Solvency II
Internal models
From risk measurement to risk management
Learning from experience

As insurance companies prepare for Solvency II implementation, they are encouraged to develop internal models that can be integrated within an enterprise risk management framework and used to support business decisions. Achieving the optimal internal model architecture to meet new regulatory standards is not a simple process. Significant work needs to be done to convince regulators to accept the results of the internal model as a replacement for the standard Solvency II Pillar I capital requirements.

Past Ernst & Young articles have addressed the advantages of internal models — not just to produce regulatory numbers, but to provide information to drive important business decisions — setting out the key arguments for investment in an internal model. This paper deals with the practical challenges of how such a framework can be implemented, with a focus on the qualitative and process aspects necessary for a robust internal model which meets the standards of regulatory internal model approval.

Where models were once used to supply single point capital estimates to assist in measuring the risk, a more comprehensive level of information is now required as the models become embedded into the risk management function. With the onset of Solvency II by the end of 2012, what should insurers be doing now to better understand, implement and validate their internal models so they can be transformed from back-office risk measurement calculations into effective risk management tools?

An essential but complex process

Within the European Union, Solvency II has been a catalyst for a substantial amount of work on internal modeling. Under this regime, internal models can be used to derive regulatory capital requirements. A key feature of Solvency II is the internal model approval process (IMAP), which establishes initial qualifying criteria and a significant period of interaction with the regulator to demonstrate the compliance of the model with the regulatory tests.
Although the Solvency II program is still evolving, there is sufficient evidence to determine how an effective internal model may look and define how the tests can be met. Companies can use this as a guideline for implementing and validating their own internal models.

Outside the European Union, the same principles and processes can be applied. However, the model tests are very demanding and nothing to date suggests there are items which are only relevant for the Solvency II regulatory regime.

The development, implementation and maintenance of internal models is a complex process. A rigorous model validation framework is essential so that these models function as intended and can be demonstrated to do so. Having a model that is robust, stable and credible is a key step to generating buy-in from decision makers who will ultimately make use of the model in driving business decisions. This will help to embed acceptance and understanding of the model within the insurer, particularly at the level of the governing body, which is the ultimate test of the appropriateness of the model.

Implementing an internal model

Companies applying for regulatory approval of their internal models have significant challenges ahead. Not only must the model itself be developed and validated, but ongoing model maintenance (such as assumption setting, relying on expert judgment and model change processes) must also be established. Components to consider in the implementation process include:

- **Governance.** Many firms are implementing a “three lines of defense” governance approach, which also applies to the governance of the internal model. Important aspects include assignment of clear responsibilities for model ownership, documentation and validation at all levels where the model is used. This will include specification of sign-off responsibilities between functions (e.g., CFO and CRO), as well as between group and business unit responsibilities where relevant. A further aspect is the formalization of policies for validation and model change, which includes the setting of appropriate procedures for review and approval of (new) models and model changes. This framework will then need to be implemented through the establishment of a control environment and the involvement of senior management and the governing body.

- **Model assumptions, data and documentation.** A common challenge faced by companies is demonstrating the validity, theoretical soundness and consistency of assumptions, in particular justifying the reliance made on expert judgment in the assumption setting process. In addition, it will be necessary to demonstrate that data is of sufficient quality and is complete, appropriate and accurate. Evidencing this is likely to be a significant challenge as inherent data quality in many insurers is poor, with data made good enough for current requirements only through time consuming manipulation and application of controls. The documentation of the model and its change history since implementation is also a key requirement. It can run into hundreds (and even thousands) of pages and should not be underestimated.

- **Implementation, calibration and testing the output.** It will be necessary to have processes in place that clearly demonstrate the successful implementation of intended methodology and assumptions. This will involve establishing processes and controls for the production version, including audit trails for data flows through the model, as well as assessing calibration and outputs through a range of techniques such as back testing, stress testing and sensitivity to model errors. Where companies have existing frameworks for financial reporting controls (e.g., SOX), these are also being applied to the internal model.

- **Business process and model usage.** It will be important to determine the range of processes where the internal model will have a role and the type and regularity of the model output that will be used (e.g., management information, stress and scenario output or degree of confidence in capital requirements). In many organizations, cultural change at a variety of levels will be required to facilitate a fuller use of the model.
Validating an internal model

The review process is critical in order for an internal model to be considered credible by business decision makers and risk managers. The aim is to provide assurance that the model is built on a firm foundation and that model limitations are known and understood. A comprehensive (model process) validation plan should include the following:

- **Validation of the model’s core components.** In addition to the calculation elements (data, methodology, assumptions and results), validating also includes whether the model is complete and covers all lines of business, product terms, options and guarantees, as well as management actions and policyholder behavior. Management actions are a particular area of focus in the life business as the risk mitigating effects can be significant; formal codification and approval of the assumed actions are necessary steps for inclusion within the model. Tax assumptions are also a frequent weak spot in existing models, for example, failing to capture asymmetric tax treatments between policy guarantees and the derivatives used to hedge these exposures.

- **Validation of the capital requirements.** This requires testing against experience (also known as back testing); testing the robustness of the internal model (i.e., sensitivity testing of key parameters); stress and scenario testing (to review model behavior under specific events); and profit and loss attribution (to test whether profits by source of risk are within reasonable bounds).

- **Validation of the supporting systems and processes.** Although the core components and output of the internal model are subject to validation procedures, the entire internal model process – from the operating governance framework to the systems and IT support – should also fall into the scope of validation.

For example, systems validation may consider the following:

- Functional operation of the end-to-end system against defined design documentation: In terms of user acceptance, does the system do what it is meant to do? Can results be reproduced if rerun with the same input?
- System integration testing of the end-to-end system: Can the data flows be traced from source systems to the final output? Is integrity of data maintained at each stage? Do the interfaces operate effectively?
- Integrity of the end-to-end system: Do the financial and operational reconciliations and controls work as planned, and is there a clear audit trail? In terms of non-functional testing, is the performance (both on-line and batch) in line with requirements? Does the model meet generally accepted IT (controls) standards for user access, scalability, resilience, back-up and recovery?

On a day-to-day basis, many of the validation activities will be carried out within the business or “first line of defense” with oversight from the risk function (“second line of defense”). The validation activities will also include regular independent reviews, which are likely to come from a combination of internal and external audits (“third line of defense”).

Building understanding of the internal model

Perhaps the key measure of successful internal model development is the level of understanding that the governing body has regarding the model, a prerequisite for the use of the model to support business decisions. For this reason, the governing body should expect regulators to raise a number of questions as part of IMAP, as indicated in the chart below. A good checkpoint is to assess the extent to which governing body members of your organization would be comfortable answering the questions posed in Figure 1.
## Solvency II Internal Model Approval Process

### Figure 1

<table>
<thead>
<tr>
<th>Questions from regulators</th>
<th>Response from insurers</th>
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</thead>
<tbody>
<tr>
<td>How are internal model results used to manage the business?</td>
<td>At the heart of the “use test,” the insurer must demonstrate sufficient use of the model to ensure a business demand that the model is maintained and continually improved.</td>
</tr>
<tr>
<td>What are the most material elements of the capital requirement?</td>
<td>Senior management should know significant assumptions and their importance to the firm. They should be aware of limitations in the analysis, how these have been addressed and whether they have been offset against areas of prudence.</td>
</tr>
<tr>
<td>What is the evidence and rationale behind the key assumptions?</td>
<td>This is of particular importance when the insurer seeks to justify a different calibration from the SCR standard approach; required evidence includes identification and analysis of relevant data and documentation of conclusions drawn by the insurer.</td>
</tr>
<tr>
<td>Is the governing body satisfied with the results?</td>
<td>Has the sensitivity-testing been used to identify key assumptions and assess the relative importance of any internal difference of opinion?</td>
</tr>
<tr>
<td>What events would trigger the need for greater capital requirements?</td>
<td>Regulators will be interested in exploring how these compare to historic experience or correspond with the firm’s own stress and scenario testing.</td>
</tr>
<tr>
<td>What has been the approach to producing the capital requirement?</td>
<td>This should cover ownership of the process, a description of governance and record information seen by the governing body.</td>
</tr>
<tr>
<td>What assurance does the governing body have over the modeling process?</td>
<td>This should cover how the models have been independently validated. It should also explain why the governing body is satisfied that the internal challenge process is effective - giving examples of issues that have arisen in the internal and external reviews</td>
</tr>
</tbody>
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## Conclusion

An internal model that is implemented, validated and understood by management and the governing body is at the heart of helping an organization manage its risk exposures. More than just a device to measure the risk, validation goes beyond the theoretical soundness of the calculation kernel. It is a process built on firm foundations that comprehensively reflect the characteristics of the business and is understood and accepted in decision making. Implementation, validation and acceptance and understanding of the model require broad thinking – without that, insurers will struggle to measure the risk, let alone manage it.
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