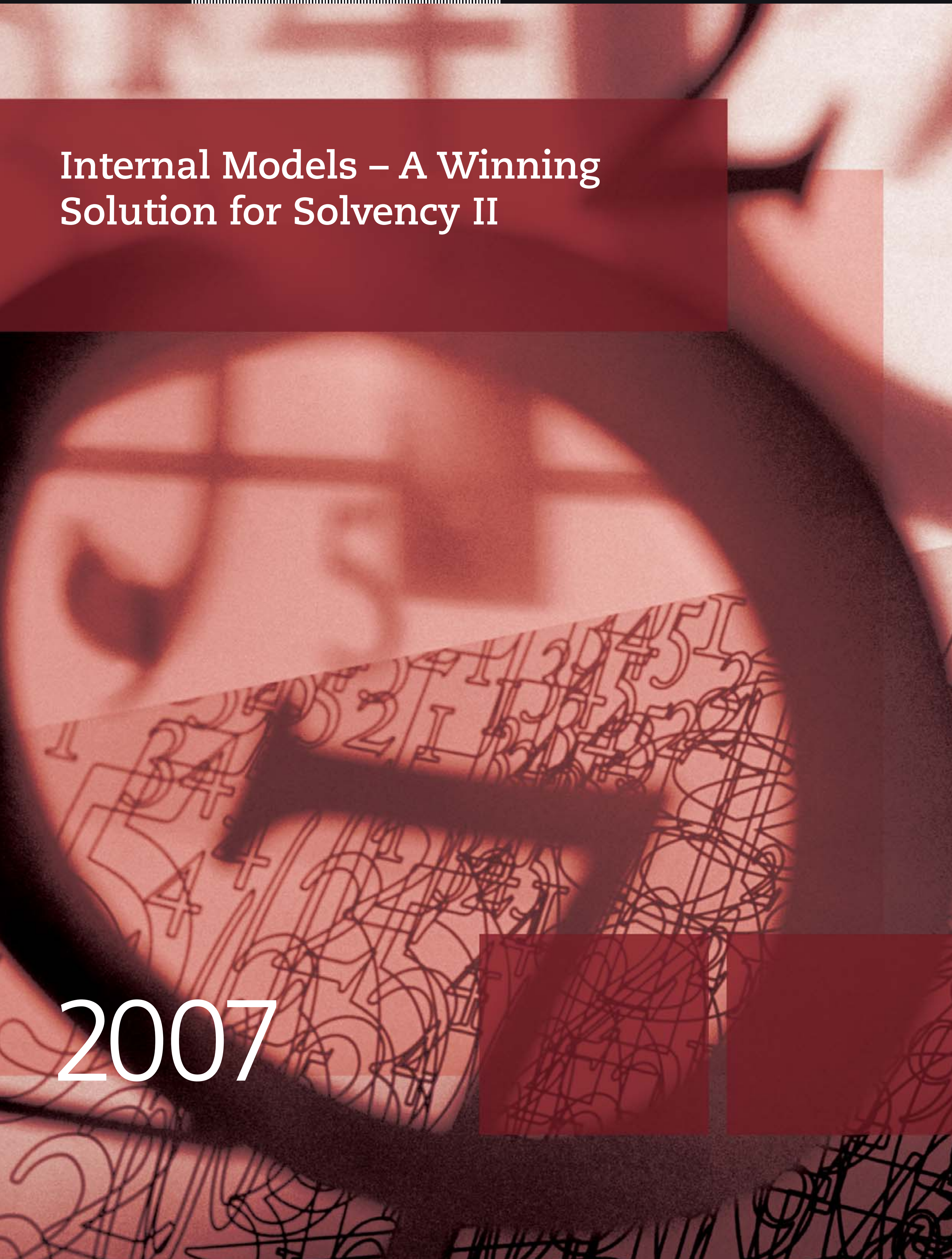
GUY CARPENTER

MARSH MERCER KROLL
GUY CARPENTER OLIVER WYMAN

Internal Models – A Winning Solution for Solvency II



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Executive Summary

Solvency II regulation is approaching, though at a slower pace than initially expected. Current projections anticipate that Solvency II requirements will be fully implemented at the end of 2012, two years later than previous estimates.

The European Commission published its proposal for a ground-breaking revision of European Union (EU) insurance law designed to protect policyholders and the stability of the financial system as a whole on July 10, 2007. This proposal is often referred to as the Framework or Draft Directive of Solvency II. In essence, the Draft Directive follows the proposals developed previously by the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS), such as market consistent valuation of assets and liabilities and the calibration of the solvency capital requirement (SCR) to a 99.5% Value at Risk (VaR) combined with strong emphasis on sound risk management and robust internal controls.

The Framework suggests a two-tiered approach for determination of regulatory capital adequacy. The first tier is the minimum capital requirement (MCR), the threshold below which an insurer will not be able to write business; the second, the SCR below which an insurer will likely need to discuss remedies with the regulator.

To calculate the SCR, companies will have the choices of the standard model, an internal capital model or a combination of both. The formulaic standard model will be easier to implement and will treat risks consistently across companies. For small companies without complicated or highly unique risks, this approach may be adequate. However the standard model will not reflect any characteristics specific to a company or its jurisdiction, such as:

> Focus on particular business niches and/or risk mitigation strategies

> Reinsurance programs with features such as profit commissions, caps, indexes or corridors

> Changes over time in business strategy

Internal models can overcome these drawbacks, but require expertise and resources for parameterization, model building, validation, interpretation and communication. Per the Draft Directive, internal models will also require supervisory approval, a process that is just starting to be addressed by CEIOPS and other interested parties.

There are many advantages to integrating an internal model into a company's enterprise risk management process in addition to its value in meeting supervisory solvency requirements. Among other things, it can be used for:

> Evaluating the company's risk profile and related reinsurance and investment strategies in the context of its risk appetite

> Discussing capital management with other external parties, such as rating agencies

> Evaluating returns on risk-adjusted capital for individual business segments

> Understanding the relative contribution of the major categories of risk (non-cat losses, catastrophes, reserve, credit and market) to the company's risk profile

> Providing quantitative input into the M&A process

Integrating an internal capital model into key enterprise business processes can turn the regulatory burden into a competitive advantage.

1. Solvency II – Background

Scope and Timeline

Under the Draft Directive, Solvency II establishes a solvency system better matched to the risks of each insurance company than the current regulations. The new framework will be based on a three-pillar approach comprising:

1. Quantitative requirements for measuring capital adequacy (Pillar I)

2. A supervisory review process including review of risk management practices (Pillar II)

3. Increased transparency and reporting requirements (Pillar III)

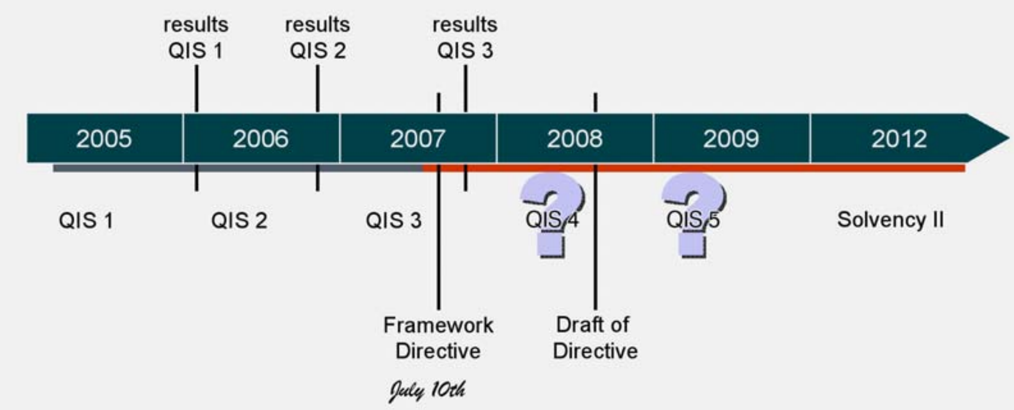
Solvency II will establish two levels of capital requirements:

1. The Minimum Capital Requirement (MCR) - the threshold at which companies will no longer be permitted to trade

2. The Solvency Capital Requirement (SCR) - the target level of capital below which companies may need to discuss remedies with their regulators

The SCR may be calculated using the prescribed standard model or a company's internal model, where the latter will be benchmarked against the output of the standard model. To gain more clarity on the standard model, Quantitative Impact Studies (QIS) are being conducted by the local regulators on behalf of the CEIOPS, according to the schedule in Figure 1.1.

Figure 1.1:
Solvency II Implementation Timeline



Economic Balance Sheet

The initial step in a risk-based capital assessment is the determination of an economic balance sheet, containing market values of assets (MVA), market values of liabilities (MVL) and available capital, being defined as the difference between MVA and MVL. The available capital will be compared to the risk-based solvency capital requirement to assess the insurer's solvency status. The market valuation approach to insurance assets and liabilities is in line with the development of new International Financial Reporting Standards (IFRS) for insurance companies.

Market values of assets are instantly available from the financial markets. On the other hand, insurance liabilities, which are not traded on any liquid market, require a significant degree of judgment to assess their market consistent values. Current proposals include a Best Estimate combined with a risk margin, called the Market Value Margin (MVM). The Best Estimate is the expected value of the unpaid liabilities stated on a present value basis. Currently, the cost of capital approach for determining the MVM seems to have the strongest support among European insurers. Under this approach, the MVM corresponds to the discounted cost of the regulatory capital required (including market and credit risks in addition to reserve risk) during the run-off of the liabilities, assuming a fictitious investor requiring a certain return on equity.

Solvency Capital Requirement (SCR)

A risk-based model is used in the Solvency II framework to measure the company's level of risk and the amount of capital that is required to support this risk profile adequately. The solvency assessment is based on evaluating the risks in the current economic balance sheet and their effects during the forthcoming one year solvency horizon. This assessment is achieved by projecting the balance sheet one year into the future with respect to both new and old business.

Under Solvency II, companies will be required to hold a level of available capital (on an economic basis) such that the probability for technical insolvency during the coming year is less than 1 in 200. The solvency capital requirement is hence defined by:

- The risk measure Value at Risk (VaR)
- The solvency risk assessment horizon of one year
- The confidence level of 99.5%

Standard Model

In the Solvency II standard model, the capital requirement is evaluated for the separate risk classes via a combination of stress tests, scenarios and factor-based capital charges. The model includes underwriting, market, credit default and operational risks, based on aggregations of sub-risks, such as market interest rate risk and non-life underwriting CAT risk. Capital charges are determined using a bottom-up approach, where the capital required to support a 1-in-200 year adverse event is first calculated for each sub-risk, followed by a final aggregation to a company total SCR using a prescribed correlation matrix. The goal is that the standard model will assess the company's net risk and calculate the capital requirement after all risk mitigation has been recognized.

The advantage of using the standard model is a less complex and a less time-consuming SCR calculation, especially for companies without internal models in place. The standard model makes it possible to assess capital requirements in a risk-based manner with limited internal data and modeling experience, and provides a good overview of what areas of the company's business are driving its capital requirements. The standard model supports a harmonized approach to risk measurement and risk aggregation in the European market and, although not as tailored to the company's own unique risk profile as an internal model, it gives incentives to start gathering internal performance data and to utilize standard risk mitigation procedures.

There are also drawbacks when using the standard model. The wide group of insurers for which it is intended is heterogeneous with respect to size, business mix and jurisdiction. Because the standard model aims to capture the risk profile of an average company, many approximations are made in modeling risks to avoid the use of many country- or company-specific parameters. In situations in which the standard model is not specific enough, it may contain conservative parameters.

Neither capturing non-linear phenomena from non-proportional reinsurance both for natural perils and per-risk covers nor measuring the effect of profit-sharing or loss-based commissions can be done satisfactorily in a standard factor-based model. Further, with its reliance on historical data, the standard model appears to assume that the present reinsurance cover has been used historically and also that it will remain in place in the future. Since reinsurance, being the most important risk mitigation for most insurers, is constantly being re-evaluated for optimal capital efficiency, this simplification can have severe consequences.

2. Fundamentals of Internal Models

The alternatives to the standard model for deriving Solvency II capital adequacy requirements are an internal model or one or more partial models. An internal model incorporates identification, measurement and modeling of a company's key risk components and their correlations. That is, the risks incorporated into an internal model are likely to be the same or very similar to those included in the standard model.

The partial model option allows companies to use limited-scope models to derive the 1-in-200 adverse-event values for selected risk components. These values are then combined with the standard-model results for the remaining risks and are correlated using either the standard-model or company-derived correlation factors.

The primary differences between the standard model and internal models are:

> The extent to which company-specific data are used to parameterize the model

> The use of simulation in place of factors to quantify risk

> The effort required to derive the capital requirement

An internal modeling framework works best with proper data management, actuarial and stochastic modeling expertise and a powerful simulation platform. The simulation platform should have the capabilities of:

> Quantitative modeling of all material risk categories, including their correlations

> Recognizing and modeling of risk mitigation structures

> Calculating the resulting capital requirement

> Providing transparent reports, including sufficient detail to compare capital requirements for each risk and sub-risk to those from the standard model

The goal should be to create a stochastic model with structures and relationships that best depict the company's unique business. For the company's own flexibility, economic capital should also be calculable using various

> risk measures, including Value at Risk (VaR) and Tail Value at Risk (TVaR)[1]

> levels of confidence

> time horizons for solvency assessment and risk assessment

and possibly including other risk classes not recognized in the regulatory model.

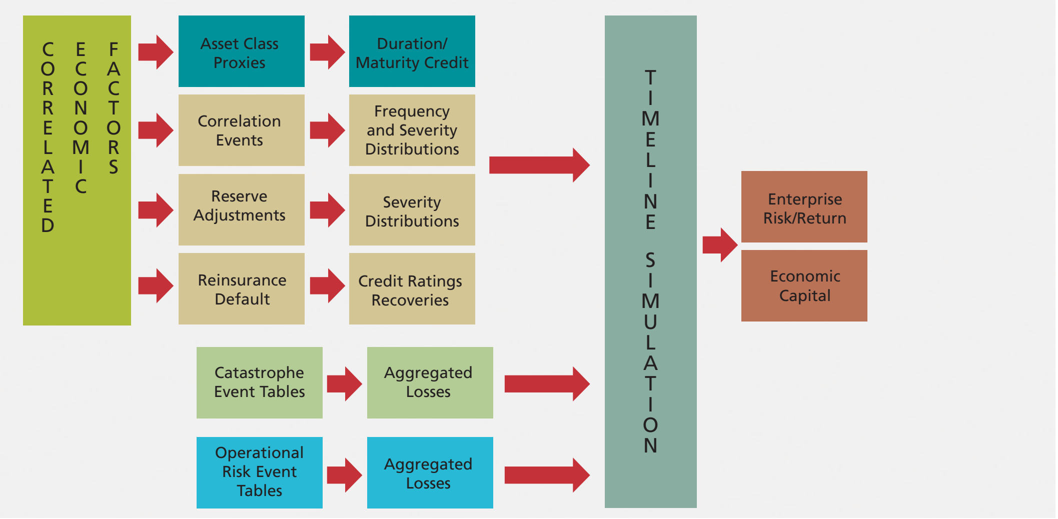
Insurance companies with full internal models have the possibility of running their businesses more effectively, focusing on the profitable areas. They are more likely to have cost-effective risk mitigation solutions in place in light of the company's qualitative and quantitative goals. With such a framework, the company can also evaluate the level of capital needed to protect against adverse events. They know that risks are being measured appropriately and thus are more likely to be managed efficiently and effectively. A full internal model is expected to be able to assess numerous effects that would not be easily quantified using a simpler standard model.

[1] *Susan E. Witcraft, "Risk Measures," Encyclopedia of Actuarial Science, John Wiley & Sons Ltd., London, 2004.*

3. Internal Models - Key Features

Internal models can vary enormously in their structure and complexity. Figure 3.1 illustrates some of the typical dynamics of a 'good' model. As one can see, there are many interactions among the key risk categories of market, underwriting (current accident year and reserve development) and credit risks.

Figure 3.1:
Fully-implemented Internal Model Schematic



Underwriting Risk

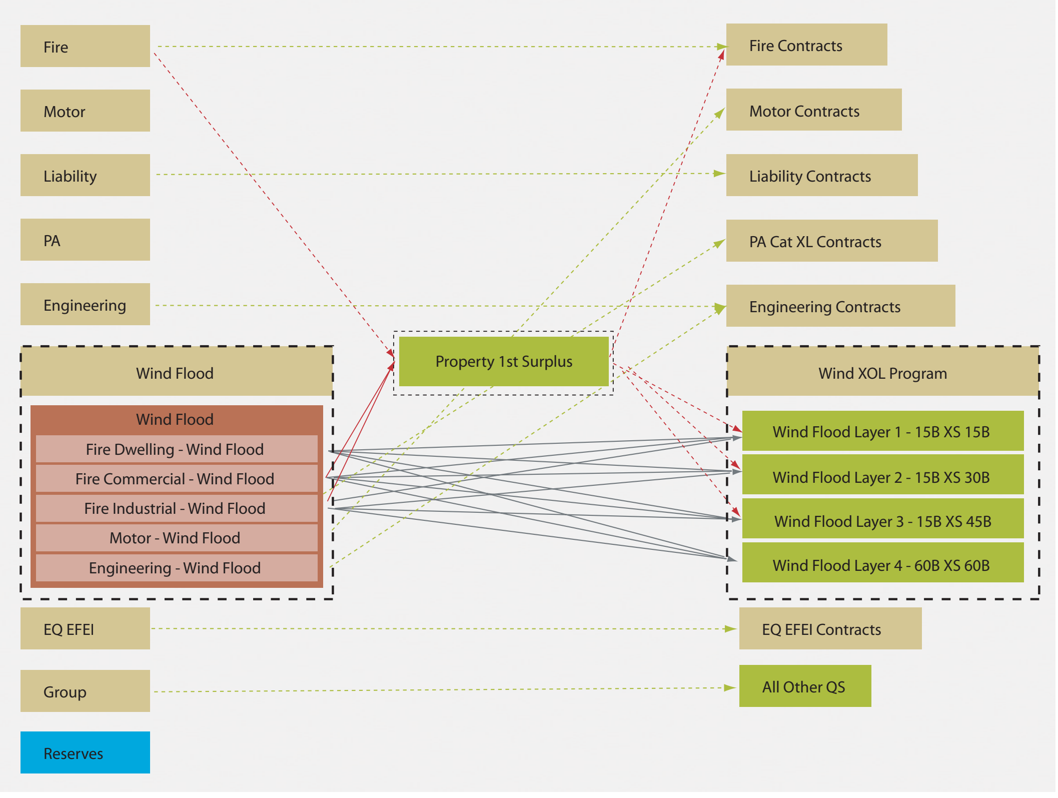
The underwriting risk model will generally start with models of gross losses, including

> Non-cat losses derived from combinations of statistical models of the company's own loss experience and exposure rating

> The output from commercial catastrophe models

It may also include an explicit model of the underwriting cycle, by including changes in the premium level separate from loss trends. Further, the model should include the risk mitigation effect of all types of proportional, non-proportional and aggregated reinsurance structures. The reinsurance programs can be very complex given the many permutations that arise among Cat XL, Per Risk XL, Surplus Share and other types of reinsurance. There is a need for flexible models that allow efficient construction of reinsurance program models. An example of such a program is shown in Figure 3.2.

Figure 3.2:
Loss Cause and Contract Diagram



Market Risk

When using an economic scenario generator, fundamental relationships between asset classes are modeled explicitly.[2] Coherent scenarios of equity dividends and returns, property appreciation, currency exchange rates, and interest rate yield curves can be generated, and their effects on investment returns and market values quantified. It is then possible to assess what other aspects of the business are dependent on the economic scenarios, and to model those cause-and-effect relationships explicitly. Economic conditions can be coupled to expenses and claims inflation, as well as trigger indexation clauses in reinsurance contracts. In a full internal model, these interest rate and index level changes will also directly impact the Best Estimate of net liabilities. Such a cause-effect structure allows the market risk effect on the net asset value of the company to be measured.

Credit Risk

Credit risk can be modeled using rating-dependent default rates together with a distribution for percentage loss once a default is simulated to have occurred. A sample input table is shown in Figure 3.3. The default rates (POD or probability of default) and percentage losses given default (LGD) are shown for each reinsurer. These parameters not only drive the simulation process in the economic capital model, but can also be used to derive the expected value of default (E[loss]) and the standard deviation thereof (SD[loss]).

Figure 3.3:
Credit Risk Model

RI CREDIT MODEL

ABC Insurance Company

No. of Reinsurers	25
Recoveries	4,950,055
Expected Loss	144,0844

Reinsurer	Recoveries	Rating	POD	LGD	E(Loss)	SD(Loss)
Reinsurer A	100,000	B-	9.563%	65.000%	65.000%	22.500%
Reinsurer B	110,000	BB-	2.792%	60.000%	60.000%	22.500%
Reinsurer C	120,000	AA+	0.019%	50.000%	50.000%	22.500%
Reinsurer D	130,000	B-	9.563%	65.000%	65.000%	22.500%
Reinsurer E	140,000	CCC	19.824%	80.000%	80.000%	22.500%
Reinsurer F	150,000	B+	3.667%	65.000%	65.000%	22.500%
Reinsurer G	160,000	BBB-	0.544%	58.000%	58.000%	22.500%
Reinsurer H	170,000	B	8.594%	65.000%	65.000%	22.500%
Reinsurer I	180,000	AA+	0.019%	50.000%	50.000%	22.500%
Reinsurer J	190,000	BBBpl	0.300%	58.000%	58.000%	22.500%
Reinsurer K	200,000	CCC	19.824%	80.000%	80.000%	22.500%
Reinsurer L	210,000	A	0.055%	55.000%	55.000%	22.500%
Reinsurer M	220,000	B	8.594%	65.000%	65.000%	22.500%
Reinsurer N	230,000	BB	2.772%	60.000%	60.000%	22.500%
Reinsurer O	240,000	BB	2.772%	60.000%	60.000%	22.500%

It is critical to adjust the "pure" default probabilities to reflect the reinsurers' unwillingness to pay certain claims in the event of disputes. In addition, correlation in defaults among the panel of reinsurers can be considered, as well as the correlation between defaults and large losses from natural catastrophes occurring in the underwriting risk module.

Credit risk is typically higher for the panel of reinsurers covering the run-off of existing technical provisions compared to the panel used for the current underwriting year. In a multiyear model, potential downgrades of reinsurers could be explicitly taken into account.

Operational Risk

In practice, today, many modelers increase the otherwise-derived required capital by a percentage (often ranging from 5% to 15%) to incorporate operational risk. Alternatively, based on relevant historical operational losses, operational risk could be modeled using a frequency/severity approach. Risk mitigation via insurance, like D&O, as well as operational risk triggers that would be captured by the company's enterprise risk management (ERM) process could be used to mitigate risk and cap losses in an internal model. When modeling operational risk, it is important to avoid double counting these risks. If insufficient reserves is considered to be an operational risk, then reserve risk data must be "cleaned" of this effect so as not to include such a loss in the model both as an operational risk and an underwriting risk. A quantitative model for operational risk will be an important part of the company's ERM.

[2] *Guy Carpenter has recently partnered with Algorithmics Incorporated to provide worldwide economic scenarios for its MetaRisk model.*

Assessing Correlation and Aggregating Capital Using Copulas[3]

The total effect from adverse outcomes is significantly influenced by the interdependence among risks. When assessing capital requirement on a 1-in-200-year level, the main interest is in the tail correlation. Assessing correlations using copulas, which measure correlations between risks across their full distributions, is recommended instead of the commonly used linear correlation coefficient which represents the average risk correlation across the distribution. The differences between linear correlation and a copula can be illustrated by comparing Figures 3.4 and 3.5. Figure 3.4 shows that correlation between two variables is constant for all values of x and y, whereas Figure 3.5 shows a copula that leads to high positive correlation when the values of x and y are both high and little to slightly negative correlation when they are both small.

Figure 3.4:
Linear Correlation

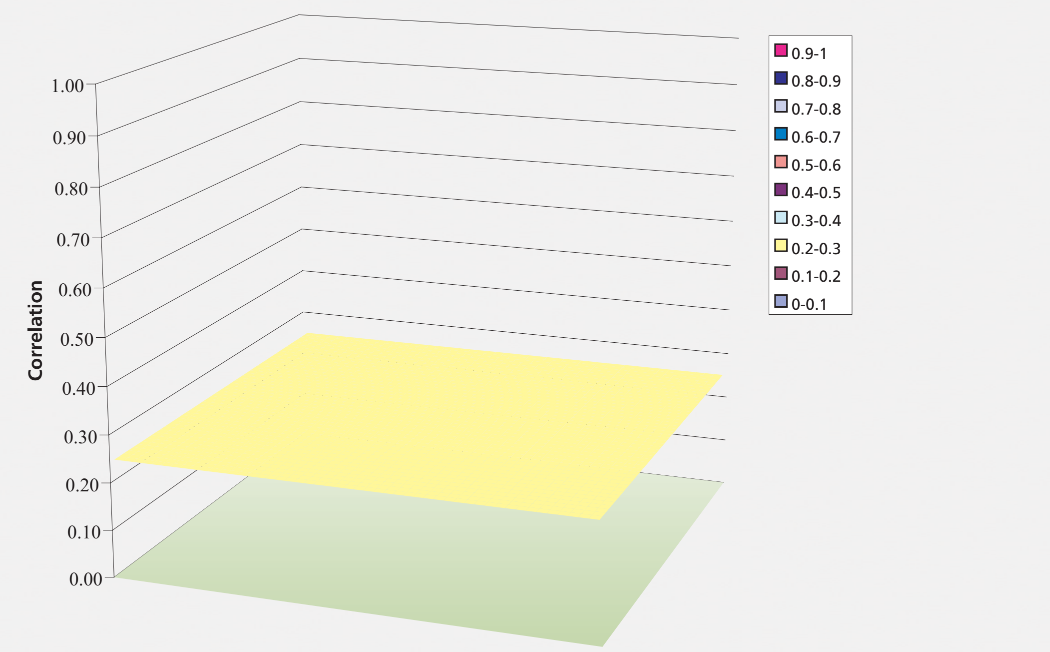
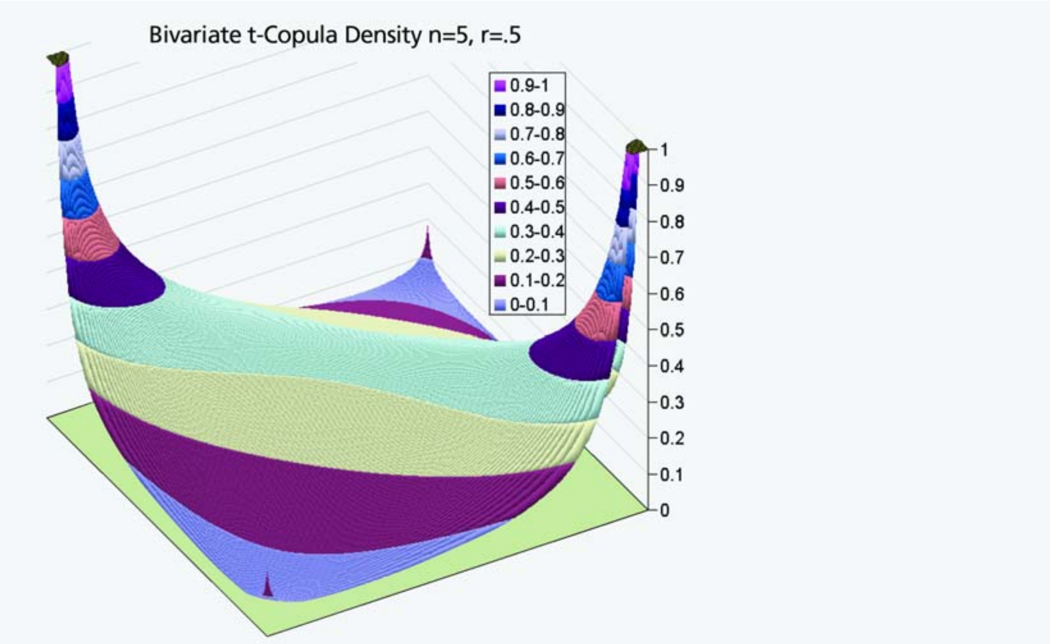


Figure 3.5:
Correlation Using a Copula



With correlation described by a copula, economic capital assessment can readily be recalibrated to other risk levels, making the regulatory risk model internally usable when calculating economic capital reflecting the company's own risk appetite, which may consider a different timeframe, metric or confidence level.

[3] *Gary G. Venter, "Tails of Copulas," Proceedings, Casualty Actuarial Society, Vol. LXXIX, 2002, pp.68-113.*

In the long term, the internal model should capture interdependencies explicitly by modeling directly all significant cause-effects among risk categories. When using partial internal models with independent modeling of single risk classes, all relevant cause-effect structures cannot be properly reflected. As long as the risk measure and calibration level for each sub-risk is VaR at the 99.5 percentile (and the distributions are not too skewed), capital charges from independently modeled risk categories can be aggregated using the correlation matrix approach in the Solvency II standard model.

Parameter Uncertainty[4]

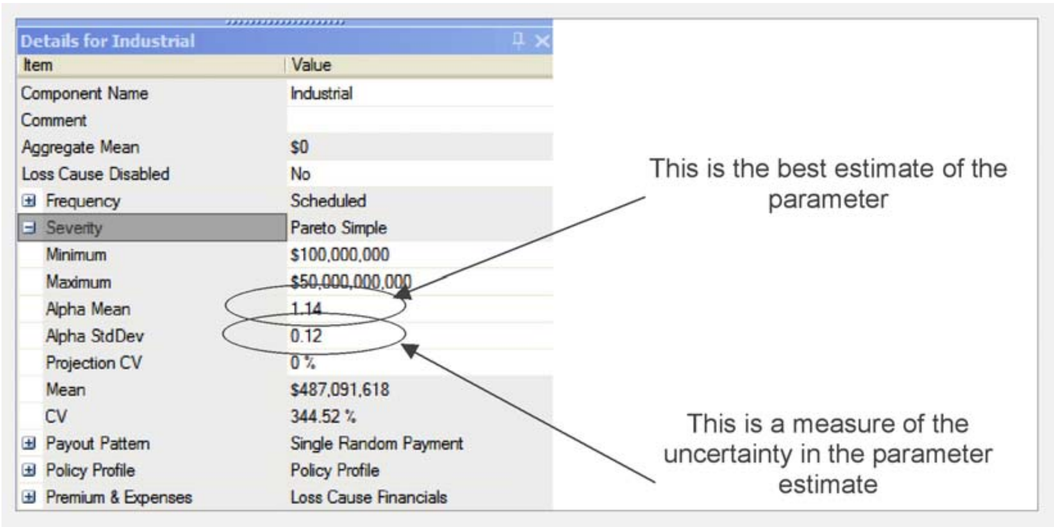
Parameter uncertainty is a significant source of risk when modeling economic capital. There are enormous differences between a mathematical model of an insurance company and the real world; these differences create parameter risk (a shorthand term), with the model necessarily being far simpler than the real world. Further, given a mathematical form, the model has parameters that must be estimated, typically based on some combination of historical company experience, insurance industry and other external data, and actuarial judgment. The term parameter risk is used for the uncertainty in both the form and the parameters of the loss model. Despite the fact that parameter risk is difficult to measure, it is often the largest source of risk in (re)insurance.

Parameter risk arises from many sources, including:

> The limitations of Company data used to measure parameters
> The potential inapplicability of industry data
> Unknown and/or imperfectly measured changes in exposure
> The impact of competitive and potentially volatile insurance markets
> Uncertainty in future inflation, trends, loss development, economic conditions
> Reliance on cat models which have their own substantial parameter risks

In an internal model, the impact of parameter uncertainty on results can be identified either through alternate runs of the model with varying parameters or additional distributions that incorporate parameter uncertainty directly into the modeling, as illustrated in Figure 3.6 where the alpha parameter in the Pareto distribution is specified not only with its mean but also its standard deviation.

Figure 3.6: Parameter Input Screen with Parameter Uncertainty



Financial Statement Capabilities

One of the main building blocks of an internal model is the opening balance sheet of assets, liabilities and equity (or net asset value), an example of which is shown in Figure 3.7 on the following page.

[4] *Spencer M. Gluck, "A Multiline Risk Factor Model," ASTIN Colloquium, Vol. 37, 2007.*

Figure 3.7:
Opening Balance Sheet Information

Assets		Liabilities	
Bonds (Market Value)	$10,000,000	Gross Loss & ALAE Reserve (Nominal Best Estimate)	$15,000,000
Bonds Average Time to Maturity	4.7	Gross Loss & ALAE Reserve Discount	$2,794,122
Bonds Average Duration	4.5	Gross Loss & ALAE Reserve MVM	$2,685,293
		Gross Loss & ALAE Reserve	$14,891,171
European Stocks	$5,600,000		
US Stocks	$960,000		
UK Stocks	$160,000		
Japanese Stocks	$80,000		
Emerging Market Stocks	$240,000		
Total Stocks	$7,040,000		
Property	$23,000,000		
Cash	$9,000,000		
Other Invested Assets	$900,000		
Total Cash & Invested Assets	$49,940,000		
Uncollected Premium	$3,000,000		
Ceded Unearned Premium Reserve	$2,000,000		
Ceded Loss & ALAE Reserve (Nominal Best Estimate)	$5,000,000	Gross Unearned Premium Reserve	$10,000,000
Ceded Loss & ALAE Reserve Discount	$931,374	Other Liabilities	$8,000,000
Ceded Loss & ALAE Reserve MVM	$895,098	Total Liabilities	$32,891,171
Ceded Loss & ALAE Reserve	$4,963,724		
		Shareholders' Equity (Net Assets)	$33,012,552
Other Assets	$6,000,000		
Total Assets	$65,903,724	Total Liabilities & Shareholders' Equity	$65,903,723

For both single- and multi-year modeling, there is a need to project balance sheets, income statements and cash flows on a yearly basis to test solvency at different points in time. Given that most of the financial statement drivers are random variables, the resulting balance sheets are stochastic. It is therefore possible to focus on a particular item like the net asset value at the end of each year to determine the probability of insolvency or failing to reach a particular hurdle level.

The financials that are produced need to be able to deliver information such as the MVM and the level of discount for gross, ceded and net reserves. Figure 3.8 shows a typical income statement that can be generated by an internal model.

Figure 3.8:
Simulated Income Statement

Income Statement	Closing Amount	Income Statement	Closing Amount
		Gross Prior AY Development	$10,963,478
Gross Written Premium	$22,000,000	Ceded Prior AY Development	$53,646
Ceded Written Premium	$5,000,000	Uncollectable Reinsurance on Prior AY	$506,123
Net Written Premium	$17,000,000	Net Prior AY Development	$11,415,956
Gross Earned Premium	$20,000,000	Gross Losses & ALAE	$28,186,597
Ceded Earned Premium	$5,000,000	Ceded Losses & ALAE	$2,997,716
Net Earned Premium	$15,000,000	Net Losses & ALAE	$25,188,881
Gross Underwriting Expenses (including ULAE)	$4,400,000	Underwriting Gain	($12,588,881)
Ceding Commissions	$2,000,000		
Net Underwriting Expenses (including ULAE)	$2,400,000	Investment Income	$1,186,566
		Pretax Income	($11,402,315)
Gross AY Loss & ALAE	$17,223,119	Income Tax	($3,420,695)
Ceded AY Loss & ALAE	$3,485,044	Net Income	($7,981,621)
Uncollectable Reinsurance on Current AY	$34,850		
Net AY Loss & ALAE	$13,772,925	Unrealized Capital Gains	$2,550,224
		Deferred Taxes	$765,067
Gross Prior AY Development	$10,963,478	Change In Net Assets	($6,196,464)
Ceded Prior AY Development	$53,646		
Uncollectable Reinsurance on Prior AY	$506,123	**Performance Ratios**	
Net Prior AY Development	$11,415,956	Net Loss Ratio	167.93 %
		Net Expense Ratio	14.12 %
Gross Losses & ALAE	$28,186,597	Combined Ratio	182.04 %
Ceded Losses & ALAE	$2,997,716	Net Income to Shareholders' Equity	-29.76 %
Net Losses & ALAE	$25,188,881	Return on Net Assets	-18.77 %
		Earnings per Share	($7.98)

Under Solvency II, economic capital needs to be generated in the aggregate and by risk category given the risk measure (VaR), survival probability (99.5%) and time horizon (twelve months). Assuming all changes in capital flow through the income statement (i.e., no "below-the-line" adjustments), the SCR equals the absolute value of the 1-in-200-year Net Operating Income. Thus, a probabilistic distribution for Net Operating Income, taking the interdependence between various risk categories into account, is needed to determine the SCR prospectively.

4. Approval Requirements for Internal Models

Solvency II regulators will likely view more favorably companies that increase their risk management capabilities by measuring and modeling risk internally. However, under the Framework Directive, before a company will be allowed to replace the standard model for regulatory capital requirement calculation with the output from an internal economic capital model, prior approval from the supervisor will be required.

There are three tests anticipated before supervisory approval will be given:

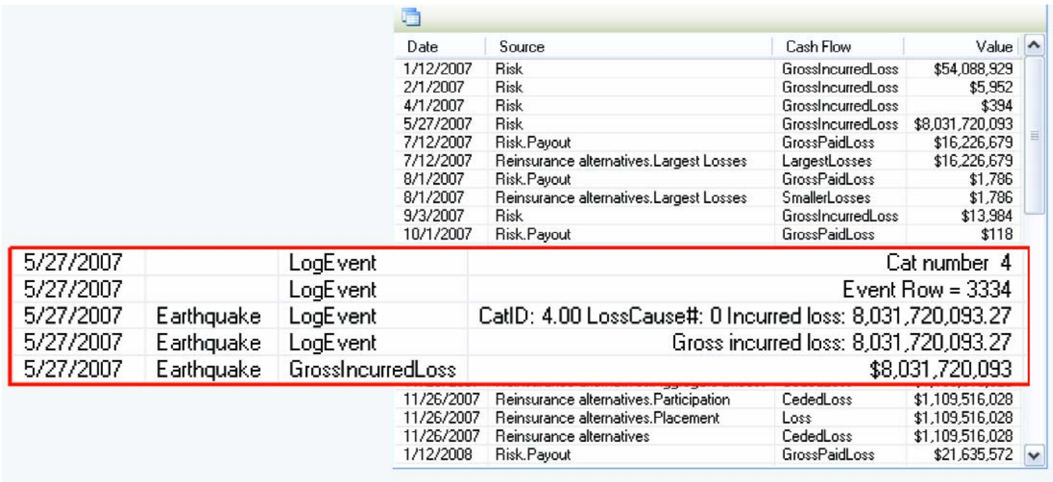
1. The Use Test. The insurer will have to show that the model is used as a decision tool in the company's daily risk management work.

2. The Calibration Test. The model must be calibrated using the risk measure and calibration level defined under Solvency II.

3. The Statistical Test. It must be demonstrated that the model is based on relevant and quality-assured data.

The simulation tool should be able to provide risk metrics at the level required by the supervisor, provide easily understandable financial statements and be transparent in its calculations such that every event impacting the capital requirement can be traced and verified by the model approver. Complete transparency for auditing purposes can only be truly achieved with a simulator based on causal timeline modeling. Further, the model should have the possibility of including management's decisions rules into the simulation process, and present reports on the company's level of risk such that management is able to assess the business implications and adjust its business plan accordingly. Figure 4.1 shows an example of the timeline for a single iteration from a model that uses timeline simulation. This figure shows the date of occurrence of each claim and the related payments based on a distribution of times between occurrence and payment.

Figure 4.1:
Sample Timeline



Date	Source	Cash Flow	Value
1/12/2007	Risk	GrossIncurredLoss	$54,088,929
2/1/2007	Risk	GrossIncurredLoss	$5,952
4/1/2007	Risk	GrossIncurredLoss	$394
5/27/2007	Risk	GrossIncurredLoss	$8,031,720,093
7/12/2007	Risk.Payout	GrossPaidLoss	$16,226,679
7/12/2007	Reinsurance alternatives.Largest Losses	LargestLosses	$16,226,679
8/1/2007	Risk.Payout	GrossPaidLoss	$1,786
8/1/2007	Reinsurance alternatives.Largest Losses	SmallerLosses	$1,786
9/3/2007	Risk	GrossIncurredLoss	$13,984
10/1/2007	Risk.Payout	GrossPaidLoss	$118
11/26/2007	Reinsurance alternatives.Participation	CededLoss	$1,109,516,028
11/26/2007	Reinsurance alternatives.Placement	Loss	$1,109,516,028
11/26/2007	Reinsurance alternatives	CededLoss	$1,109,516,028
1/12/2008	Risk.Payout	GrossPaidLoss	$21,635,572

5/27/2007		LogEvent	Cat number 4
5/27/2007		LogEvent	Event Row = 3334
5/27/2007	Earthquake	LogEvent	CatID: 4.00 LossCause#: 0 Incurred loss: 8,031,720,093.27
5/27/2007	Earthquake	LogEvent	Gross incurred loss: 8,031,720,093.27
5/27/2007	Earthquake	GrossIncurredLoss	$8,031,720,093

The internal model approval process for Solvency II is a very complex area, and CEIOPS has only recently focused on this process. Key strategic issues currently being discussed include:

> Should the risk management framework under Pillar II be included?

> How does one evaluate partial models?

> Do supervisors have enough resources with the right level of expertise?

> Will approval be outsourced and, if so, how?

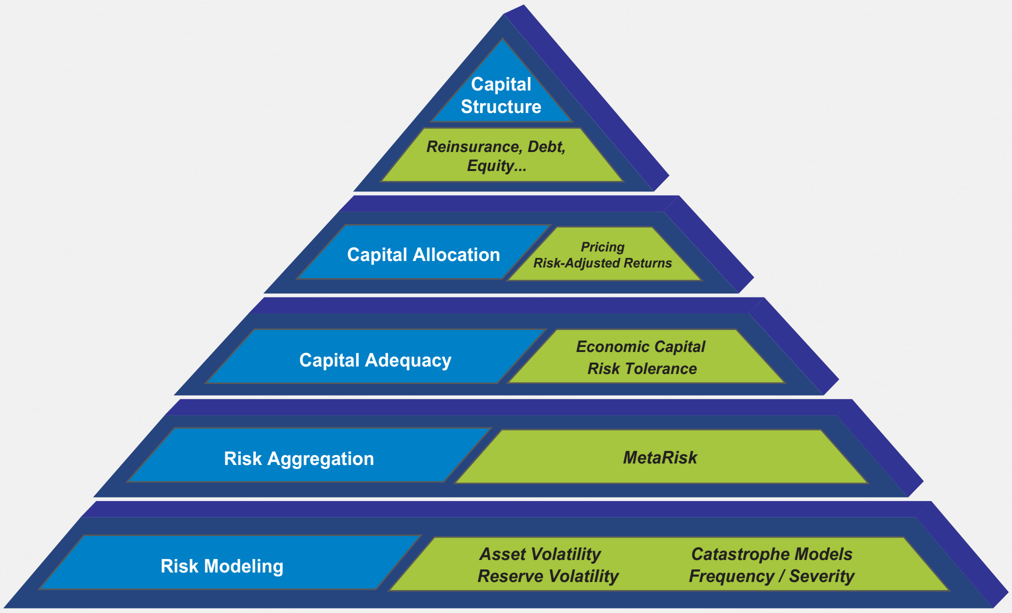
> How should the use test be applied?

However, there is good news in that serious attention is now being given. During the summer of 2007, the UK Financial Services Authority met with representatives of the Institute of Actuaries Solvency II Group to pursue the approval requirements and plan an approach. Also, the International Actuarial Association has produced a draft paper on internal model assessment.

5. The Value of Internal Models

We view development and implementation of internal models as a process that requires a strong foundation to support higher level decision-making, as illustrated in Figure 5.1.

Figure 5.1:
Internal Model Implementation Schematic



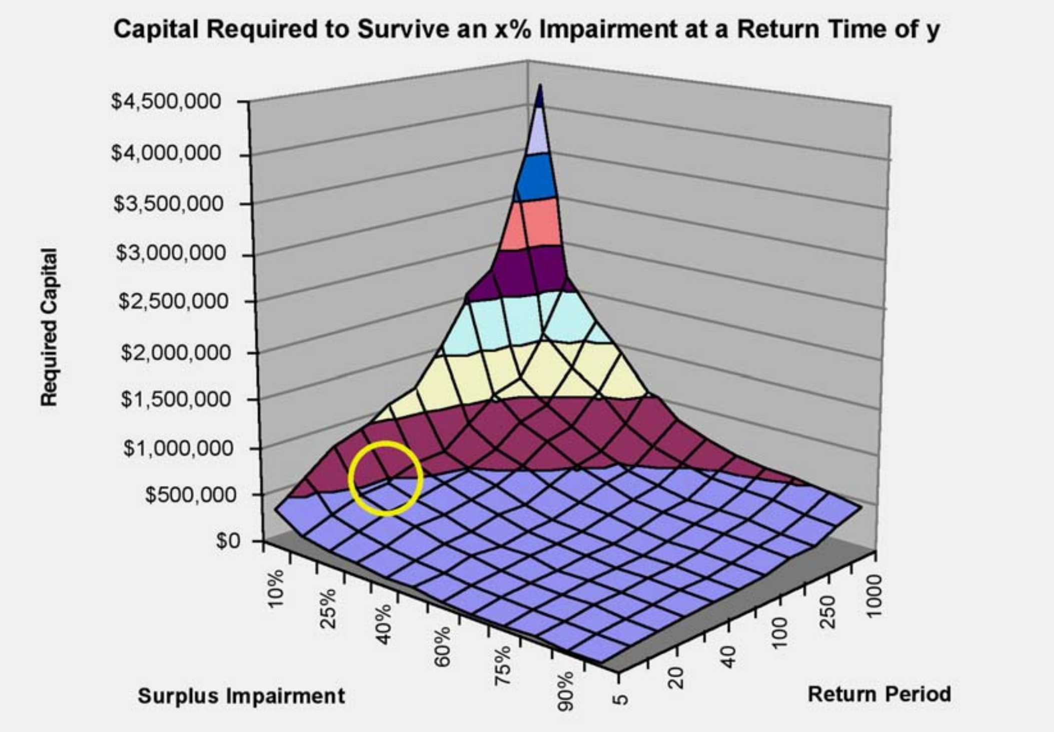
Many companies have already started addressing many aspects of the Risk Modeling foundation. Investment managers, either internal or external, work with detailed models of the investment portfolio. Models are run to evaluate exposures to catastrophes, such as earthquakes, windstorms and terrorism. Many actuarial techniques have been developed to evaluate volatility in loss reserves.

The next step is integrating these models, either bringing the models together in their entirety or using them as prototypes for creating a new model. Guy Carpenter's MetaRisk software platform, used to generate the illustrations in the previous section, has all of these components to allow for aggregated risk modeling.

Capital Adequacy

With an integrated model, companies can then start evaluating capital adequacy both for regulatory and internal purposes. Concurrent to the model development process, companies need to evaluate and quantify their own risk tolerances. A model can provide exhibits, such as Figure 5.2 on the next page, that indicate the capital needed to support the company's modeled risks within certain risk tolerances, but the company needs to use its judgment to determine which risk tolerance best applies to its business model. In Figure 5.2, the vertical axis shows the amount of capital required to survive impairments of different percentages of capital at various return times. For example, this company needs just under $0.5 billion of capital (bottom of the purple stripe) to have a 3% (1-in-30-year) chance of losing 10% of surplus, as indicated by the yellow circle.

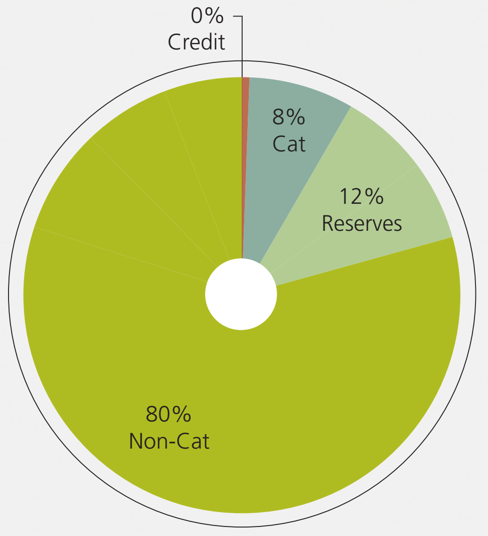
Figure 5.2:
Required Capital



Capital Allocation and External Communication[5,6]

If internal models were only useful for regulatory economic capital assessment, they probably would not receive the attention they do. However, companies have realized the importance of measuring and aggregating risk to ascertain that their level of risk is in line with the company's risk appetite. An internal model also facilitates the allocation of overall capital requirement to different risk units such that risk-adjusted-capital performance measures can be calculated, resulting in a better assessment of each risk unit's performance and a clear picture of the cost of capital among operating units.

Figure 5.3:
Allocation of Capital
to Risk Source



[5] Gary G. Venter, "Risk Measures and Capital Allocation Methods—An Overview," North American Actuarial Journal, April 2004, pp. 96-107.
[6] Donald F. Mango, "Insurance Capital as a Shared Asset," ASTIN Bulletin, Vol. 35, 2005.

As the rating agencies put increased emphasis on a company's ERM capabilities and the relationship between available and economic capital when determining the rating, having the capability to communicate results from an internal model to various external parties becomes necessary. A good internal model is an effective tool for strategic decision-making, since too little capital would threaten the company's ability to meet its liabilities and too much capital, relative to the company's risk profile, reduces the return on equity and can potentially distort economically based decision-making.

Once capital has been allocated, the same process can be used to determine the capital released by different risk mitigation strategies or used by different expansion strategies. The cost of the risk mitigation strategies or marginal returns on expansion strategies can be compared to the costs of other sources of capital to determine the optimal capital structure.

Summary

To summarize, Guy Carpenter believes that, for many companies, a flexible full internal model is the right goal. In addition to its value in meeting supervisory solvency requirements, it can be used for:

> Evaluating the company's risk profile and related reinsurance and investment strategies
> Discussing capital adequacy and management with other external parties, such as rating agencies
> Evaluating returns on risk-adjusted capital
> Understanding the relative contribution of the major categories of risk (non-cat losses, catastrophes, reserve, credit and market) to the company's risk profile
> Providing quantitative input into the M&A process

For more information about parameterization, development and use of internal models, please refer to Enterprise Risk Analysis for Property & Liability Insurance Companies – A Practical Guide to Standard Models and Emerging Solutions.[7]

Who to Contact at Guy Carpenter
For more information, contact your Account Executive or one of the Financial Integration Team members listed below.

> **Susan Witcraft, Managing Director,** Minneapolis, Chair
1.952.832.2143

> **David Lightfoot, Managing Director,** Seattle
1.206.621.3954

> **Frank Achtert, Senior Vice President,** Munich
49.89.28.6603.361

> **Deborah Griffin, Senior Vice President,** New York
1.917.937.3119

> **Scott Lohman, Senior Vice President,** Seattle
1.206.621.2929

> **Richard Shaw, Senior Vice President,** London
44.20.7357.5039

> **Michael Wynne-Jones, Senior Vice President,** Seattle
1.206.621.2906

> **Gina Carlson, Vice President,** Minneapolis
1.952.832.2224

> **Jörgen Olsén, Vice President,** Stockholm
46.8.505.735.56

[7] *Paul J. Brehm et al, Enterprise Risk Analysis for Property & Liability Insurance Companies – A Practical Guide to Standard Models and Emerging Solutions, Guy Carpenter & Company, LLC, New York, 2007.*

Guy Carpenter’s Financial Integration Team
Guy Carpenter has brought together experienced finance, accounting and actuarial professionals from its broking and Instrat® groups worldwide in its Financial Integration Team (FIT). The principal objectives of the FIT are to 1) keep clients and brokers informed on emerging issues related to regulation, accounting and rating agencies and 2) ensure that Guy Carpenter’s modeling tools meet clients’ needs related to these areas of expertise. The FIT includes members from the UK, Continental Europe and the United States.

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MARSH MERCER KROLL
GUY CARPENTER OLIVER WYMAN