOA Risk Management Section White Paper Project

Linkage of Risk Management, Capital Management and Financial Management

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Executive Summary

We live with constant risk. One-in-one-hundred year hurricanes seem to be happening every few years, while world-wide flu pandemics, previously unheard of, could become reality with the ease of global travel. Meanwhile, the events of September 11, 2001 and various accounting scandals – both within and beyond the insurance industry – have changed the landscape for life insurers and property casualty insurers alike. Insurance companies have always faced risk, but there is increasing pressure for a more comprehensive approach to managing risk in relation to capital needs and the resulting impacts on financial performance. Risk-based financial metrics will allow for more intelligent decision making and improved management accountability through better understood and communicated financial results.

Some of the pressure on insurers to demonstrate linkage of risk management with capital management and financial management stems from regulatory and rating agency sources. Regulatory compliance often drives action in the financial services industry, and the banking industry already has requirements relating to the measurement and management of risks through Basel II. Similar requirements are coming soon to European insurers with the advent of Solvency II, and the International Association of Insurance Supervisors also has a solvency project underway.

Rating agencies are providing perhaps even more impetus, with A.M. Best, Standard & Poor's, Fitch's and Moody's all recently commenting on enterprise risk management and capital models. Each of the rating agencies is asking pointed and detailed questions about companies' risk management practices, and while stopping short of requiring an internal economic capital model, all have acknowledged that they will consider internal models when evaluating capital adequacy.

Executive Summary, continued

Full linkage allows for a continuous recognition of the risks facing an organization and their impacts both individually and in the aggregate on capital needs. Such linkage leads to well-defined strategic decisions. Ideally, this is a process ingrained throughout the organization whereby decisions made and actions taken are deemed advantageous from senior management's perspective. The interaction evolves through a direct means of monitoring capital needs and performance with an awareness of the risk environment within which the organization operates. For linkage to be successful, a cultural shift must occur wherein senior management "buys in" to the value added from the process, and there is active participation at all levels of the organization.

The Joint CAS-CIA-SOA Risk Management Section commissioned this report to explore the practices that would enable a company to optimize the integration of risk, capital, and financial management. Based on our research, several effective practices have emerged relative to implementation of a linked environment. These include:

1. Development of a corporate oversight committee, representing senior management commitment to implementation.
2. Development of a framework, specifying how the goal of linkage will be accomplished.
3. Risk identification and assessment, clearly key to the understanding of the organization's risk profile.
4. Actual linkage of risk, capital and financial management through the use of economic capital modeling and performance measurement on a risk-adjusted basis.
5. Education and communication throughout the organization.

A number of benefits will result through linkage -- from an improved understanding of risks and their true costs to the ability to measure individual business units' contribution to the whole organization to greater transparency in results. An organization may even be able to point to tangible improvement in financial results due to specific strategic decisions made in a risk-aware environment, and many companies are also recognizing that the intangible benefits make the journey worthwhile.

Executive Summary, continued

However, we also recognize a long list of challenges associated with implementation of linkage. These include resource constraints, the difficulty in effecting a cultural shift to a new way of considering risk, capital and financial management, and a myriad of technical issues that are still unresolved within the industry. The list of challenges is long enough to seem overwhelming, yet our research shows that value is gained from breaking off manageable pieces within the implementation process. For an insurance company just embarking on this journey, the following practical suggestions are worthy of consideration as the process begins:

1. Establish buy-in and direction from senior management.
2. Establish a well-defined framework for linking risk, capital and financial management.
3. Recognize that certain components of the process are already in place.
4. Keep it simple, at least at first.
5. Become familiar with best practices but realize that there is no one right approach and that integration of best practices can come over time.

The integration of risk, capital and financial management appears to be a concept whose time has come. While the tasks may be difficult, those who have already embarked on the process are finding the journey worthwhile.

Introduction

The functions of risk management, capital management and financial management have long been recognized as critical aspects of an insurance company. Increasingly, the concept of intertwining such functions has gained traction, with the recognition that such linkage may add value to a company. This perspective is being driven by heightened regulatory and rating agency interest in enterprise risk management, and such interest may ultimately prove to be the main motivator for company action. However, even without such pressure, Boards of Directors, shareholders and senior management of many companies are realizing that a consistent and studied approach to linking risk, capital and financial management enhances strategic decision making, reputation, and viability. While the theoretical concepts of linkage are not new, how do these functions and activities connect with one another in the real world?

The Joint CAS-CIA-SOA Risk Management Section sponsored this research report with the objective of exploring the general principles, processes and frameworks that would enable a company to optimize the integration of risk, capital and financial management. Specifically, the research focuses on a practical framework with common definitions, consideration of measurement and metrics, and the interest of global regulators and rating agencies. The study was conducted by KPMG LLP, which performed a literature review as well as interviews with a variety of insurance companies to gain perspective on real-world practicalities. We would like to thank all of the company personnel who agreed to participate in the interviews in order to share their thoughts on the state of linkage at their companies and in the insurance industry.

We further thank the following members of the Project Oversight Group which oversaw the completion of this report:

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Introduction, continued

The research is premised on theoretical principles pertaining to the evolution from an environment whereby companies operate in “silos” to a fully linked environment, with a backbone of practical experience learned from companies who have already embarked on this journey. Two appendices are included to supplement the research. Appendix A provides a glossary of terms. Appendix B presents relevant literature sources which the reader may wish to access to learn more; this appendix is loosely grouped by topic.

Background

The concept of integrated risk management has been circulating at least since 1974 when Gustav Hamilton of Sweden's Statsforetag proposed the "risk management circle" to describe the interaction of all elements in the risk management process, including assessment, control, financing and communication. (Kloman, 2) It seemed that the merits of such a holistic approach would be apparent to the insurance community which lives and breathes risk every day. Enterprise risk management (ERM) became the phrase of interest shortly thereafter, and this phrase remains much in vogue today. While the theoretical merits of ERM are understood, the practicality for an organization in breaking down the rigid, "silo" approach to risk management has been difficult. Under the "silo" approach, financial performance management for a particular business unit may be based on premium growth without a clear understanding of the nature of such growth and consideration for the long-term impact on risk and capital needs. Similarly, a segment of a company may acquire a block of business in order to increase market share without evaluating, understanding or communicating the risks to the overall organization. A company may choose to change its risk profile by shifting its focus from one type of coverage to another, or through diversification to multiple geographies, without fully considering the implications of variations in location, policyholder behavior or other hazards; the intention to reduce an aggregate risk profile may in fact result in more risk to the organization as a whole.

A practical step in breaking down these "silos" is the inherent linkage of risk management, capital management and financial performance. Fundamentally this linkage of risk management, capital management and financial management and performance will result in reduced risk, leading to a lower level of required capital. In turn, this triggers the need for risk-adjusted financial metrics (i.e., utilization of economic capital) and capital requirement comparisons by business unit. Better management accountability through an ability to understand and communicate financial results more intelligently through inclusion of a risk based component will surely result.

Background, continued

Enterprise Risk Management – Definition

Enterprise risk management (CAS) – a discipline by which an organization in any industry assesses, controls, exploits, finances and monitors risks from all sources for the purpose of increasing the organization's short- and long-term value to its stakeholders.

Enterprise risk management (COSO) – a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risks to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives.

This paper explores the evolution of the silo approach to a desired end state wherein comprehensive risk management and capital management are intertwined, resulting in risk-based financial performance management. In the long-term, improved strategic, risk-based decision-making will yield increased value and competitive advantage. Our research involves a survey of current theory as well as practical considerations in linking the various elements.

The Current Environment

Insurers have a long history of identifying and quantifying risks, often including risk modeling and capital allocation with more sophistication than most industries. However, it is common for each function of risk management, capital management, and financial management to operate in a vacuum. Figure 1 provides an example of how an insurance company might currently be organized, with each function and activity existing in a vacuum.

Background, continued

Silos, Non-Integrated Risk Management

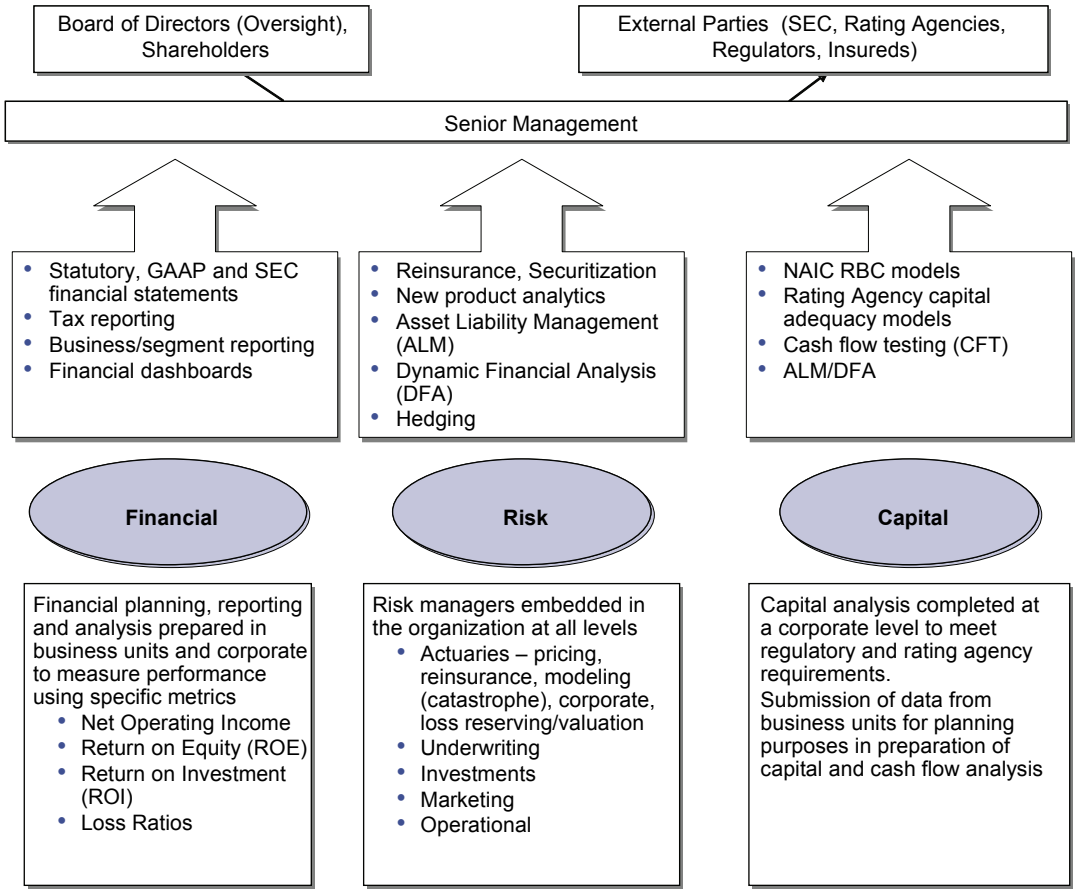

Figure 1: Silos exist at the functional level of an organization and within each function.

Background, continued

Risk is examined within many facets of an organization, such as underwriting selection or reinsurance structure, though the linkage to capital management may not be well defined. Capital analysis often primarily exists to meet external requirements by mechanically applying Risk Based Capital and rating agency capital models. The application of these capital models may result in capital allocations to business units at various levels of complexity. While organizations analyze and strategize over various financial metrics, such as combined ratios, interest spreads, and return on equity, management accountability often still relies principally on one core measurement, such as net operating income (NOI). Management accountability in achieving a 10% increase in NOI for a given year is an important metric given an organization's focus on profitability. However, such a focus says nothing about the impact on the balance sheet over the long-term or the recognition of the relative volatility embedded in the risks taken. Further, managing to a specific, one-dimensional goal negates the incentive to achieve even greater returns, perhaps through intelligently assuming more risk while engaging less capital. A multitude of metrics, from NOI to employee turnover to investment return to exposure mix, influence the bottom line.

Background, continued

The silo environment is multi-dimensional. Not only do functional areas tend to operate independently, but the hierarchical reporting structures seen in insurance companies lend themselves to rigidity. A sample reporting structure is shown in Figure 2, whereby each reporting unit may stay segregated from other reporting units. Multiple lines of business (LOBs) may exacerbate such segregation.

Silos Within The Organization

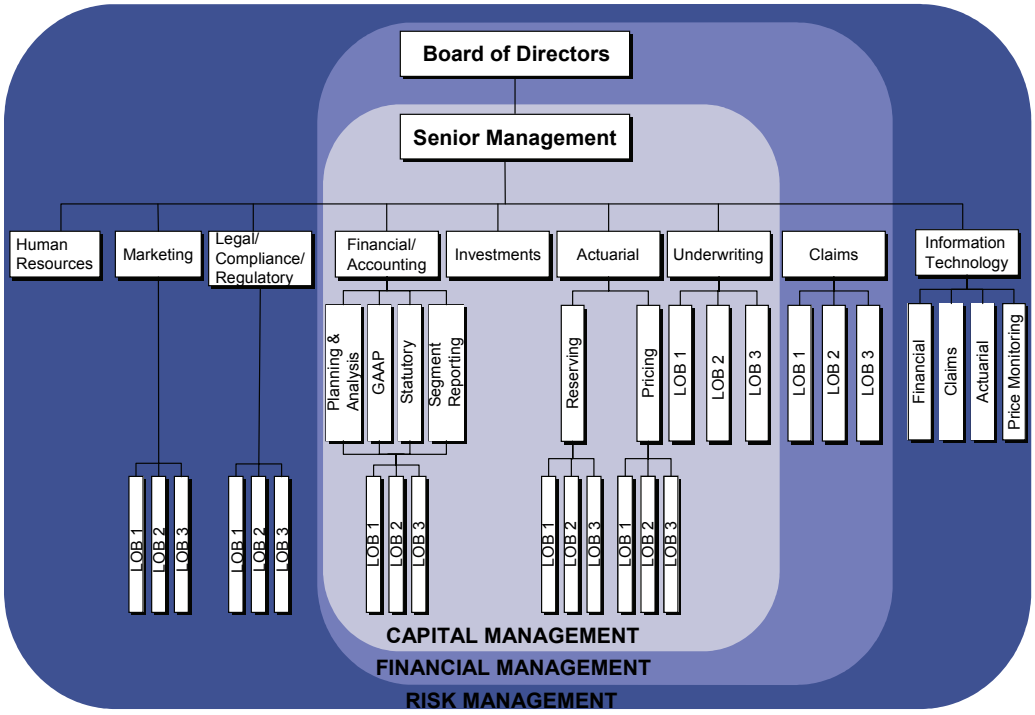

Figure 2: Silos exist within the reporting structure of an organization. This figure shows only a small sample of possible reporting silos within an insurance company.

As an example relating to organizational silos, a company may decide to write a new product without considering whether the assets available to support claims payments will have the proper duration, or a business unit may make the decision to purchase reinsurance without consideration of corporate reinsurance protection or natural internal hedges.

Background, continued

Components Of Risk Management

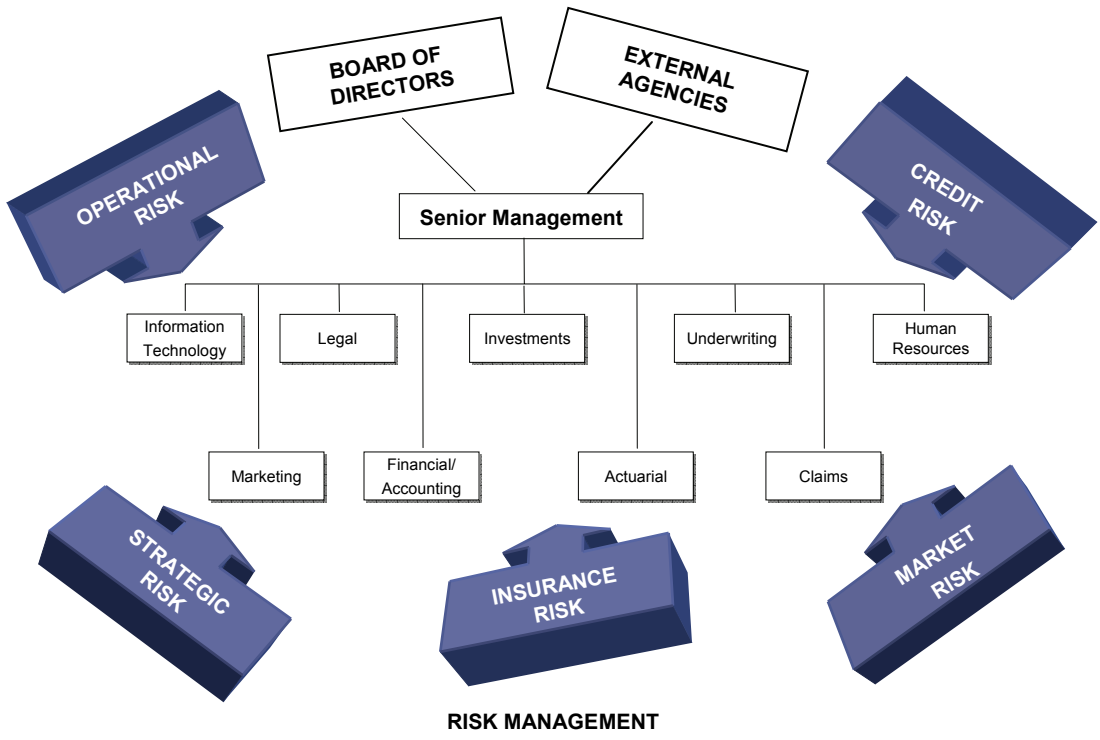

Figure 3: Multiple types of risk impact all functional and reporting levels of an organization.

Likewise, companies write multiple types of business and may branch into life insurance, investment products, health insurance, and property casualty insurance over varying regions of the country and world. The implications of risk interaction among each of these areas and their effects on financial performance can only be estimated.

Background, continued

Figure 3 illustrates the myriad risks that may face an insurance enterprise. Depending on the decisions made and paths followed, the interaction of these risks may result in unintended or undesirable consequences.

While our focus will center on linking the functional areas of risk, capital and financial performance, integration between and among functional and reporting structures will provide the greatest enhancements to strategic decision-making.

Even when the linkage does occur, for example, when a life insurance product is designed in conjunction with recognition of the organization's investment philosophy, or global catastrophe coverage is purchased in order to protect capital and financial results, companies may not perceive that they are working in a linked environment. Such a culture is not yet ingrained.

However, the environment is changing. A multitude of pressure points are exerting influence on the industry to recognize the value of linking risk management, capital management and financial management. The regulatory and rating agency environments often are significant drivers of change, especially for the financial services industry. Basel II, in the banking arena, expands previous guidance related to the measurement of various risks, including market, credit, and operational risks. Minimum capital requirements, supervisory review, and market discipline form the three "pillars" of Basel II, resulting in a framework for improved management. Ultimately the framework encourages more sophisticated and technical approaches for measurement. Basel II forces an increased need for others in the financial services sector to pay attention to these same issues. The approaching implementation of Solvency II for insurers in Europe is another example. The three pillar approach of Solvency II is highly consistent with that of Basel II. While full implementation may be several years away and impacts only insurers with European operations, many U.S. insurance companies see this regulation as a wake-up call. The Financial Services Authority in the United Kingdom has already instituted guidance for insurers to provide Individual Capital Assessments, internal views of capital adequacy taking into account sources of risk, consideration of risk aggregation and confidence levels associated with capital needs.

Background, continued

The ever-increasing globalization of insurance will only speed this process. In fact, through its Solvency and Actuarial Issues Subcommittee, the International Association of Insurance Supervisors (IAIS) also has a solvency project underway. The National Association of Insurance Commissioners is a member of IAIS, and while the timeframe may not be set, regulatory pressure is likely coming to the U.S.

Concurrently, rating agencies have chimed in on the importance of risk and capital management. A.M. Best has noted many pressure points on the industry, from volatile investment markets to unprecedented natural and man-made disasters. While A.M. Best will be maintaining their Best's Capital Adequacy Ratio for evaluation of insurers' capital strength, they have gone on record that they will now consider companies' capital models as well in its ratings evaluations. Similarly, Standard & Poor's is adding a new category, entitled Enterprise Risk Management, in its analysis of insurers; this category includes consideration of company internal models. Each of the major rating agencies has developed pointed questions regarding companies' risk frameworks and assessment procedures.

Each of the actions taken by regulators and rating agencies brings companies closer to using risk based approaches to capital assessment, with attendant modeling to determine some form of economic capital. Economic capital is virtually assured of being a key tool in complying with all of the new guidance, and companies that have already implemented economic capital modeling may gain competitive advantage relative to their peers.

Background, continued

Current State – Definitions

Risk management – the process utilized by management to identify potential events which may affect the entity or business unit/function and managing the identified risk to the organization's risk appetite. The resulting volatility may be considered to have both a downside component (i.e., risk) and an upside component (i.e., opportunity). The term "risk" may be used within this article to represent both risk and opportunity.

Capital management – the process of managing the organization's capital requirements and optimal uses of capital. This may include the deployment of the capital to the individual business units.

Financial management – the process utilized by management to evaluate the organization's performance using financial metrics (e.g., premiums, underwriting profit, combined ratios, ROI, ROE, return on invested capital, embedded value) relative to the organization's objectives and competitors.

While regulators and rating agencies clearly exert external force on insurers, pressure from shareholders and Boards of Directors is also evident. With the increasing complexity of business and highly publicized cases of accounting irregularities and misstatements over the past few years, there is an increasing push toward more strategic and more transparent decision-making based on a reliable assessment and quantification of risks, including aggregated risks, and capital needs. Two recent studies examining significant drops in shareholder value over various recent time periods concluded that such declines in value stemmed from failure to react to risks. A Mercer Management Consulting study found that strategic and operational risks were the primary cause of stock declines in fully 89% of examined cases. (Compustat) Meanwhile, a Deloitte Services study concluded that 80% of affected companies experienced multiple, interdependent risk events. (Deloitte, 1) The implication is that the ability to cohesively manage risk and its impact on a company should result in enhanced, stable financial performance.

Although the form of models may range from simplistic to sophisticated, insurance companies already possess many of the tools needed for the evolution to a more integrated system. For example, cash flow testing, catastrophe modeling, and asset liability matching are not new concepts in the insurance industry. Some insurance companies have made progress in employing dynamic financial analysis, which may appear as a "black box" methodology to many but which has the potential to deliver exactly the information needed by those well versed in insurance. As computing power – through data availability and system capabilities – catches up to theory, and as external and internal forces demand that the insurance industry pays attention to risk management, capital management, and financial management, the financial modeling tools will be on hand. One must still guard against the propensity to generate multiple quantitative measures with no cohesiveness; such masses of statistics may overwhelm the users, resulting in a tendency to ignore the information. Rather, the analytics with which actuaries are so familiar must be generated, but in a disciplined manner where all components are bound together and understandable to others.

Background, continued

The Desired End State – A Fully Linked Environment

The need to manage risk, capital and financial performance is not a revolutionary concept for the insurance industry. Insurance organizations are in the business of assessing various components of risk in their day-to-day operations and, as a result of regulatory and rating agency requirements, capital is allocated to those risks. In addition, like other organizations, insurance companies manage their financial performance on a variety of profit related metrics. In the current environment with conflicting priorities and methodologies, it is no longer prudent or competitive for an organization to view these functions as "silos" that interact on an ad-hoc basis. Therefore, in order to effectively allocate resources, satisfy all stakeholder demands, manage the diverse risks, allocate capital to those areas that add value, and measure the organization's performance, it becomes apparent that an evolution needs to take place to link the "silos" permanently.

One possible framework for achieving such integration is the concept of full linkage or integration of risk, capital and financial management. This process allows for a continuous recognition of the array of risks facing an organization, their individual and collective impact on capital, leading to well-defined strategic actions. Whether recognized or not, a risk profile exists in every organization, based on the array of risks (both upside and downside) inherent within such organization. Each decision that is made changes the overall risk profile in some manner, impacting capital needs. Through linkage, decisions are made strategically to impact the organization's risk profile in a manner deemed advantageous from senior management's perspective. This could involve risk mitigation, risk avoidance or opportunistic exploitation. Specified risk and performance metrics are necessary upon which to base informed decisions. The interaction evolves through a direct means of monitoring capital needs and performance with an awareness of the risk environment within which the organization operates. The triangle shown in Figure 4 depicts such interaction, with constant ties between each of the risk, capital and financial management components.

Background, continued

Holistic State

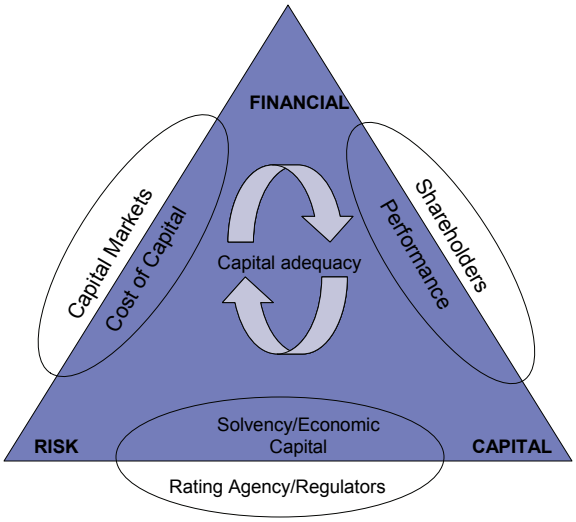

Figure 4: The holistic state allows for integration of risk, capital and financial management.

The mechanics of such a process can only be successful with a cultural shift that stresses acceptance that the decision-making revolves around consideration of what is best for the organization as a whole rather than for an individual silo. Buy-in and accountability should exist in all functional areas of the organization. Support and commitment from senior management are particularly important as such acceptance sets the tone for the entire organization.

The integration of risk, capital and financial performance within an organization achieves the following benefits:

- Improving the understanding of risks and true costs of those risks to the organization;
- Understanding the risks assumed and the effect on capital and performance;
- Enabling ability to measure the contribution of business units and functions to the overall organization in a consistent manner;

Background, continued

- Embedding this linkage into the overall organization, resulting in enhanced insight into risks and rewards;
- Driving an understanding of the overall organization's risk appetite for more informed decision-making;
- Allocating capital and resources to functions that add value;
- Enhancing opportunity to swap, keep, avoid and pursue other risks;
- Reducing volatility in cash flows, capital needs, and financial returns, commensurate with the amount of risk assumed;
- Satisfying stakeholders, capital markets, rating agencies and regulators by creating a balance between growth, desired returns and risk in a transparent manner;
- Improving corporate governance and the perception of corporate governance to external parties;
- Potentially reducing professional liability insurance costs;
- Increasing management accountability by linking the risks taken with the value received.

This linkage invariably brings forth a need to redefine current terminology for risk, capital and financial management:

Risk management – the discipline by which an organization identifies, assesses, controls, measures and monitors various risks and opportunities for the purpose of achieving the entity's strategic and financial objectives.

Capital management – the discipline by which capital is deployed within an organization based on management tolerance for risk, economic constraints, and performance objectives for the organization as a whole, while still satisfying regulatory and rating agency requirements.

Financial management – the discipline by which an organization evaluates its performance utilizing risk-adjusted measures which reflect returns, capital consumption and volatility on an enterprise and individual business unit basis.

Background, continued

Evolution and Challenges

The evolution from “silos” to linkage is not an effortless endeavor as it will require an organization to potentially change its culture in order to achieve success as well as commit valuable time and resources. That said, an organization should not become overwhelmed because, unlike other industries, insurance companies currently have some degree of linkage between risk, capital and/or financial management. This may exist within the organization on an ad-hoc basis or as a documented procedure within a business unit or function. For example, during the product development process, it is common for an organization to develop a “financial dashboard” to present to senior management demonstrating the financial feasibility of the product. In the past, this “dashboard” would have been comprised of profit related metrics for a short time horizon (one to five years) prepared solely by the product development area. Depending on the nature of the business, it has evolved to include capital related metrics over a longer time horizon (up to 30 years) as needed, with input from various functions within the organization. There may be analysis whereby the addition of the product line marginally changes the overall risk profile, including consideration of whether there is adequate reward for the new risk. It may even be that the addition of a new product lowers risk and thus improves the overall risk profile, with illustrative profit related metrics to show this. The “dashboard” may include other “risk related” assumptions such as reinsurance, catastrophe and interest related risks.

This is not meant to underestimate the challenges that an organization will face during the evolution. Some of these challenges are:

- Understanding and validating the current state as well as the communication of the desired end state to the organization;
- Ability to move past the understanding and validation of the current state as a result of infrastructure issues pertaining to people, processes, tools and technology;
- Struggle with defining the risk appetite of the organization;

Background, continued

Definitions:

Risk measures – measures (e.g., standard deviation, VaR, CTE) aimed to capture volatility and the potential loss associated with a given risk over a given time horizon.

Risk-adjusted measures – performance measures (i.e., RORAC) that take into account the change in expected losses and economic capital.

Economic capital – the measure of the capital needed to support the business to operate within a pre-defined risk profile, based on a modeled assessment of possible returns over a specified time horizon.

Risk appetite – the amount of risk an organization is willing to assume, singularly or in the aggregate.

- Achieving buy-in from the overall organization and management;
- Need to identify all of the risks within an organization and determine the interactions among those risks;
- No common approach within the industry for measuring risk – Value at Risk (VaR), Tail Value at Risk (Tail VaR) or Conditional Tail Expectation (CTE);
- No common approach for measuring performance – economic capital, embedded value;
- Need to develop complex integrated risk capital models – stressing the capabilities of existing technology and resources;
- Integration of multiple capital requirements from a regulatory, rating agency and management perspective.

The challenges facing the organization may appear overwhelming, but insurance companies need to be cognizant that value will be added throughout the evolutionary journey. Value will be achieved as risks are identified, capital needs are tied to performance, capital adequacy is consistently quantified for stakeholders, and resources are managed effectively. In order for the organization to be successful, there are some practical steps to consider:

- Establish clear roles and responsibilities (i.e., steering committee and a risk champion) - to bring guidance, structure and oversight to the effort;
- Ingrain the process into the organization's culture – this is not a one-time project but a change in how the business is managed;
- Maintain a cost versus benefit perspective – initially focus on the functions that can yield benefits without taxing the organization's resources or on those functions that will yield the greatest benefits;
- Monitor – the risks and opportunities will change and evolve over time;
- Understand the time commitment – building complex models takes time; don't rush the process;

Background, continued

- Leverage models developed for other purposes;
- Build upon success.

Comparison with Other Industries

A recent survey across a number of industries indicates that a majority of companies consider some type of enterprise risk management framework to be desirable. Not surprisingly with the advent of both Basel II and Solvency II, the impetus for the financial services industry to focus on a more integrated risk management approach is driven by regulatory requirements. However, across all industries surveyed, from energy to manufacturing to financial services and more, two-thirds responded that the desire to reduce potential losses and to improve business performance drove their focus on integrated risk management. (KPMG, Driving ERM Management, 7)

For many industries, the process has not expanded far beyond the risk identification stage. The assessment of many risks tends to be more qualitative than quantitative, and quantitative measurements are generally not based on sophisticated modeling. Due to Basel II, an exception is the banking industry, where Value-at-Risk is the commonly calculated measure. The energy industry is also somewhat advanced in integrated risk management. The energy sector faces a myriad of risks relative to price volatility; like the insurance industry, regulatory and market risk as well as weather events have great potential for significantly impacting results. Like the banking industry, the energy industry commonly uses Value-at-Risk for risk measurement. The time horizons used in these industries tend to be quite short, which may have some relevance for short-duration property casualty insurance contracts but likely are not viewed as sufficient for life insurance and investment products or long-tailed property casualty lines of business.

Dealing with the identification, assessment and mitigation of risks for their customers on a day-to-day basis should clearly bring a higher comfort level to insurance companies as they embark on a more integrated approach to risk and capital management, leading to enhanced financial performance. Insurance companies may face extremely complex risks, but they also possess considerable modeling capabilities to face those risks. While implementation may not be fully realized, familiarity with the concepts of risk quantification and aggregation, such as Probability of Ruin, Tail Value-at-Risk, Expected Policyholder Deficit, Correlation matrices, Copulas and the like, is already present.

Background, continued

The banking industry currently appears to have the most sophisticated modeling around, but as Standard & Poor's and others have observed, the most commonly reported measure of market risk, Value-at-Risk, is inherently flawed. It ignores risk in the "tail" and does not satisfy the mathematical property of coherence. It also is less robust from a computational point of view than such measures as Tail Value-at-Risk / Conditional Tail Expectation. Even more cutting-edge statistics, such as spectral risk measures, are currently being researched in mathematical and statistical circles. Thus, even the banking industry, while relatively cutting-edge, has not yet reached its full potential.

The insurance industry can, however, learn from the banking industry's journey over the past several years. A recently conducted survey of the banking industry confirms that some commonly cited challenges, such as lack of sufficient technology and lack of sufficient data are very real. Further, one cannot discount the time commitment and costs associated with implementation. Over half of respondents in the Americas consider the ability to meet implementation deadlines a cause for concern. Even more striking, 83% of Americas respondents cite cost as a major obstacle to implementation of Basel II with respect to credit risks. (KPMG, Results of the Basel Survey, 33) A healthy respect for the challenges should allow the insurance industry to understand and prepare for such obstacles as they arise in their own endeavors. Despite these concerns, respondents also overwhelmingly perceived added value from the process, not only from regulators and rating agencies driving change but also from a business performance standpoint.

Framework

The specific approaches to integration will be as varied as the risk environments and cultures that insurers face. No one methodology can fit every situation; trying to fit the “square peg” into the “round hole” will only lead to frustration and a lack of buy-in from those who are to implement any new processes. However, a conceptual framework affords the structure within which companies can consider their own unique situations, including detailed implementation.

Essentially, as Figure 5 illustrates, integration involves active participation at all levels of the organization, with specific concentrations for both senior management (a top-down perspective) and operational personnel (a bottom-up perspective).

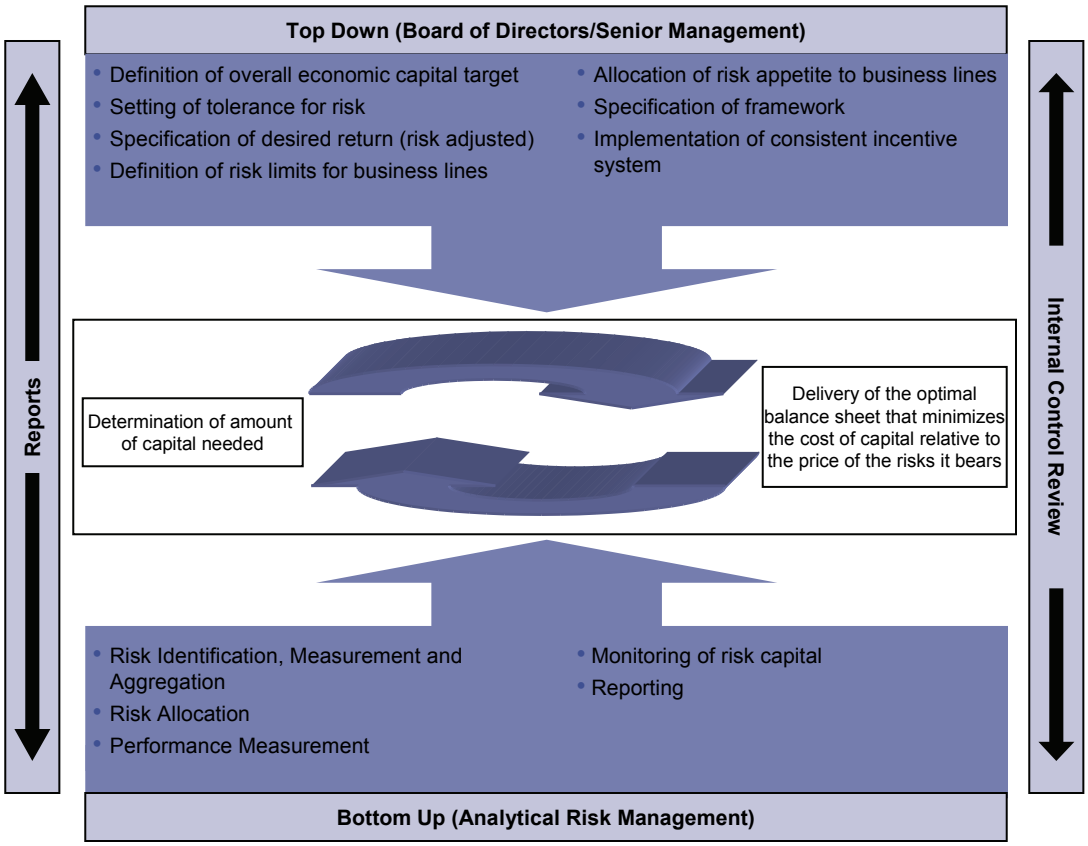

Figure 5 - Top Down and Bottom Up Approaches

Framework, continued

Implementation – Top Down

- Development of general business plan objectives.
- Structural design of risk committees and reporting objectives, including timeframes for communications.
- Development of definitions and policies to be utilized consistently throughout the organization.
- Specification of management's risk tolerance, perhaps expressed as maximum allowable probability of default within a given time horizon.
- Specification of performance measures to be utilized, including:
  - Risk Adjusted Return on Capital
  - Return on Risk Adjusted Capital
  - Embedded Value
  - Appendix A.i. provides definitions of these performance measures.
- Development of monitoring process and expectations, potentially including a reward system.

The Top-Down Perspective

Senior management sets the tone at the top and evaluates the cultural implications for any major endeavor considered worthy of execution. Relative to risk, capital and financial management, senior management would be expected to drive the framework, define the overriding goals and objectives, and be aware of major risks threatening such objectives. Fundamentally, this should include the specification of management's desired risk appetite, desired return, and risk limits. Is the definition of senior management's risk appetite, for example, an unwillingness to lose thirty percent of capital in a year, or an unwillingness to cut return on equity in half? Questions for senior management to wrestle with include what process is in place to identify risks outside the organization's risk appetite, what performance measures and hurdle rates will be used for decision-making, and what monitoring techniques will be in place to review the adequacy of the system on an ongoing basis. The ultimate linkage may even include a compensation mechanism that rewards effective risk management in alignment with business objectives. The importance of senior management support in embarking on a journey of linking risk, capital and financial management cannot be overestimated; without senior management "walking the walk", such a complex undertaking will surely lose momentum.

The Bottom-Up Perspective

Day to day operational activities form the bottom-up perspective. Tasks may include identification, quantification, and mitigation of individual risks, as well as the aggregation of individual risks taking into consideration diversification and correlation effects. Questions to consider include what process exists for identifying risks, how to model risks, with the attendant technical questions regarding data, assumptions, and appropriate analysis techniques, as well as how to capture movements in risk profiles over time. The consideration of risk metrics may be both quantitative, through various modeling techniques, and qualitative, such as through high-level "what-if" scenarios. These activities represent the framework's backbone, with regular communication between the operational level and senior management a crucial aspect of the process.

Framework, continued

Implementation – Bottom Up

- Identification of risks, including:
  - Market risks
  - Credit risks
  - Insurance risks
  - Operational risks
  - Strategic risks
  - Other risks (e.g. Liquidity risk, Concentration risk, Model risk)
  - Appendix A.ii. provides definitions of these risk types.
- Quantification of risks, using desired risk metrics, including:
  - Standard deviation
  - Probability of ruin
  - Value at Risk
  - Tail Value at Risk (Conditional tail expectation)
  - Expected policyholder deficit
  - Appendix A.iii. provides definitions of these risk measures.
- Aggregation of risks, through consideration of correlation.
- Prioritization of risk.
- Mitigation or exploitation of risks (opportunities).

Any of the implementation steps can be performed within the functional silos that already exist in an organization. Linkage occurs as a risk-aware culture considers risk metrics in conjunction with performance measures, throughout all decision points of the organization, be they new product development, investment allocation, or advertising campaigns.

Evolution in the Real World

The comments in this section are based on a literature survey as well as interviews with multiple insurance companies of various size, line of business distribution, and corporate configuration.

A renewed interest in linkage arose early in this century, whether due to the events of September 11, 2001, the collapse of the hedge fund Long Term Capital Management in 1998, various accounting scandals leading to passage of the Sarbanes-Oxley Act, or simply technological advances allowing for more sophisticated modeling of risks. The motivation for progress has picked up speed even more recently, given the regulatory and rating agency environment discussed earlier. In fact, many companies who have begun the evolution to a more linked environment cite rating agency interest as the primary driver. Some companies have been particularly proactive, researching models in order to discuss utilization and effectiveness with regulators and rating agencies prior to such agencies promulgating any official guidance. Others credit a Board or senior management member with an interest in understanding risk-adjusted returns and earnings. Still others – particularly those who are not constrained by capital – do not consider evolution to be necessary and do not plan to alter their traditional operations unless forced to by external parties.

Even those companies that are not moving toward a more integrated environment exhibit strong risk management practices. Depending on the company, review of exposures to natural catastrophes or to pandemics, analysis of reinsurance structure and asset liability matching are all examples of common-place activities well ingrained within any company. For those companies embarking on the journey towards linkage, several common themes relating to implementation have emerged.

Evolution in the Real World, continued

1. Development of Corporate Oversight Committee

This committee, whether known as an Enterprise Risk Management Committee, a Risk and Capital Management Committee, a Risk Council, or some other nomenclature, represents senior management commitment to implementation, the top-down perspective of the conceptual framework. Such commitment drives buy-in at all levels of the organization as well as education for all levels of the organization. The makeup of any such committee will vary, but could naturally include the Chief Executive Officer, Chief Financial Officer, Chief Risk Officer, Chief Actuary, Chief Underwriter, and other business unit leaders, e.g. those from Human Resources and Information Technology. The committee may even have sub-groups depending on the entity's complexity and organizational structure. Regular timeframes for communication, perhaps quarterly, would be specified.

2. Development of Framework

In the initial stages of implementation, a key component of the committee's charge would be development of the framework – how will the overriding goal of linkage be accomplished? As discussed previously, consistent terminology and definitions along with specific risk appetite, hurdle rate and risk and performance measures to be used throughout the organization go a long way in defining the approach.

Different companies have different preferences and needs. A catastrophe reinsurance company may need to focus on probability of ruin, while a company in a more stable market may wish to consider not only the tail of the distribution of outcomes but also a spectrum of results at multiple confidence levels. Ideally, both types of companies will examine both probability of ruin and dispersion of results.

Evolution in the Real World, continued

3. Risk Identification and Assessment

Many companies already have in place or are embarking on a path whereby individual business units inventory their risks. A schematic representation of key risks and their potential impacts over a given time horizon, such as may be seen on a risk dashboard, could be useful to open dialogue between operational personnel and senior management, and between and among multiple areas of the organization. As a first step, these inventories may exist only at each individual business unit or functional level but would evolve such that risks are examined and questioned concurrently and in the aggregate. Previously unnoticed correlations and patterns are likely to jump out. For example, an insurance company writing homeowners insurance of coastal properties which also invests heavily in municipal bonds in these same coastal areas could be assuming even more risk than the obvious property claims incurred from a hurricane.

Risk assessments involve both identification and quantification of risks, before and after any risk mitigation activities. Multiple models – quantitative and qualitative – likely exist within one company or business unit to measure risk. Insurance risk, being a highly evolved risk area where companies have considerable data, is surely being quantified, very possibly through stochastic modeling techniques, but at least deterministically based on historical experience.

On the other hand, little data likely exist on operational risks, those that relate to failures in processes, systems or behavior due to internal or external influences. How does one determine a proper distribution and parameterization for stochastic analysis? In such cases, scenario analysis or stress testing may be efficient and appropriate solutions. Additionally, it may be that implementing a corporate governance and control environment which minimizes operational risks can effectively relegate quantification to a secondary goal rather than a necessity.

Risk assessment can seem overwhelming. Often companies begin implementation with the idea that all risks will be assessed comprehensively, only to find the need to scale back. To start, companies should concentrate on material risks – pricing for a product with considerable market share in North America may be easily modeled whereas the same product in South America may not have sufficient volume for modeling. Consider that value is gained even from this recognition. The key is to have a risk-aware culture driven from the top.

Evolution in the Real World, continued

4. Linkage of Risk, Capital and Financial Management

Ultimately, it is desirous to determine true capital requirements and financial outcomes related to the strategic consideration of risks and opportunities as they are identified and assessed. Risk measures provide the opportunity to translate risks into the amount of economic capital needed to withstand the volatility that has been assumed. Economic capital is a key component of linkage, producing an absolute value of funds needed to bear a specific risk, given senior management's defined risk tolerance, but also providing a mechanism by which various strategic decisions relating to risk mitigation and exploitation may be compared and contrasted, even when such decisions involve risks relating to completely different aspects of the company operations. The cost of capital, or economic capital multiplied by senior management's hurdle rate, similarly allows for ease of comparison in strategic decision-making. To estimate economic capital, one should address the probability or confidence level at which risks are to be withstood as well as the time horizon under consideration. A timeframe of one year seems to be common for ease of use and due to the fact that many property-casualty insurance companies write annual contracts and many life insurance companies have annual surplus declarations. (KPMG, Risk and Capital Management, 7, 27) Other timeframes could complicate the modeling techniques but may be quite relevant particularly for life insurers writing long duration products.

In a highly evolved environment, one stochastic modeling technique can be utilized for all risks, with consistent application to the risk at hand, whether it be the impact of a new distribution system, product pricing, or liquidity of investments. Further, an aggregate view of risk for senior management review will be determined through a correlation mechanism. No consensus exists on how best to model risks and capital needs but whatever methodology is selected, a consistent view on how to calculate economic capital will be most effective. Consistency allows for ease in comparison of multiple options, informed decision-making, and assessment of multiple business units. Economic capital can be a direct means for making informed decisions that will lead to value creation. However, even the most technologically sophisticated of companies consider there to be room for improvement in risk quantification and aggregation. Currently, there simply is not enough data or knowledge of distributions to adequately model certain risks.

Evolution in the Real World, continued

Financial measures will always be paramount for senior management and for stakeholders; profit and loss metrics obviously drive any business. The new dimension in a linked environment allows for performance measurement on risk-adjusted bases. Due to the accounting environment in which the insurance industry operates, companies must still track traditional GAAP and statutory financial statement balances. But any of a multitude of financial measurements, from return on equity to combined ratio, can be translated into a risk-adjusted metric, at least for internal purposes. From an economic value perspective, cash-flow driven metrics such as duration or internal rates of return are particularly valuable, preferably taking into account risks, timing of such risks, and the associated time value of money. Such metrics give a complete picture of the "value" of a given decision.

The culmination of an integrated environment may be the assessment of management performance and resulting compensation through a review of risk adjusted financial metrics. Today, very few companies link management compensation with financial performance stemming from risk and capital management. Clearly, the majority of companies have not been on this journey long enough to have accomplished the necessary linkage. Some do have both the conceptual framework and technological capabilities in place to perform such measurements. Yet even for these companies, there is general reluctance to rate performance solely on risk-adjusted metrics; a minority do base management compensation on some combination of risk adjusted metrics and traditional financial metrics. For the most part, there are too many unknowns associated with modeling certain risks, and no standards within the industry on what the best measurements of either risk or performance are. Explicit management compensation linked to risk-adjusted metrics could also drive individual behavior in ways that are not intended. Until these issues are more fully addressed, concern exists that the external world might believe a company is playing with its financials, rather than reporting credible, robust and useful results. Still, many companies see the future state of full linkage, not only with risk-adjusted metrics but also with management compensation, arriving within a matter of only a few years.

Evolution in the Real World, continued

Models and Metrics

There is a perception that only highly sophisticated modeling will yield results, but this not a correct assessment. Stochastic models may be preferred because the ability to assign probabilities to outcomes is highly desirable in evaluating strategic outcome. Yet models which try to do everything for everyone in every situation may be too unwieldy to be of great use. Not every company has the resources to build ground-up sophisticated models; all have the ability to measure the most significant risks and equate them with capital needs and financial results.

There is no right answer regarding which risk measures and performance measures to model for strategic decision-making. If the modeling capabilities exist, several measures should be programmed into the model, with guidance by senior management of which measure or measures will receive priority, perhaps varying by situation. Ideally, in consideration of every risk, no matter its nature, the decision-making process would follow the same discipline.

The goal of modeling is to cast risks and returns in an economic value light, i.e. risk-adjusted and reflective of the present value of cash flows, rather than a traditional accounting perspective, i.e. on a non-risk adjusted, calendar year basis. However, GAAP and statutory accounting financial statement and capital requirements exist; therefore, the most effective models will first and foremost provide the desired economic information, without losing the capability of reporting the more traditional accounting bases as needed.

5. Education and Communication

Regardless of the amount of technical rigor applied throughout the linkage process, a key component of success is education and communication at all levels within an organization as well as the Board of Directors and Audit Committee. Part of the educational process is "buy-in" from participants that evolution is worth the considerable time and effort that it entails. Since senior management does set the "tone at the top", it is highly likely that they distill the desire to take such an undertaking seriously down throughout the company. Others may drive the education upward to senior management, by explaining how complicated models that may appear to be "black boxes" actually work and provide value. Often, risk owners at the functional level present information upward on the risks and opportunities being faced in the field.

Evolution in the Real World, continued

In particular, communication enables all functional areas to learn about risks and responses throughout the organization, thus encouraging an environment wherein different areas become cognizant of how their actions impact others. This is the manner by which patterns and correlations become apparent. Regardless of the overall framework in place, day-to-day operations and decisions drive a company's activities, and a risk-aware culture operates more strategically than one operating within silos. Over and over, companies who have already embarked on the journey to full integration maintain that this is at least as important as the technical exercise.

6. Monitoring

A functional framework for the overall process includes regular monitoring of risks and results. This could include periodic status reports such as risk dashboards and meetings among senior management, including the Board of Directors, and risk owners at pre-defined intervals. It could also include triggers for action under certain circumstances. Whatever the form, monitoring reinforces the importance of linkage and the discipline needed to achieve such linkage.

Whether small or large, mutual or stock, any company can benefit from a more integrated approach to strategic decision-making, though the journey to integration will vary. Smaller companies may not have the same data and resources that a larger company may have, but techniques still exist for risk identification and measurement. Mutual companies may have a different risk appetite and philosophy than stock companies but even if their ultimate goal is capital preservation for the policyholders' benefit, an understanding of the risk profile and impact of decisions on capital will be valuable.

Benefits

Implementation of an integrated risk, capital and financial management environment is resource intensive on many levels over a long time horizon. Why are companies willing to make this long-term commitment? In theory, the more holistic state should lead to better decision-making, and therefore, better key performance indicators such as loss ratio or rate of return.

Anecdotally, some companies maintain that certain key decisions made in a linked environment have led to favorable results. For example, a large, diversified property casualty insurance company had traditionally not purchased significant reinsurance, assuming that its size and diversification did not merit the cost. After reviewing its risks and economic capital position, the company developed a complex reinsurance program. The hurricanes of 2005 resulted in significant claims payments for the company, but its return on equity at least met the cost of capital, a positive outcome in such circumstances. Another points to a block of new business that it declined to write due to the perceived risk-adjusted returns not meeting its hurdle rate, only to learn subsequently of the block's poor experience.

Examples of improved financial results are intriguing, but the majority of the industry is still wary that a well-functioning integrated process automatically will have a positive impact. Rather, the benefit that is universally recognized is the ability to understand events and respond intelligently to shareholders, the Board of Directors, regulators and rating agencies. Further, the communication and education that follows from embarking on this journey is viewed positively by both senior management and those in operations – certain risks or interactions among risks that might have been previously unnoticed may become apparent, and awareness around the importance of decision-making becomes heightened. This creates a learning environment at many levels within an organization. One consistent approach, e.g., through prioritized risk measurement and performance measurement used to reach all conclusions, takes cultural and functional biases out of the decision-making process. There are companies who continue to believe that they function effectively even in a silo environment and those who will evolve only in response to external pressures, but even these companies cite the above intangible benefits as being worthwhile.

Challenges

Not surprisingly, the resource commitments necessary for implementation are significant. Even if some value is recognized from the exercise, the costs relative to perceived benefits do not always stack up favorably as both senior management and operational personnel go about their day-to-day activities. The building or purchasing of a model to be used for analysis is a good example. In all companies, competing objectives will vie for actuarial and information technology resources that would be necessary to build an internal model. For smaller companies, technical resources may not exist internally. However, external models may be prohibitively expensive. It also may be time-consuming and difficult to adapt a generic or industry-based model to a specific company's risk profile. A further complication is the likely existence of certain models already developed, if only those such as risk based capital or asset liability matching models; how will these be adapted to integrate with economic modeling? However, an existing model may be viewed as a benefit as well as a challenge; often, it is possible to leverage such models to accomplish at least certain degrees of economic modeling, rather than starting from scratch. Despite the direction of Solvency II in Europe and rating agencies in the United States toward consideration of internal models, many companies perceive that they will not get "credit" for using their own models.

The technical and theoretical challenges related to modeling are pervasive, even for those companies that are highly evolved. Stochastic modeling may be preferred, but there is still great debate over the proper distributions and parameters for insurance risk, much less those risks, e.g. operational, with little historical data available for analysis. The proper estimation of risk aggregation is still particularly demanding; again, much debate centers around the most appropriate manner in which to capture dependence and diversification. Potentially, correlations may exist, e.g. between homeowners insurance and variable life products or between investment portfolio returns and workers' compensation claims, but an accurate quantification is difficult; this is compounded further when an organization participates in multiple insurance and non-insurance businesses. Even computing power and time, while considerably more advanced than even a few years ago, are challenging when one considers the amount and complexity of data potentially available.

Challenges

Stepping back from more technical aspects, achieving a culture wherein risk owners and senior management actively interact on risks and decisions between and among various areas is easier said than done. The silo mentality is well ingrained within organizations, and change can be difficult. The best decision for a particular risk owner in a particular function may not be the best decision for the organization as a whole. If a company, for example, designs a new product with pricing features that are different from the norm, the marketing department may resist promoting it, fearing a backlash by agents and loss of market share. It also remains a constant struggle in all companies to position risk management as allowing for strategic and opportunistic growth, rather than just being a proponent of risk reduction. Viewed opportunistically, risk owners at all levels of the organization will tend to be more enthusiastic when facing the associated challenges.

Cultural differences may be accentuated when an organization is relatively de-centralized. By its very nature, such decentralization potentially contributes to a more ingrained silo perspective. Even the development of standardized terminology within a complex organization can be onerous. Often, risk terminology is subtly different depending on one's perspective, and standards have yet to be developed within the industry; even insurance product terminology can vary within one organization with operations in multiple countries. A lack of understanding at this fundamental level will only lead to confusion as the evolution progresses.

Just Starting Out? Consideration

The focus on a holistic risk, capital and financial management environment is intensifying. More and more companies are realizing the need to embark on an evolutionary process, but even with good intentions, the process might seem overwhelming. The following are practical suggestions for getting started and gaining momentum.

1. Establish buy-in and direction from senior management and the Board of Directors. Ensure operational functions and business units understand the desired goals and have an opportunity to participate in shaping the process, thus establishing operational buy-in as well. This encompasses education and communication between and among all participants in the process.

2. Establish a well-defined framework that links risk, capital and financial management. Include standardized terminology, role clarity and accountability for specific tasks. As the evolution proceeds, it will be important to see that strategic decisions are being made on a risk-adjusted basis using the defined framework.

3. Recognize that, being in the business of risk, certain components to the process are already in place. Even if the terminology is foreign, every business unit identifies and evaluates risks in some manner; build on this recognition rather than starting from scratch.

4. Keep it simple, at least at first. Start with the most material risks, basic financial metrics and economic modeling commensurate with technical resources. Consider the cost-benefit tradeoff of analytical completeness with technical complexity. Economic modeling capabilities are clearly important, but not at the expense of inertia in performing analyses or inability to explain results to senior management or external parties.

5. Become familiar with best practices but realize that integration of such practices can come over time and are dependent on each individual company situation. Many well-developed frameworks, risk measures and performance measures exist within the industry, but there are no right answers. The best approach is the one that helps an organization understand its own unique balance between risks taken and rewards achieved.

Conclusions

The linking of risk, capital and financial management is not a passing fad. In the real world, many companies are well on their way to achieving an integrated state, while many others are just beginning the journey. A whole spectrum of companies lies in between. Many formidable tasks lie on that evolutionary path; a multitude of components must be considered. But there is nothing wrong, and in fact it may be advantageous, to break down the multitude into smaller, simple pieces. Figure 6 shows a sampling of components that may be intertwined.

Holistic State – Risk Adjusted Value Management

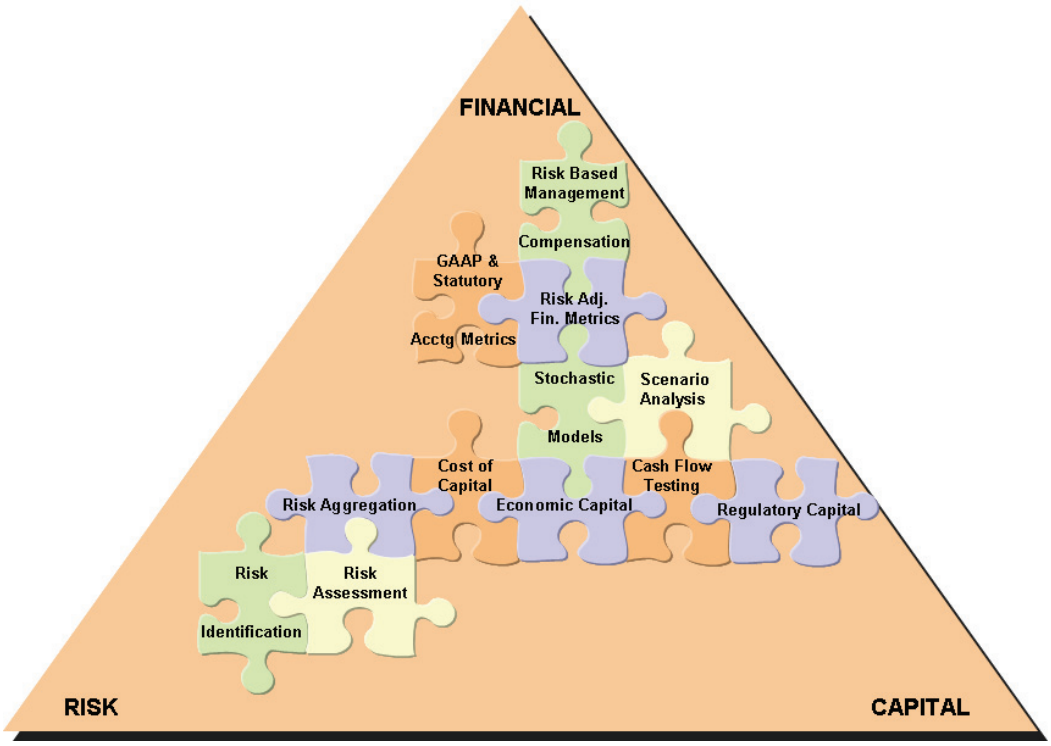

Figure 6 - Multiple components make up a linked risk, capital and financial management environment.

The culmination is an end-state where risk and capital management are intertwined, producing risk-adjusted financial measurements, and where risks are both mitigated and exploited in a controlled, strategic manner. Linkage allows for a continuous cycle of risk awareness, capital and financial performance considerations. Right now, generally companies have not achieved complete integration, but those that are striving toward that ultimate goal consider it worth the trip.

Appendix A

Appendix A

A. Detailed Terminology

- **Performance Measures**
  - Economic Capital – capital determined to cover potential losses at a given risk tolerance level and time horizon. The risk tolerance level relates to the probability with which risks are to be withstood.
  - Economic Value Added (EVA) – absolute performance measure; should be positive:
    - EVA = Income – Claims – Costs – Change in Expected Loss – Cost of Capital
    - Income = premium, investment income on provisions and economic capital
    - Income – Claims – Costs = actual net cash flows for the period
    - Expected Loss – covers all “expected” risks
    - Cost of Capital – product of economic capital and the hurdle rate
  - Embedded Value – measure of the value of business currently on the books of an insurance company (adjusted net worth plus the present value of expected future profits on in-force business); essentially, Present Value of Distributable Earnings. Performance is typically expressed in terms of growth in embedded value rather than the absolute value.
  - Risk-adjusted Return on Risk-Adjusted Capital (RORAC) – a relative performance measure that takes into account the change of expected loss. Requires a comparison to a benchmark return.

Appendix A, continued

$$\text{RORAC} = \frac{\text{Income} - \text{Claims} - \text{Costs} - \text{Change in Expected Loss}}{\text{Economic Capital}}$$

- Risk Based Capital – regulatory capital requirement by NAIC. Formula driven minimum capital standards.
- Sharpe Ratio – typically related to investment strategies, defined as expected return excess of a benchmark return divided by the standard deviation of the excess return.

- **Risk Types**
  - Concentration risk – the risk of a higher than normal exposure to a single segment, product, or geographic location.
  - Credit risk – the risk of default and change in the credit quality of issuers of securities or intermediaries to which the company has an exposure, such as reinsurance companies.
  - Disintermediation risk – see liquidity risk.
  - Group risk – the risk of insolvency and credit downgrading of one member in a group having an adverse impact on another member of the group.
  - Insurance risk – the uncertainty on the frequency, severity and time to payment of future claims and associated expenses. This is also known as underwriting or liability risk.
    - Life companies – mortality
    - Property Casualty companies – frequency/severity, including extreme events
    - Health companies – morbidity
  - Liability risk – see insurance risk.
  - Liquidity risk – the risk that an organization may be unable to meet its obligations due to timing mismatches between asset and liability cash flow patterns. Other risk types may lead to liquidity risk, for example through higher than expected mortality rates due to a pandemic or due to a drastic exit from a specific business line. Also known as disintermediation risk.

Appendix A, continued

- Market risk – the risk that the economic value of the company is affected by the performance of the financial markets, the resulting impact on actual asset and liability values and cash flow.
- Model risk – the risk that assumptions and techniques are inappropriate for the problem being modeled or of formulaic errors in the modeling system.
- Operational risk – the risk of loss resulting from inadequate or failed processes, behavior, and systems, from either internal or external events. This can include:
  - Legal risk
  - Compliance risk
  - Tax risk
  - Fraud risk
  - Facility risk
  - People related risk

  Operational risk tends to be extremely difficult to quantify due to the lack of objective and credible data.
- Reputation risk – the risk of loss resulting from negative publicity relating to a company's business practices.
- Strategic risk – the inability to implement appropriate business plans and strategies, including change management.
- Underwriting risk – see insurance risk.

Appendix A, continued

- **Risk Measures**
  - Standard Deviation – quantification of how much the possible outcomes of a distribution differ from the expected value. Limitations are:
    - Difficult to use in calculating economic capital because linking its level directly to insolvency with a certain probability is generally not possible
    - Does not differentiate between positive and negative deviations
    - Does not fulfill concept of monotonicity, i.e. for random variables X and Y where X <= Y, P(X) <= P(Y)
  - Probability of Ruin – measures the probability of an event of such nature as to lead to the ruin or insolvency of a company, i.e. point at which capital is exhausted.
    - Is not sub-additive, i.e. for random variables X and Y, P(X+Y) <= P(X) + P(Y)
  - Expected Policyholder Deficit (EPD) – represents the average shortfall of capital relative to losses in the event of ruin or insolvency. Also known as Economic Cost of Ruin.
  - Value at Risk (VaR) – measures the maximum possible loss to a given confidence level over a given time horizon, usually one year. Benefits and limitations are:
    - Considers the risk appetite of the organization
    - Does not differentiate between losses beyond the risk appetite defined
    - Is not sub-additive

Appendix A, continued

- Tail Value at Risk (TailVaR) – the expected loss under the assumption that a loss occurs that is larger than the VaR at a given confidence level over a given time horizon. Also known as Conditional Tail Expectation or Expected Shortfall.
  - Accounts for possible losses beyond the confidence level and weighs them appropriately
  - TailVaR is a sub-additive measure for continuous distributions; conditional tail expectation fulfills sub-addivitiy even for a discontinuous distribution.
- Spectral Risk Measures – the weighted loss under the assumption that a loss occurs that is larger than the VaR at a given confidence level over a given time horizon, with the weighting based on a risk aversion function.
  - TailVaR is a special case of spectral risk measure, with equal weights given to tail loss quantiles and zero weight given to other quantiles.
  - Spectral Risk Measures satisfy the mathematical property of coherence if the weights are positive, sum to zero and assign larger losses at least the same weight as smaller losses.

Appendix B

Appendix B

B. Literature Sources

The following presents the results of our literature survey regarding seminal literature on the topic of enterprise risk management, and specifically, linkage of risk management, capital management and financial management. These sources are categorized loosely by topic for ease of reference.

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